Abstract Book

Fifth International Conference on Plants and Environmental Pollution

(ICPEP-5)

24-27 February, 2015

Organised by

International Society of Environmental Botanists

&

CSIR-National Botanical Research Institute
Lucknow, INDIA

CSIR-National Botanical Research Institute, Lucknow
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ICPEP-5

Abstracts

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&
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Preface

A host of urgent issues would fill their agenda, when world scientists and academia from different nations meet in CSIR-NBRI, Lucknow, India for the "Fifth International Conference on Plants and Environmental Pollution" (ICPEP-5). Among the pressing problems to be debated would be global climate change, freshwater, dwindling forests, biodiversity losses, emergent ecological disturbances on plants, environmental issues and other factors in environment and plant relation.

This "ABSTRACT BOOK' is a compilation of five hundred seventy two abstracts on different environmental aspects, from renowned scientists having long working experience in their corresponding field of expertise. The volume elucidates the plant-pollutant relationship in a manner that defines not only the drastic effects of pollutants on plants but concomitantly highlights the hitherto less focused areas namely phytotoxicity, phytoremediation and plant-microbe interaction, Waste/water management, stress tolerant bioaesthetic development, thus concentrating more on plant than the pollutant.

The abstracts included in this volume are those, which were received within prescribed date and found suitable for publication. All abstracts were peer-reviewed for acceptance and then partitioned in different sessions for Oral and Poster presentation. Many abstracts were not in desired formats as well as were long. Abridgement of such abstracts has been done with care to include significant points. The basic purpose of this abstract book is to evaluate, identify the knowledge gaps and provide direction for future research areas of environmental problems and consequent changes and to develop desired management protocols.

We express our deep sense of gratitude to Dr. C.S. Nautiyal, Director CSIR-NBRI for his moral and material support. We thank Drs., P.V. Sane, B.P. Singh, K.J. Ahmad, S.C. Sharma and R.S. Tripathi, for their encouragement and valuable suggestions to structure this book. We are indebted to our contributors who despite their various commitments acceded to our request to share their valuable expertise.

Thanks are due to the Scientific Program Committee for categorizing the abstracts and editing them. We are also thankful to staff of Ecology and Environmental Science Division for their co-operation in various ways.

We are also thankful to the various sponsoring agencies for financial support, which made this publication successful. The publication plan finally crystallized through the efforts of M/S Army Printing Press and their team, we sincerely thank all these people.

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ICPEP-5

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Climate Change

SI/KN-1

Climate Change and Global Food Security: Challenges and Opportunities

V.R. Reddy

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The carbon-based products, such as food, fiber, fuel, carbon-based chemicals, and fresh water supply, come from the thin living skin covering the earth's land surface called the terrestrial ecosystem. The earth's thin mantel of soil captures, stores, and releases the water to vegetation, aquifers, streams, and lakes and provides the major portion of the world's fresh water supply. Within the next fifty years, human population is projected to double, and economic buying power for carbon-based products could triple. As there are no more unexplored frontiers, this increased demand from our terrestrial ecosystem will have to be met with the existing natural resource base. Added to this is the uncertainty introduced by the future global environmental changes. Potential global environmental changes include atmospheric carbon dioxide concentration, temperature, rainfall, and ultraviolet radiation intensity. Extreme weather events such as floods, drought, and heat waves are expected to be more common in the changed global climate of the future. In addition, regional increases in soil erosion and atmospheric pollution could also have negative impacts on crop productivity and the natural resource base of the planet. With existing scientific knowledge it is impossible to predict how these changes in the global climate may change the productivity of various crops worldwide and overall productivity of the terrestrial ecosystem. One way to deal with the complexity of the system, and its impact on crop productivity, is to develop and use mechanistic, process level computer simulation models, both at the field level and at the ecosystem level. This presentation outlines some examples of the development and use of the crop models for various applications to increase crop productivity and to mitigate the harmful effects of adverse environmental variables on natural resources, both in the current and in the future changing environment.

Key words: Climate change, Food security, Crop productivity

SI/L-1

Climate Change Studies in India with Various Approaches, Simulation and Modelling

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The increasing CO_2 concentration of atmosphere and associated predictions of global warming have stimulated research programs to determine the likely effects of future elevated CO_2 levels on agricultural productivity and on the functioning of natural ecosystems. Researcher reported the results on plant responses on elevated level of CO_2 by conducting experiments with different types of structure and simulation modelling which include growth chamber, controlled environmental chambers, open top chamber and free air CO_2 enrichment facilities etc,. The effects of atmospheric CO_2 enrichment have been studied for many years in green house, controlled environmental chambers, OTCs and other elevated structures to confine the CO_2 gas around the experimental plants. The accuracy on maintenance of CO_2 inside chamber installed around the crops did not succeed in many other studies because of technical constrains. In the enclosed structure, the experiment will not be the same as that in the open top chamber and FACE facilities.

Genesis Technologies is one of the leading organizations in India working on different models of climate change studies like Temp. Gradient Tunnel (TGT), Open Top Chamber (OTC), Free Air CO_2 Enrichment System (FACE), Free Air Temp. Enrichment System (FATE), Free Air O_3 Enrichment System (FAOE) and Elongated Tunnel (ET) with instrumentation, control and automation system. We have successfully established systems for IIT, Kharagpur, ICRISAT, Hyderabad OUAT, Bhubaneswar, ICAR-Patna, ICRISAT-Hyderabad, JNU-New Delhi,CSIR- IHBT-Palampur, IARI (CSIR)-New Delhi, National Bureau Agriculturally Important Insects (NBAII), Bangalore, Assam Agricultural University (AAU), Jorhat, and Central Rice Research Institute, Cuttack, CSIR-NBRI , Lucknow and IIVR (ICAR), Varanasi , Indian Forest Research Institute (FRI), Central Potato Research Institute (CPRI),

Jalandhar, Bharatidasan University, Trichy on various projects like OTC, TGT, FACE, FATE, CO_2 Gradient Tunnel and elongated tunnel and CO_2 elevated/ controlled bioreactor for Azolla Cultivation. Various research work and experiments are being conducted on different crops and tree species on effect of elevated CO_2, temp, and ozone The present article highlights different executed projects in India on different model and simulation with respective crops for last seven years.

Key words: FACE, FATE, TGT, OTC, ET

SI/L-2

Predicting Climate Change Driven Species Extinction Based on Climatic Niche Modelling in Eastern Himalayas

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Response of the species to the changed climatic conditions is evaluated through ecophysiological experiments by monitoring specific species traits. This often is time consuming and could be prone to experimental errors. We hypothesize in this communication that ecological niche of the species could be used as an indicator of species response. This hypothesis is based on the principle that species with smaller climate envelopes are more susceptible to extinction than the broader than the species with broader climate envelopes. Such an approach would also confirm the exclusive impact of climate change on species response. Since the assessment method is based on climatic envelope of the species, the impact of other factors such as habitat fragmentation, pollution, over-exploitation, invasion of alien species and pathogens, and human population explosion would be excluded. For the study, we selected 10 threatened species of eastern Himalayas viz., *Lagerstroemia minuticarpa*, *Ilex khasiana*, *Ilex venulosa*, *Acer hookeri*, *Angiopteris evecta*, *Embellia ribes*, *Swertia chirayita*, *Begonia satrapis*, *Cyathea spinulosa* and *Calamus inermis*. In order to understand the climatic preferences of these species, climate niche modelling for each species was undertaken using MaxEnt. The results confirmed our hypothesis that the species with narrow climatic envelope are more susceptible to climate change scenarios than the species with broad climatic envelope. We further conclude that ecological niche could be a powerful tool to evaluate the species response to climate change.

Key words: Climate change, Eastern Himalayas, Ecological niches

SI/O-1

Pollen Records of Vegetation and Climate Change in the Northern Region of Chhattisgarh, India during the Late Quaternary Period: Signatures of Global Younger Dryas and Period of Climatic Optimum

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Pollen analysis of a 1.8m deep sediment core from Lakadandh Swamp, Baikunthpur Forest Range of Koriya District in Chhattisgarh, India has been carried out with a view to study the vegetation and climate history during the Late Quaternary. The study revealed that between 12,785 and 9,035 cal. yrs BP, tree savannah vegetation, which largely comprising grasses, Cheno/Am, Tubuliflorae, along with tree taxa *Holoptelea*, Sapotaceae and sparsely distributed other trees viz., *Madhuca indica*, *Emblica officinalis*, *Ailanthus excelsa* and *Syzygium* occurred in the region under a cool and dry climate with reduced monsoon precipitation. The early part of this phase is comparable with the global Younger Dryas (YD) event which occurred between the time-span of approximately 12,800 and 11,500 yrs BP. Between 9,035 and 4,535 cal. yrs BP, the tree savannah vegetation was transformed in to open mixed tropical deciduous forest as a result of proliferation of the existing taxa such as *Holoptelea*, Sapotaceae, *Madhuca indica*, *Ailanthus excelsa*, *Lagerstroemia*, and also the debut of *Acacia*,and *Shorea robusta* under a regime of a warm and moderately humid climate with increased monsoon precipitation, coinciding partly with the Period of Climatic Optimum which falls within the temporal range of 7000-4000 yrs BP at global level. Since 4,535 cal. yrs BP to Present, with the improvement of most of the forest constituents particularly *Madhuca indica*, *Holoptelea*, Sapotaceae,

Ailanthus excelsa, *Syzygium*, *Lannea coromandelica* and also with the immigration of some more arboreal viz., *Terminalia*, *Diospyros*, *Butea*, *Maytenus*, etc. (though meagerly), the mixed tropical deciduous forest succeeded the open mixed tropical deciduous forest under a warm and relatively more humid climate with further increase in monsoon precipitation. The cereal-based agriculture practice was there in the region in every phase, but its pace increased during the latter two phases, which could be attributed to increase in monsoon precipitation.

Key words: Pollen, Vegetation and climate change, Late quaternary, Younger Dryas (YD), Climatic optimum, Chhattisgarh, India

SI/O-2

Free Air CO_2 Enrichment of Wheat: Impact on Growth, Photosynthesis, Yield and Proteome

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Atmospheric CO_2 has implications for agriculture and the environment as a whole and represents an environmental factor that is currently undergoing great changes, from 280 ppm in the preindustrial era to 385 ppm currently with further increase up to 700 ppm by year 2100. It is well established that eCO_2 enhances plant growth though degree of enhancement varies between plant species. Wheat is one of the most important crops in the world due to its value as a major food source and its unique suitability to bread production. In the present study, locally grown wheat variety 'Kundan' was exposed to either ambient CO_2 (385 ppm) or eCO_2 (480 ppm) under FACE condition. CO_2 enrichment was started after seed germination and continued untill final harvest. Growth, physiology, yield attributes and leaf and seed proteomics were done in both set of plants. Higher photosynthetic rate (*A*) rate was observed at vegetative stage than at flowering stage and *A* was more in eCO_2 at both the stages. Similar responses were found in stomatal conductance. There was no difference in root dry weight but shoot dry weight was increased at both the stages in plants grown under eCO_2. All the yield parameters also showed upward trend under eCO_2, including grain wt/plant, 1000 grain wt and HI. There was slight decrease in soil N levels in eCO_2 soils, while more N was found in leaves and seeds of plants grown under eCO_2 treatment. Wheat leaf proteomics revealed that 50 proteins were differentially expressed out of which 20 were up-regulated while 30 were down-regulated. Thirty two proteins were identified by MALDI TOF TOF. Up-regulated proteins were related to defense, photosynthesis, energy metabolism etc. While down-regulated proteins were Chl a/b binding protein, many Rubisco proteins and proteins involved in glycolysis and gluconeogenesis. Wheat grain proteomics showed that out of 49 differentially expressed proteins, 24 were upregulated and 25 were downregulated in wheat grains under eCO2 condition. 33 proteins were identified and functionally characterized. They were found to be involved mainly in carbon metabolism, storage, defence and proteolysis. Gluten proteins are the major component of wheat storage proteins. Our results showed both high and low molecular weight glutenins were more in eCO_2 wheat seeds. The study showed moderate increase in growth and yield of wheat plants under eCO_2. Wheat seeds showed more gluten content under eCO_2 condition.

Key words: Carbon dioxide, FACE, Wheat, Proteomics

SI/O-3

Impact of Climate Change on Medicinal Plants in India: A Review

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Medicinal plants are highly valuable to human livelihood and the medicinal plant wealth of India is well recognized. Studies on possible effects of climate change on medicinal plants are particularly significant due to their value within traditional systems of medicine and as economically useful plants. There is evidence that climate change is causing noticeable effects on life cycles and distribution of the plant species. However, the effects of climate change on secondary metabolites in plants is not well understood. A need for research to improve our understanding of climatic effects on medicinal plants is stressed in the present article. An attempt is being made here to review

the work so far done on this important issue with Indian perspective. Reviews have been collected from different sources related to medicinal plants.

The impact of climate change with respect to medicinal plants has been discussed under the following heads. Effect of elevated CO_2/GHGs, Future strategies for research. The impact of climate change on medicinal plants both cultivated and wild is very significant. The need of the hour is to have a focused research approach specially on the accumulation of secondary metabolites of health significance. The research on medicinal plants with respect to climate change is very sporadic and insignificant in comparison with other commercial crops. It is the high time that, these group of plants should not be left as they are potential sources of bio-molecules and neutraceuticals.

Key word: Medicinal plants, Climate change, India

SI/O-4

Adaptability of *Commiphora wightii* (Guggul), a Desert Medicinal Plant towards Climate Extreme: A Metabolomics Approach

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Commiphora wightii (Arnott) Bhandari commonly known as Guggul is one of the major guggal gum-resin producing species in India. It is a threatened plant species of Indian arid region which is reported from the States of Gujarat and Rajasthan with restricted distribution. Guggul is used in the allopathic, ayurvedic, and unani systems of medicine due to its anti-inflammatory, antirheumatic, hypocholesteremic, hypolipidemic, anti-fertility, and anti-cancer activity. The medicinal importance of *C. wightii* resin is attributed to the presence of two-ketosteroids, guggulsterone-E and guggulsterone-Z, the geometrical isomers (cis and trans) of pregna-4,17(20)-diene-3,16-dione which are present in stem resin of the plant. Non-targeted metabolite profiling of leaves, stem, root, latex and fruits of *C. wightii* reveals a wide array of metabolites of primary (central metabolism) and secondary metabolism (DOXP/MVA, Shikimate and Phenylpropanoid pathways). Plant accumulated substantial quantity of small molecules (metabolites) such as glycinebetaine, glycerophosphocholine (GPC), myo-inositol, proline and trehalose suggests adaptability of the plant towards drought and temperature stresses, as the plant grows under extreme drought stress where no rains for months and temperature reached up to 46^{o}C during hot summer. Roots of *C. wightii* were found to accumulate crotonic acid an allelochemical compound which may help in reducing interspecies competition in their natural habitats. Multivariate principal component analysis (PCA) on NMR and GC–MS data revealed clear distinctions in the primary and secondary metabolites among the different plant parts. Detection of chemically diverse metabolites of different metabolic pathways suggests a complex adaptive metabolic combination. The study may assist in understanding of the adaptation patterns of *C. wightii* that prevail during abiotic stress conditions.

Key words: *Commiphora wightii*, Guggul sterone, Threatened species, Adaptibility, NMR

SI/O-5

Range Shift of Plant Communities in Temperate and Alpine Forests of Eastern Himalayas Due to the Changes in Climatic Regimes and Human Interventions

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The impact of climate change on biodiversity is known to all. A little change in air temperature, precipitation etc. from the earlier existed condition resulted to severe change in the ecological assemblage and plant communities of the temperate and alpine forests of Arunachal Pradesh. In addition to the global climate change, the impact of human interventions and natural disasters also play key role in range shift of many plant communities in those difficult natural habitats. This study has compared the changes in

climatic regimes and plant communities of the temperate-alpine habitats of Tawang district of Arunachal Pradesh after one decade (2003-2013). A total of 29 species of herbaceous plants and 28 species of shrubs were recorded between the elevation range from 2400-3600 m asl, where, greater value of species richness and diversity index was recorded between the elevation range of 2800-3200 m asl. during the year 2003. But, most of these plant species were shifted their range to higher elevations between the range of 3200-3600 m asl. Most of the herbs and shrubs from the habitats which lie between the range of 2400-2800 m asl. were naturally shifted to 2800-3200m asl. Most dominant herbaceous genera of the study site are *Anthopogon, Carex, Cyanotis, Dicrocephala, Echinochloa, Eleocharis, Galium, Juncus, Polygonum, Potentilla* and *Psilocarya*, and the most dominant genera of shrubs are *Acer, Anemone, Aster, Berberis, Daphne, Dipsacus, Elaegnus, Euphorbia, Gentiana, Litsea, Lyonia, Mahonia, Meliosma, Prunus, Rhododendron, Rubus, Rumex, Sumbacus, Senecio, Viburnum* etc. Air temperature, rainfall, snowfall etc. among the climatic variables played key role in range shift of those plant communities. Human interventions, such as road construction, urbanization, forest fire, conversion of natural forests to other land use systems etc. also played a significant role in such changes in ecological assemblages and range shift in plants at high elevations.

Key words: Climate change, Range shift, Arunachal Pradesh, Rhododendron

SI/O-6

Effect of Multi-Polarized Microwave Data on Tropical Forest Biomass Assessment using Geospatial Modelling

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Rising CO_2 has prompted attention on the role of forest as '*carbon sink*' because forests store a large amount of carbon/biomass in vegetation and soil. Land use changes can exert a crucial effect on the terrestrial carbon cycle and global climate change. As technological concern it is established that Satellite Remote Sensing is a very useful tool for biomass Assessment. Microwave SAR data has the potential to give better forecasts for biomass estimation than the Optical Remote Sensing data, even during adverse climatic environments and diurnal disparities due to its unique capability of volumetric scattering and its interaction to surface roughness and dielectric property. The present study targets to reveal the potential of multi-polarized L-band Microwave data for estimating biomass of moist tropical Indian forest. Backscatter values are correlated with field-based biomass values and are regressed to generate models for estimating biomass. HH and HV polarizations seem to provide maximum information regarding biomass. Coefficient of determination of 0.395 is attained with HV polarized L-band data. In this study cubic order polynomial showed best results out of all the regression models for estimating forest biomass. Most of the forest area under study seem to give over-estimation of >200 t/ha, while a significant amount of area with biomass ranging within 0-50 t/ha. The current study reveals that estimation and assessment of tree biomass can serve as useful benchmark for future studies related to global climate change.

Key words: Multi-polarized, Biomass, Tropical forest, Spectral response modeling

SI/O-7

Climate Change and Mountain Lives: A Case Study of a Mountain in Central Garhwal Himalaya, India

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Ecosystems will experience climate change but ecosystem of the high mountain is considered to be particularly sensitive to warming because they are regulated by low temperature conditions (Pauli et.al. 2001). The high mountain zone comprises real wilderness' habitat with ecosystem undisturbed by direct anthropogenic impact. This allows the study of impact caused by climatic change without or with the minor masking effect caused by human land use. The effect of climate change may be more pronounced compare to lower altitude (Korner, 1999). Effect of climate change may lead to extinction of variety of species. Mountain area are excellent laboratories for studying adaptation to change in temperature because

temperature decrease rapidly as elevation rise. Mountain provides cool escape routes for these species already inhabiting summit regions are in a very situation, because they can go nowhere else. When the environmental conditions change, organism, populations either have adopt, escape or become extinct. Therefore such disappearance and extinction of plant species should be documented. Objectives of the present study are effect of climate change on plant life of mountain summit. To study the change in lifestyles, biodiversity, biomass, agriculture and social life of the tribes due to climate change. To understand adaptation strategies followed by backward and tribal people in response to change the climate pattern and to increase the awareness level within community through school students.

Investigation will be carried out in ten cosequitive years in order to explore plant diversity and existing flora. Vegetation would be analyzed following Smith 1990, Singh- Yadava 1974 and GLORIA (Global observation research initiative in alpine environments) 2001. Diversity have been analyzed as per method given by Cody 1993. Plant migration, rout escape and ecosystem functioning was measured method given by Korner and Pauli 2005.

Key words: Climate change, Mountain life, Ecosystem functioning

SI/O-8

Evaluation of Sensitivity Among Six Cultivars of *Trifolium alexandrinum* L. by using Phenotypical, Physiological and Biochemical Characteristics under Ambient and Elevated Levels of Ozone

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Tropospheric ozone (O_3), a potent air pollutant and a significant greenhouse gas, has been recognized as a major component of global climate change (Mills et al., 2007). Concentration of O_3 is increasing at the rate of 0.5-2% year^{-1} over the Northern Hemisphere due to increase in anthropogenic activities on the earth surface (Vingarzan 2004). The O_3 on which attention has becoming increasingly focused in the context of its negative impacts on human and vegetation (Ashmore et al. 2006). The present study has been designed to evaluate the impact of elevated concentrations of O_3 on phenotypical, physiological, and biochemical responses of six cultivars of clover, *Trifolium alexandrinum* L. (Bundel, Wardan, JHB-146, Saidi, Fahli, and Mescavi) using open top chambers ventilated with ambient air (NFC) and chambers with elevated (ambient+10 ppb) O_3 exposure (NFC+). Ozone monitoring data showed high mean ambient concentration at the experimental site was above the threshold value of 40 ppb. Significant effect of elevated O_3 was detected on different morphological, physiological, and biochemical parameters depicting differential response among the test cultivars. Ozone exposure induced generation of reactive oxygen species (ROS) which led to higher membrane damage *vis-a-vis* solute leakage and also showed visible foliar symptoms of varied magnitude in different cultivars. Elevated O_3 significantly depressed total chlorophyll, photosynthetic rate (Ps), stomatal conductance, and quantum yield (F_v/F_m) although the extent of variation was cultivar specific. The activities of antioxidative enzymes and metabolites increased in all the cultivars upon exposure to O_3, however, the magnitude of change was higher in Fahli, Saidi and Mescavi as compared to other three cultivars. Elevated O_3 treatment diminished total biomass of all the cultivars; reduction was highest in Wardan indicating its highest sentivity towards O_3. Cumulative sensitivity index (CSI) showed that two cultivars (Wardan and Bundel) were sensitive to O_3, three cultivars (Fahli, Saidi, and Mescavi) were resistant, while JHB-146 showed intermediate sensitivity. Thus, the results of present study clearly demonstrated a possibility to screen the sensitive cultivar of clover as a bioindicator for O_3 under Indian conditions.

Key words: Ozone, *Trifolium alexandrinum* L., Foliar injury, Cumulative sensitive index, Open top chambers

SI/O-9

Climate Change and Biodiversity; Impacts, Vulnerability and Mitigation: A Review of 20 Years in Indian Context

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The rapid climate change and accelerating

biodiversity loss risks human security. The decline in biodiversity, which has been happening worldwide, poses a serious threat to mankind. An analysis of the current trends and future scenarios shows that this loss is likely to continue in the foreseeable times. India is immensely rich in biodiversity would be to state the obvious. With only 2.5% of the world's land area, India accounts for 7.8% of the recorded species of the world including 45,500 recorded species of plants and 91,000 recorded species of animals. In the last few decades, biodiversity has come under threat from various sources of pollution especially at a time when new industrial processes are generating a variety of toxic wastes and also increased mushrooming of urban sprawls. This paper is based on the most recent update of the biodiversity portfolio and summarizes the efforts over the past 20 years to promote the conservation and sustainable use of biodiversity. The review showed that the Climate change is a serious environmental challenge that could undermine the drive for sustainable development. Climate change has become the key environmental concern of the decade. Much attention is rightly focused on reducing carbon emissions and greenhouse gases from industrial, power generation and auto exhaust through reduction in fuel consumption and adoption of improved advanced technologies. Nevertheless, as countries look in to medium and long-term mitigation and adaptation measures, protection of natural habitats, should be a key part of climate change strategies. Strengthened support for protected areas, and systematic sustainable resource management, can contribute to adaptation strategies, as well as to protection of the biological resources and ecosystem.

Key words: Biodiversity, Climate change, Sustainable development

SI/O-10

Should we Say Goodbye to Global Warming and Welcome to Global Cooling?

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Global climate is changing continuously and showing abrupt nasty behaviour in recent years. Among the long debated topic of global warming, a surprising truth of global cooling has emerged recently. The average global temperature has shown downward trend during the last decade. The year 2013 was recorded as the coolest year since 2000. The intensity and duration of winter period are becoming longer. The beginning of 2014 was also cooler than that of 2013. In January 2014, due to heavy snowfall, US has recorded the minimum temperature of the century – 53^{o}C even lower than that of the coolest Antarctica. The decline in average global temperature is creating an erratic climate change in different parts of the world including India too. The incidences of untimely heavy snowfall, stormy rains with hails, rains and floods are depicting an upward alarming trend every year.

On 16th February 2011, the north- eastern part of Bihar adjacent to Himalayan range of Nepal was heavily affected with short- lived icy storms with rains and large-sized stony hails. Supaul district was damaged heavily. People faced great difficulties due to extreme bone-chilling colds and long lasting accumulated hails up to 2 feet on the roads, courtyards and pucca buildings. According to Govt. report about 32707 hectares of cropland were completely destroyed and 19804 houses were damaged. The wheat and maize crop fields were turned into pastures for the animals. It also caused heavy damage of banana, mango and litchi crops. Several birds were found dead after the incidence. Several cattle, street dogs and people got injuries including death of at least one woman. This trend was repeated in 2012 but in larger areas causing heavy damage of cereal, pulse, fruit and vegetable crops in about 6 districts of Bihar. Katihar district was the worst affected. The same trend was followed in 2013 with an increasing area of almost 50% districts of Bihar. The cold wave due to heavy falling of snow and hails broken the record of 146 years of the lowest temperature in Bihar state with 1.1^{o}C at Patna and 0^{o}C at Gopalganj district. Is this the beginning of the global cooling?

Key words: Global cooling, Hail storms, Croplands, Buildings, Damage, North-Eastern Bihar

SI/O-11

Evaluation of Genetic Diversity of Barnyard Millet in Central Himalayan Region: Prospects for Climate Resilient Agriculture

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Climate in Central Himalayan Region (CHR) is characterized by vagaries of weather. It is expected that climate change will be an important driver of global biodiversity loss and thus will pose many new challenges in the management of plant genetic resources. CHR is a store-house of highly valuable genetic variability which provides the basis for adaptation, allowing living organisms to respond to natural selection, and adapt to their environment. Over the past two decades, many of the world's important agricultural crops have lost genetic diversity. The continued loss of genetic diversity of such crops may have major implications on food security.

Barnyard millet (*Echinochloa* spp.) is an important millet crop in the CHR. The crop is largely grown in harsh and fragile environments with minimal use of agricultural inputs due to its remarkable ability to withstand erratic rainfall and varying weather conditions, sturdiness, resistance to abiotic and biotic stresses. For increasing the yield potential and identifying the superior sources for different traits a total of 174 accessions of barnyard millet (*Echinocloa frumentaceae*) having distinct traits of agronomic importance have been collected from altitudinal range of 175 – 2250 m asl in the CHR of India and characterized for different morpho-physiological and biochemical traits viz., plant height, flag leaf length, flag leaf width, peduncle length, number of productive tillers, number of leaves on main tiller, days to 50% flowering, ear head length, days to 80% maturity, finger length, finger width, number of fingers/ear, days to harvesting, 1000 grain weight, yield / plant. In addition, these accessions have been evaluated for variability in chlorophyll content, lipid peroxidation, catalase, peroxidase, superoxide dismutase activity. As well, seeds have been analyzed for diversity in dietary fibres, carbohydrate, fat, and protein content. Substantial diversity has been noticed in these traits. Cluster analysis indicates that genotypes collected from similar altitudinal ranges have similar traits and these are closely related. Untapped genetic diversity might be utilized for crop improvement program to develop new abiotic/ biotic stress tolerant varieties as well as research for providing a deeper understanding of plant biology.

Key words: Plant height, 1000 grain weight, Chlorophyll, Lipid peroxidation, Dietary fibres

SI/O-12

Development of Powdery Mildew Caused by *Sphaerotheca fuliginia* on Bottle Guard and Pumpkin under Elevated Levels of CO_2

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An experiment was conducted to investigate the effect of intermittent exposures of CO_2 on the development of powdery mildew disease caused by the fungus, *Sphaerotheca fuliginia* on two cucurbits. Four week old bottle gourd and pumpkin were inoculated with the conidia of *S. fuliginia* by the leaf roll method. The uninoculated plants served as control. The plants inoculated or not inoculated with the fungus were exposed to three elevated levels of CO_2 (400, 450 and 500 ppm) for 6 hrs on alternate day during day time for 60 days. The cucurbit plants exposed to CO_2 showed greener foliage and better plant growth. The photosynthetic rate, stomatal conductance, trichome length etc. were also increased in the plants exposed to CO_2 as compared to the plants exposed to ambient air (380 ppb CO_2). All two cucurbits were found susceptible to the powdery mildew fungus and developed characteristic symptoms of talcum like powdery colonies on the leaves. The severity of the disease increased on the plants exposed to 450 or 500 ppb CO_2. The physiological functions were also suppressed in the inoculated plants.

Key words: CO_2, Powdery mildew, Cucurbita, Photosynthesis

SI/O-13

An Indirect Method of Estimating Leaf Area Index of an Indian Tropical Moist Deciduous Forest using LAI 2000 Plant Canopy Analyzer

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Rapid, reliable and meaningful estimates of leaf area index (LAI) are essential to the characterization of forest ecosystems. The leaf area is the exchange surface between the photosynthetically active component of the vegetation and the atmosphere, which controls not only the radiation regime within the canopy, but also the thermal and hydric conditions. LAI is a key variable in driving the biological processes of the plants, thus is a necessary input variable in many ecological models studying canopy structure and productivity. This paper reports an indirect method for seasonal monitoring of the leaf area index (LAI) at topical moist deciduous forest of northern India using LAI-2000 Plant Canopy Analyzer. We measured the LAI in two seasons (summer; leaf senescence stage and post monsoon; full green stage) in three tropical deciduous forest communities (dry miscellaneous, sal mixed and teak plantations) in Katerniaghat Wildlife Sanctuary, Uttar Pradesh, India. Ground LAI values ranged between 2.41 - 6.89, 1.17 - 7.71 and 1.92 - 5.19 during post monsoon season in dry miscellaneous, sal mixed forests and teak plantations, respectively. Annual litter fall is showing significant positive correlation with LAI in all three forest communities ($R^2 > 0.8$). We found a positive correlation of LAI with three structural parameters (tree density, tree basal cover and species richness). We found strong positive correlation between LAI and functional parameter i.e. aboveground biomass (AGB) in all three forest communities.

Keywords: Tropical forest, Moist deciduous forest, Leaf area index, Plant canopy analyzer, Aboveground biomass, Litter fall

SI/O-14

Mapping Spatial Pattern of Environmental Condition in Govind Wildlife Sanctuary, Utilizing GIS and Lichens

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Lichens due to their unique morphology and physiology have an ability to withstand extreme of environmental conditions. However, the symbiotic association of lichens exhibit higher sensitivity to acidic gases, thus become a valuable model for monitoring of environmental condition of an area. The Himalayan (alpine) environment and ecosystem are exposed to both natural and anthropogenic threats. The past developmental activities, tourism and possible climate change exert heavy pressure on alpine environment. Several methods are recently initiated for monitoring the climate change, atmospheric pollution by lichens in different regions of the world. Thus, so far available methods such as Index of air purity (IAP), diversity measurement, zone mapping, transplant techniques, pollutants sequestration measurements are time consuming and complex methods.

The GIS/remote sensing technique, owing to its repeatability, can be used in the mapping of lichen species and characterization of lichen land cover. The GIS methods provide information that is remotely similar to field samples and which would allow to considerably reduce extensive field survey.

In the present study, the application of GIS has been the estimation and mapping in unsampled locations based on the sampling few locations of western Himalaya. The results obtained after GIS analysis and the weighted rasters using the co-kriging method for anthropogenic vehicular and carcinogenic reveal the spatial pattern of bioaccumulation of eight heavy metals and 13 polycyclic aromatic hydrocarbons (PAHs). The application of GIS data along with multivariate analysis may be used in future biomonitoring studies related to air pollution and climate change in a given area.

Key words: Lichens, GIS, Atmospheric pollution, Co-kriging, Climate change

SI/O-15

New and Renewable Energy: India's Approach towards Sustainable Development

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The development discourse has been linked to the increasing use of energy and intensification of greenhouse gas (GHG) emissions. Renewable energy

(RE) has the potential of negating this linkage up to large extent and contributing to sustainable development (SD). Renewable Energy utilization is defined as "sustaining natural capital as long as its resource use does not reduce the potential for future harvest" therefore RE can effectively contribute to three-pillar model.RE offers the opportunity to contribute to a number of important SD goals: such as social and economic development; energy access; energy security; climate change mitigation and decreasing the adverse impacts on environment and health. The mitigation of dangerous anthropogenic climate change is seen as one powerful driving force behind the increased use of RE worldwide. In the context of India the economic growth is placing gigantic demand on its energy resources. The demand and supply disparity in energy sources is pervasive which requires serious efforts. India imports about 80% of its oil and there are apprehensions that this might increase in future, which would create serious problems for India's energy security. Higher fossil fuel prices, energy security concerns, and environmental considerations further necessitate the demand for new grid-connected renewable energy sources. The renewable energy needs to be seen not just as "alternate energy", but will increasingly become a key part of the solution to the nation's energy needs. Renewable energy has been an important component of India's energy planning process since quite some time. The importance of renewable energy sources in the transition to a sustainable energy base was recognized in the early 1970s, G.O.I took the initiative by creating the Department of Non-Conventional Energy Sources was in 1982, which was later on upgraded to a full-fledged Ministry of Non-Conventional Energy Sources (MNES) in 1992 subsequently renamed as Ministry of New and Renewable Energy (MNRE) this is the only such Ministry in the world .This speaks in volume regarding the seriousness and significance attached to new and renewable energy resources in India ,however there are still critical gaps in leveraging the benefits of new and renewable energy resources for marching towards sustainable development and tackling the menace of climate change.

Key words: Greenhouse gas, Renewable energy, Climate change, Sustainable development

SI/O-16

Combined Abiotic and Biotic Stresses in Host Plants Modify the Preference-Performance Relationship in Insect Pests: Implications for Climate Change?

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Climate change is predicted to increase temperatures, reduce rainfall and increase the frequency of extreme weather events. For a Small Island Developing State (SIDS) such as Mauritius, which is already classified as a water-stressed country, changes in precipitation amounts and/or patterns can have significant impact on crop health and yields. The climate change related increase in insect and other crop pests will exacerbate the situation, with further negative consequences for agricultural productivity, food security and livelihoods.

The host plant preference-offspring performance hypothesis (also known as the optimal oviposition theory) states that females exhibit a preference for host plants that provide for optimum development and fitness of the offspring. There are numerous empirical studies that either support or refute the validity of the concept. Some studies have demonstrated that females demonstrate a preference for host plants that give the larvae a better chance at survival and growth, while in others there was no correlation between host selection by females and larval performance.

An abiotic stress, e.g. drought, has been shown to modify host preference and host selection in the leafminer, *Liriomyza huidobrensis*. Biotic stress, such as the previous infestation by conspecifics or heterospecifics have also been reported as influencing the host preference and host selection processes in *L. huidobrensis* on potato plants.

The present paper reports the combined impact of an abiotic stress (mild and strong drought conditions) and the concomitant presence of conspecifics on host preference and host selection in the leafminer, and the subsequent effect on larval performance. The paper also discusses the implications of the results of this study in the context of the climate change-related decrease in precipitation and increase in insect populations.

Key words: Climate change, Plant allelochemicals, Drought, Infestation, Insect-plant Interaction

SI/O-17

Carbon Storage and Sequestration as Ecosystem Services of Forests of Siwaliks in Northern India

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The forests provide various ecosystem services such as biomass production, habitat provision, carbon storage and sequestration, soil protection, and climate regulation. The enhancement and optimization of carbon storage in forests is essential for social, ecological and economic sustainability. The objective of this study was to analyze carbon storage and sequestration as indicators of regulatory services in forests of Siwaliks, Yamunanagar forest division, northern India. The carbon stock in plant biomass, soil microbial biomass, and soil up to 60cm soil depth were estimated in the plains and Siwaliks *Shorea robusta* forests, the mixed dry deciduous forest, and the plantation forests. The natural forests showed distinctly higher carbon storage (plant biomass =73.07 to 223.413 Mg C ha^{-1}; soil =28.58 to 39.73 Mg C ha^{-1}) than the plantation forests (plant biomass =51.01 to 52.78 Mg C ha^{-1}: soil =27.26 to 27.28 Mg C ha^{-1}). In the *Shorea robusta* forests, about 90% of carbon storage in the tree layer was mainly contributed by *Shorea robusta, Mallotus philippensis, Ehretia laevis,* and *Terminalia tomentosa.* Integrating remote sensing and field inventory data, the total AGB carbon stock was 12.96 Tg in the forest ecosystems on a regional basis. Annual carbon flux in NPP in different forests was (Mg C $ha^{-1}yr^{-1}$): 7.95 to 3.938, natural forests; 5.23 to 5.29, plantation forests. The soil microbial biomass carbon (0.709 to 0.985 Mg C $ha^{-1)}$ was found to be a good indicator of soil carbon. The soil carbon storage was mainly regulated by forest type, spatial variability of soil carbon, the soil aggregate composition, and clay mineralogy. Biodiversity conservation, and maintaining carbon stores and sinks in forests could play a key role in climate change mitigation and adapting to changing environmental conditions. The various enabling conditions for synergy between mitigation and adaptation measures for forest ecosystems of Siwaliks are discussed.

Key words: Carbon stock, Soil carbon, Carbon flux, Microbial biomass, Climate change

SI/O-18

Sustainable Crop Production Opting Seed Priming Technology

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Success of green revolution dramatically changed the countries picture by reducing hunger and by bringing rural prosperity. But simultaneously it has disturbed the homeostasis in between the surrounding and the system; results are the environmental pollution, loss in biodiversity, microbial equilibrium, fertility status and carbon imbalance in soil, increase in soil salinity and water logging, resurgence of new pests and diseases etc. All these have created an Increase in cost of production and disintegration of economic and social conditions especially in rural communities. These, initiate the scientists, social activists and policy makers to emerge with a concept of "Sustainable Agriculture" which reflects the idea that 'The sustainable agriculture is that form of farming which produces sufficient food to meet out the need of present generation without eradicating the ecological assets and productivity of life supporting systems for future generation'. But in the era of fast growing population, expecting to be more than 10 billion by 2050 may lead over exploitation of arable lands with a great loss in biodiversity, causing climate change. It has been predicted that a rise in temperature in range of 1 to 2^{o}C may reduce 50% productions in rain fed agriculture. Now also we are often facing the problems of climate change.

In Agriculture high quality seeds are always in demand because they can perform synchronized germination with high seedling vigor, make them to achieve optimum genetic potential. Now a day's integrated approach of physiology, genetics and seed technology have generated Seed Enhancement Technology ,represents a range of treatments of seed that improves their performance after harvest and conditioned, but before they are sown. One of them is Seed Priming represents Pre-sowing hydration treatment, includes non-controlled water uptake

systems (methods in which water is freely available and not restricted by the environment) and controlled systems (methods that regulate seed moisture content preventing the completion of germination). Priming materials can be various types of inorganic and organic chemicals, and PGRs. This technology has a no. of beneficial effects on various growth phases of plant's life in general and it also develops a qualitative change in growing plants by improving their tolerance capacity towards abiotic and biotic stresses beside yield improvement. Minute amount of chemical/chemicals is/are required during processing of this technique hence eco-friendly in nature. However present paper elaborates the physiological mechanism of this technique and how does it helps in sustainable agriculture in the era of evergreen revolution.

Key words: Sustainable agriculture, Food security, Seed Enhancement Technology, Seed priming

SI/O-19

Impact of Climate Change on Human Health in Hot and Arid Regions: A Quantitative Assessment

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The climate change is anticipated to have a long-term impact on human health, marine and terrestrial ecosystems, water resources, and vegetation. This paper presents future changes in the temperature, precipitation and humidity and their direct and indirect potential impacts on human health in Yemen, Oman, United Arab Emirates, Qatar, and Bahrain. The analysis is based on the long-term changes in the values of temperature, precipitation and humidity as predicted by the global climatic simulation models under different scenarios of GHG emission levels. Monthly data on temperature, precipitation, and humidity were retrieved from the Intergovernmental Panel on Climate Change (IPCC) databases for longitude 41.25°E to 61.875°E and latitude 9.278°N to 27.833°N. Using an average of 1970 to 2000 values as baseline, the changes in the humidity, temperature and precipitation were predicted for the period 2020 to 2050 and 2070 to 2099. Based on epidemiological studies on various diseases associated with the change in temperature, humidity and precipitation in arid and hot regions, empirical models were developed to assess human health risk in the Gulf region to predict elevated levels of diseases and mortality rates under different emission scenarios as developed by the IPCC. The preliminary assessment indicates increased mortality rates due to cardiovascular and respiratory illnesses, thermal stress, and increased frequency of infectious vector borne diseases in the region between 2070 and 2099.

Key words: Climate change, Desertification, Gulf countries, Health risk, Thermal stress, Vector-borne diseases

SI/O-20

Impacts of Tropospheric Ozone on Plant Production in India

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In this paper we present the current understanding of the magnitude of a potential ozone risk in India, considering the plant productivity and food production. Increasing anthropogenic and biogenic emissions of precursor compounds have led to high tropospheric ozone concentrations over Indian area particularly in Indo-Gangetic Plains (IGP), which is the most cultivated area of this rapidly developing country. However, there is a large temporal and spatial variation in NOx and ozone distribution over India. Current ozone risk models are based on European and North American data, and therefore cannot provide accurate estimations for growth losses in Indian plant species and cultivars. During the past decade, several ozone experiments have been conducted in India with the most important crop species (e.g. wheat, rice, mustard). Experimental work has been conducted in natural field conditions and utilizing open top chambers and EDU (ethylene diurea) applications. Significant yield losses, impaired photosynthesis processes and seed quality, increased visible and membrane injuries, antioxidants defence and altered protein profiles have been reported for these crop species. Information is still very scarce

for genetic differences among cultivars/varieties and mechanisms of ozone tolerance. In addition, more systematic nationwide monitoring and modeling for precursor and ozone formation over Indian region are urgently needed, accompanied by studies on wider scope of plant species (including tree species) and interactions e.g. with soil nutrients and elevating CO_2. We also show the main results of our own field and chamber experiments conducted in Lucknow, India and Finland. Large numbers of local cultivars of wheat, rice and mustard have been screened for ozone sensitivity. In addition, experiments have been conducted with linseed, teak and Gladiolus, having high economic importance locally or globally. Our results indicate, that prevailing ozone concentrations in IGP area impair biomass accumulation and yields, and cause oxidative stress and metabolic changes in these species. However, the defence strategies vary between the cultivars. The best cultivars and the best indicators for ozone stress can be identified.

Key words: Ozone, India, Wheat, Rice, Mustard, Cultivars

SI/P-1

Interactive Effect of Potassium Nutrition and Carbon Dioxide on Soybean Growth and Physiology

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Potassium deficiency limits crop yield worldwide due to its direct effect on the plant water relation, leaf area expansion, photosynthesis, and plant growth. The crop demand for nutrients such a K is expected to be higher due to the use of high yielding cultivars and increased plant growth under rising atmospheric carbon dioxide (CO_2) concentration. To evaluate the combined effects of K and CO_2 on soybean growth, development, and biomass partitioning, plants were grown in controlled environment growth chambers with three levels of K supply (optimum, 5.0 mM; K-stress, 0.50 and 0.02 mM) under ambient (aCO_2, 400 ppm) and elevated (eCO_2 800 ppm) CO_2. Plant height and mainstem nodes at maturity were not significantly affected by either CO_2 or K supply. Results showed that, K deficiency tended to decrease whereas eCO_2 tended to increase soybean growth and photosynthesis. As compared to optimum K supply, the averaged 65% lower biomass under K-deficiency was associated with decreased leaf area and both above and below ground biomass production. The contribution of seeds to the total biomass was about 6% in the lowest K supply while 48% in the optimum K supply. However, biomass partitioning to the leaves, stems and roots were higher under K deficiency. Elevated CO_2 significantly increased leaf area (8-70%) and plant biomass (11-58%) across K supply. Thus, the K deficiency altered the biomass partitioning among the plant parts. In addition, eCO_2 increased the seed production up to 37% mainly at the two higher K supply; however, showed about 6% decrease at the lowest K. Leaf tissue K decreased with the K supply and was lower at eCO_2. However, results showed that total amount of K extracted was greater in eCO_2. Plant growth and seed parameters increased at eCO_2 but only at higher tissue K concentration. A severe K deficiency highly reduced the positive effect of eCO_2 on biomass production and completely offset the seed yield. Thus, the degree of beneficial effect of CO_2 enrichment on soybean growth and seed yield is dependent upon the K nutrition.

Key word: Critical concentration, Nutrient, Photosynthesis, Uptake, Utilization

SI/P-2

Effect of Elevated Levels of CO_2 on the Plant Growth, Physiology, Biomass Production and Root-Knot Disease Development on Cucumber and Sponge Guard

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A study was conducted to investigate the effect of elevated level of carbon dioxide on plant growth, physiology, biomass production and root-knot disease development on cucumber and sponge gourd. Four week old plants were inoculated with the root-knot nematode, *Meloidogyne incognita* (2000 J2/kg soil) and the uninoculated plants served as control. Two days after inoculation the plants were exposed to 400,

450 and 500 ppb CO_2 for 6 hrs on alternate day during day time for 60 days of monitoring. The cucurbit plants exposed to CO_2 had relatively higher photosynthetic rate, stomatal conductance, trichome length, number of leaves per plant, plant growth, biomass production and yield as compared to the ambient plants exposed to air (380 ppb CO_2). Both the cucurbits were found susceptible to the root-knot nematode and developed characteristic galls on the roots. The nematode disease became severe on the plants exposed to 500 ppb CO_2. The elevated level of CO_2 (500 ppb) significantly enhanced the fecundity and egg mass production of *M. incognita*. The soil population of root-knot nematode was also higher in the root zone of plants exposed to CO_2.

Key words: CO_2, Cucurbits, Ambient, Root-knot, Fecundity, *Meloidogyne* spp.

SI/P-3

Comparative Study of Nitrogen and Carbon Metabolism in Two Varieties of *Cyamopsis tetragonoloba* under CO_2 Elevation

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Nitrate Reductase (NR), Nitrite Reductase (NiR), Glutamate synthetase (GS), Pep Carboxylase (Pep C) enzyme activity were assayed in two varieties of *Cyamopsis tetragonoloba* namely RGC 1002 and RGC 1066 under elevated and ambient CO_2 concentration. Total carbohydrate, starch and total chlorophyll contents in leaf were estimated. The results showed that the NR, NiR and GS activity were found suppressed in elevated CO_2 (490ppm) in both varieties as compared to ambient CO_2 (400ppm). Total soluble protein content was found increased in both varieties grown under elevated CO_2 concentration. Pep C activity showed significantly increased trend under elevated concentration when compared with ambient. Total carbohydrate and starch showed higher concentration in leaf of both the varieties under elevated CO_2 concentration. It can be inferred that under elevated CO_2 concentration, Photosynthetic Carbon Gain and Net Primary Production in Guar varieties is upregulated. The results showed that RGC1002 was found resistant to elevated CO_2 than RGC1066.

Key words: NR, NiR, GS, Pep C, *Cymopsis tetragonoloba*, Photosynthetic Carbon Gain, Net Primary Production

SI/P-4

Effect of Elevated CO_2 on Leaf Proteome of Two Guar Cultivars

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Continuous rise in the ambient CO_2 levels has been considered to be the major factor in global climate change. Such higher concentrations of CO_2 are likely to have effect on global climate and also on growth, physiology, and chemistry of plants. Many previous studies have reported how plants will respond to rising CO_2. Free Air CO_2 Enrichment (FACE) experiments are the most naturalistic as they provide the best indication of the responses of plants to increased CO_2 under the natural conditions. *Guar* (*Cyamopsis tetragonoloba*) or cluster bean is an annual legume and its gelling-agent-containing seeds (*guar* gum) are of high economic value. Guar gum as natural gums is advantageous as natural gelling agent for different industrial purposes. It is used in industries such as food, animal feed, textile, pharmaceuticals, personal and health care, nutrition, cosmetics, paper, explosives, mining and oil drilling. Present study was conducted on two cultivars of guar, RCG1066 and RCG 1002. FACE setup consisted of 6 rings, out of which 3 are ambient and 3 are elevated. The average CO_2 during experimental period in ambient and elevated rings was 383ppm and 465ppm, respectively. Plants were exposed to elevated CO_2 for two months. The average temperature, humidity and PAR were 35C, 53% and 611 μ mol m^{-2} s^{-1}, respectively. Leaf protein extraction was performed using Acetone/methanol/phenol method**.** IEF was done on 7 cm IPG strip (pH 4-7). Second dimension was done on 12% SDS-PAGE. Image analysis of protein spots was performed using Image Master 2D Platinum software. Analysis showed more than 450 protein spots in both the varieties. In RCG 1066, out of 50 differentially expressed protein spots, 23 were up-regulated and 27 were down-

regulated as compared to plants grown in ambient rings. In RCG1002, out of which 64 protein spots which were differentially expressed, 40 were up-regulated and 24 were down regulated. Identification of proteins is being done using MALDI TOF/TOF.

Key words: Elevated CO_2, FACE, *Cyamopsis tetragonoloba*, Guar, Cultivars

SI/P-5

Differences in Responses of Two Mustard Cultivars to Ethylenediurea (EDU) at High Ambient Ozone Concentrations in India

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EDU ([N-(2-2-oxo-1-imidazolidinyl) ethyl]-N'-phenyl urea) is widely used in research to evaluate ozone impacts on plants. Although the actual mechanism how EDU confers protection to plants is not fully understood, it is suggested to prevent ozone injuries by up-regulating antioxidative defense. In the present study, EDU was used as a tool to study the response of two locally grown mustard (*Brassica rapa* syn. *campestris*) cultivars, Kranti and Peela sona, under ambient ozone in field conditions in Indo-Gangetic plains of India. Two different concentrations of EDU (200 and 400 ppm) were applied as foliar spray weekly until the final harvest. Seed weight, biomass, oil content of the seeds and chlorophyll content increased at both EDU treatment levels in both cultivars. Gas exchange parameters (stomatal conductance and photosynthesis) were not affected by the EDU treatment, while the responses of antioxidative enzymes varied between the cultivars. The results indicate that EDU-induced ozone protection in these mustard cultivars is mediated by an antioxidative defence system, and that the cultivars adopted different strategies against ozone stress. The cultivar Kranti, characterized by higher biomass accumulation and number of pods, showed stronger antioxidative defence through several enzymes throughout the experiment, whereas the cultivar Peela sona, characterized by earlier senescence and a greater resource allocation to seed weight, invested in enzymatic detoxification only during the vegetative phase. The seed oil content increased by 4-5% at higher EDU treatment in both cultivars, which causes concern for mustard oil production at current ozone levels in India.

Key words: EDU (ethylenediurea), *Brassica campestris*, Mustard, Cultivars, India

SI/P-6

Invasive Plant Species in Delhi Flora

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Compilation of alien flora from phytogeographically distinct regions is of close relevance not only for better understanding the patterns of plant invasion but also for explaining the processes promoting invasion at local, regional or global scales. Despite being at higher risk of invasion by plants because of its European colonial preceding, south Asia has received very little attention in respect of characterization of its alien flora. This dearth of baseline data necessitated compilation of the first list of alien flora from Delhi. Total alien flora of the region is represented by 102 plant species, belonging to 75 genera and 34 families. It represents a relatively higher (18.57%) proportion of the total flora of the region. Families with largest number of alien instances are Amranthaceae and Fabaceae (13 species), Asteraceae (12 species), Malvaceae (8 species). However, families such as Amranthaceae and Fabaceae (38.23%) and Asteraceae (35.29 %) show higher percentage of aliens relative to their total number of plant species in the region. Most of the alien plant species (80.39%) trace their origin to America, followed by Africa (11.76 %), Europe (3.92 %) and Asia (2.94 %). Present study also reports, for the first time, occurrence of four plant species in this region. Each alien plant species is provided with information on the origin, habit, mode/

purpose of introduction, current invasion status, and the primary published source.

Key words: Invasive Alien species, Nativity, List, Delhi

SI/P-7

Carbon Sequestration in Tree Plantations on Degraded Forest Lands in Northern Haryana

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Seasonally dry forests cover more than 42% of the total area of tropical forests worldwide. These forests are considered to be highly threatened and are attracting the attention of workers for their sustainable management and conservation. Forestry plantations could serve as sink of carbon on degraded forest lands. The objective of the study was to analyze plant biomass and carbon sequestration in the soil-plant system, carbon storage in soil aggregates and soil microbial biomass carbon. The tree plantations of *Eucalyptus tereticornis*, *Prosopis juliflora*, the natural forest, and the degraded forest are located at Saraswati Reserve Forest, Kurukshetra ($29^0$59'N, $76^0$31'E, 247m above msl) in northern Haryana, India. The climate of the study area is tropical monsoonal and semiarid. Tree density was 418.75 to 581.25 trees ha^{-1} in about 25 year old tree plantations (*Eucalyptus tereticornis* and *Prosopis juliflora*), the natural forest and the degraded forest. Aboveground biomass ranged from 114.29 to 191.32 Mg ha^{-1}; belowground biomass accounted for 15.60% to 23.95% of the total tree biomass. The organic matter input to the soil in the form of litterfall was 4.63 to 7.12 Mg ha^{-1}. Total biomass carbon stock ranged from 144.59 to 235.08 Mg ha^{-1}, the value being higher in the case of natural forest. The soil carbon stock upto 60cm soil depth (Mg C ha^{-1}) was: organic carbon 29.83 to 41.95, inorganic carbon 10.77 to 20.51. The microaggregates (250µm, 53µm and <53µm) formed a large fraction of soil aggregates and protected most of the soil organic carbon in the soil. The XRD pattern of soil clay showed the predominanace of Illite, Montmornilonite, and Kaolinite, which play an important role in soil carbon stability. The soil microbial biomass carbon varied from 154.27 to 313.01 µg C g^{-1} soil and showed a significant relationship with soil organic carbon. The forestry plantations played an important role in soil enrichment and bioamelioration as well as provided ecosystem services of carbon sequestration for climate change mitigation and adaptation.

Key words: Tree plantations, Soil carbon sequestration, Carbon stock, Soil aggregates, Clay mineralogy

SI/P-8

Evaluation of Impact of Tropospheric Ozone on an Ornamental Plant using Ethylenediurea (EDU)

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Tropospheric ozone (O_3) is one of the most damaging air pollutants affecting plant growth and yield and posing a serious threat to agriculture. The use of antiozonant EDU (N–[2–(2–oxo–1–imidazolidinyl) ethyl]–N phenylurea) facilitates wider screening of crops against high level of ambient ozone under natural field conditions. In the present study, we examined the impact of ambient O_3 and its amelioration by EDU on an ornamental plant, *Gladiolus* cv Tiger flame. The cultivar was planted under natural field condition and treated with foliar EDU spray (200 and 400 ppm) at 7 days interval. The plant sampling was done at vegetative and flowering stage. Photosynthesis, stomatal conductance, pigment content, lipid peroxidation, antioxidants and antioxidative enzymes along with vase life of the flower were studied. During the study period, 8 h average O_3 concentration was 60 ppb. The results showed that both EDU treatments elevated the levels of chlorophyll, GSH, GR and CAT, especially at flowering phase. Level of lipid peroxidation significantly decreased and yield parameters like number of stalks were increased in comparison to non-EDU treated plants. This study showed that O_3 is responsible for the damage of this economically important ornamental plant as application of EDU delayed the senescence thus enhancing its vase life.

Key words: Ozone, EDU, Gladiolus, Lipid peroxidation

SI/P-9

Effect of Ethylene Diurea Treatment on *Zea mays* L. Plants Grown under Ambient and Elevated Levels of Ozone at a Suburban Site of Eastern Indo-Gangetic Plains

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Increase in concentrations of tropospheric ozone (O_3) in last few decades is one of the main concerns for global agriculture causing a threat to food security. For maize which is an economically important crop plant, the estimated global relative yield losses due to O_3 range from 3% to 5%. Field experiment using open top chambers (OTC) was conducted on a popular maize cultivar (Prakash) grown under ambient (AO) and elevated (EO) concentrations of O_3 to assess the ameliorative effect of an anti-ozonant ethylene diurea (EDU) applied as soil drench. EDU helped in maintaining higher level of photosynthetic pigments (chlorophyll and carotenoids) and caused reduction in ROS (H_2O_2 and $O_2^{\cdot-}$) production, resulting in protection of membrane depicted in form of decreased MDA content. Increased activities of antioxidative enzymes (SOD, POX, APX, CAT and GR) and non-enzymatic antioxidants were maintained by EDU. Changes in the foliar proteins through one dimensional gel electrophoresis showed that EDU helped in increasing photosynthetic proteins (PEPC and RuBisCO LSU and SSU). EDU treatment led to a reduction in salicylic acid and an increase in jasmonic acid contents resulting in lesser visible injury due to O_3 compared to non-EDU-treated plants. The protective influence of EDU was further supplemented by enhancement in biomass accumulation and yield attributes of EDU-treated plants over non-EDU-treated ones. EDU is more effective in ameliorating O_3 effects with higher concentration of O_3.

Key words: Ozone, Ethylene diurea, Maize, Enzymatic activities, Visible injury, Yield

SI/P-10

Adaptation Mechanisms of Plants Aligned with Climate Change

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Being sessile in nature plants have ability to cope with a plethora of unfavorable growth conditions, which are mainly caused by unpredictably environmental conditions. The unstable climate can delay growth and development of plants and affect productivity. Plants have very unique complex system where plants stress responses occur in every possible structure. Plants respond to the continuous environmental instability with suitable physiological, developmental and biochemical changes to adapt various stresses. Among plants secondary metabolites and volatile isoprenaids are mainly involved in a range of physiological and ecological interaction, because they have important roles in stress resistance and adaptation. This review fosuses on different mechanism of plants like mechanism of plasticity, mechanism of plasma membrane, mechanism of acclimation, embolism resistance, biochemical adaptation, epigenetic adaptations like DNA methylation and Histon modification. Mechanism of plasticity allows a species to increase potency under most ancillary biological conditions and improved tolerance of plants against abiotic stresses. The extracellular freezing produces mechanical stress on the plasma membrane as a result plasma membrane induces osmotic contraction. In continuation the emboli help plants to stay alive in drought or frost stress. The increase in extent of osmo protective proteins like dehydrins along with soluble sugars against biological stress is called as mechanisms of acclimation. Epigenetic adaptation of stress-induces phenotypic responses of plants which involve gene regulation.

Key words: Environmental instability, Adaptation, Plasticity, Abiotic stress

SI/P-11

Physiological Performance of Two Contrasting Rice (*Oryza sativa*) Varieties under Drought Stress

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Certain regions of world are now chronically drought prone due to erratic precipitation, dropping water levels, consecutive monsoon failure and changing climate condition. World's more food crops along with rice are suffering from losses due to scarcity of water. There is a need of some drought tolerant crop varieties which can improve production per drop of water. Rice feeds more than half of the world's population. It plays a major role in India's diet, economy, employment, culture and history. Four rice varieties PR-113, PR-115, SUPER-7 and SR-26B were investigated under drought stress and different physiological activities has been measured like photosynthesis, transpiration, PSII and PSI activities and pigment concentration. Photosynthesis rate decreased in all rice varieties under drought stress. However, PR-115 showed highest and SR-26B lowest photosynthesis rate under water stress. Electron transport rate (ETR) through PSII and photochemical quantum yield of PSII [Y(II)] decreased under water stress condition in all studied rice varieties. While, ETR through PSI and Y(I) increased in PR-115 and SUPER-7 variety under water stress condition. This increase in ETR(I) led to enhancement of alternative ETR pathway cyclic electron flux. Cyclic electron flux found increased by 4, and 3.2 times as compare to watering plants in PR-115, and SUPER-7 respectively under water stress and high light condition ($800\mu molm^{-2}s^{-1}$). The Y(I) showed an increase in PR-115 and SUPER-7 under drought stress as compared to their watered plants. Limitation at donor side decreased in SUPER-7 rice variety under drought stress. Chlorophyll and carotenoid content decreased while anthocyanin content increased under water stress condition in all rice varieties. PR-115 variety showed minimum chlorophyll and carotenoid degradation and minimum increase in anthocyanin, while highest accumulation of anthocyanin was observed in SR-26B variety under drought stress. Electrolyte leakage was also found to increase maximum in SR-26B variety under water stress which indicates more membrane damage in this variety. Thus on the basis of physiological performance PR-115 behaves as the most tolerant and SR-26B as sensitive towards drought stress amongst the varieties studied.

Key words: Anthocyanin, Cyclic electron flux, Drought, Electron transport rates, Photosynthesis

SI/P-12

Photosynthetic Performance of Cluster Bean (*Cyamopsis tetragonoloba*) Subjected to Water Stress

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Cluster bean (*Cyamopsis tetragonoloba* L. Taub) locally known as gaur belongs to the family leguminaceae. It is mainly grown under rainfed condition in arid and semiarid regions of tropical India during *kharif* season. It is a hardy and drought tolerant crop and is especially suited for soils and climates of Rajasthan. Cluster bean is grown for different purposes viz., vegetable, green fodder, green manure and for production of seeds. Seeds contain 28 to 33 per cent gum. Guar gum has its use in industries like papers, petroleum, pharmaceuticals, food processing, cosmetics, mining explosives, oil drilling etc. Three varieties of potted guar plants, RGC-1066, RGC-1002 and RGC-936 were grown under roof covered poly-house. Three week old plants were subjected to water stress for 10 days and the relative water content (RWC) in these droughty plants was about 60% in comparison to 95% in well watered plants. The photosynthetic efficiency of these varieties was monitored by studying their carboxylation efficiency. Under water stress conditions the anthocyanin content showed maximum increase of the pigment in RGC-1066 and least in RGC-1002. While the total phenolic content showed maximum increase (46%) in variety RGC-1002 under

drought while it was least in RGC-936 (22%). The Proline content was maximum in RGC-936 and was minimum in RGC-1002 under drought stress. Our studies showed that the variety RGC-1002 was the most tolerant, while RGC-1066 was sensitive and RGC-936 showed an intermediate behavior towards drought.

Key words: Carboxylation efficiency, Cluster beans, Photosynthesis, Proline, Water stress

SI/P-13

Physiological Responses of Cluster Bean (*Cyamopsis tetragonoloba*) under Ambient and Free-Air CO_2 Enrichment (FACE) Conditions

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Atmospheric CO_2 concentration has risen at an accelerating pace since the start of the Industrial Revolution. The findings of FACE experiments are important for Predicting the future terrestrial biosphere and understanding that how crops may need to be adapted to the changed and changing atmosphere. Free-Air CO_2 Enrichment (FACE) has been developed at CSIR-NBRI, Lucknow, as a means to grow plants in the field at controlled elevated CO_2 (480 µmol mol^{-1} air) under fully open-air field conditions. The effect of increased CO_2 was studied on the physiology of cluster bean locally called as guar plants. Two varieties .of Guar (RGC-1002 and RGC-1066) were grown under ambient and elevated conditions of CO_2 during the summer season. Photosynthesis rate increased by 9% and 36% in RGC-1002 and RGC-1066 respectively under elevated CO_2 conditions. Transpiration rate decreased by 28% and 4% while stomatal conductance increased by 13% and 33% in RGC-1002 and RGC-1066 varieties under elevated CO_2 condition. Carboxylation efficiency and CO_2 compensation point increased in RGC-1002 variety while decreased in RGC-1066 variety under elevated CO_2 conditions. Carboxylation efficiency probably increased due to increase in total chlorophyll and carotenoids content in RGC-1002 variety. However, in RGC-1066 variety Chlorophyll and carotenoids content decreased under FACE condition. Anthocyanin content also increased in FACE conditions which may regulate non photochemical quenching under stress condition. Vc_{max}, J_{max} and triose phosphate utilization also increased in both guar varieties under elevated CO_2 conditions. Stomatal frequency did not change on lower or upper surface of the leaf in both guar varieties under elevated CO_2 conditions. Photochemical quantum yield and electron transport rates (ETR) of PSII did not change significantly however, Y(I) and ETR(I) increased in both varieties under elevated CO_2 conditions. This may indicate towards activation of cyclic electron flux (CEF) around the PSI. Limitation at acceptor and donor side of PSI decreased and non-regulated photochemical energy dissipation of PSII also decreased while regulated energy dissipation through xanthophylls cycle increased in both guar varieties under elevated CO_2 conditions.

Key words: Cluster beans, Cyclic electron flux, Electron transport rate, FACE, Photosynthesis

SI/P-14

Whether Land use Change Brings ^{13}C Homogenization Faster Than ^{13}C Enrichment?

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Stable carbon isotope (^{13}C) is the prevailing tool to explore land use change, soil organic carbon (SOC) dynamics and ecosystem processes in soil, plant and microbial interface. Previous studies have illustrated that, land use change (LUC), preferentially conversion of (C3) forest land to pasture land or agricultural land results in ^{13}C enrichment of SOC, either due to isotopic heterogeneity of plant material entering into the soil or due to isotopic fractionation occurring during mineralization. Although, land use change induced enrichment in naturally occurring stable isotopes are well established, yet the pattern or trends of fortification occurs during isotopic fractionation are still unclear. On the other hand,

glomalin is alkaline-soluble glycol-proteinecious stuff produced by ubiquitously distributed symbiotic Arbuscular mycorrhizal fungi (AMF), in colonization of more than 80% of terrestrial higher plant roots. It faintly termed as glomalin related soil protein (GRSP) are very stable (resistant to heat and microbial decomposition) and precise pool of soil C. However, in contrast to this, few studies reported that GRSP is very sensitive against tillage and land use. In this study, we had studied the GRSP and its stable isotope (^{13}C) in the vicinity of a tropical dry forest (TDF) located in Sonebhadra district, Uttar Pradesh, India. We hypothesized that, since GRSP is a very precise component of soil carbon pool, it may help to get the trends of ^{13}C enrichment. In this context, instead of usual fractionation, we sequentially extracted the whole GRSP, and studied ^{13}C. We found that, GRSP extract which was initially heterogeneous in ä ^{13}C, get homogenize following LUC. Even though, this ^{13}C homogenization may be more rapid in comparison to ^{13}C enrichment. Our result indicates that, GRSP along with ^{13}C homogenization can be a more accurate indicator of land use change.

Key words: Land use change, Tropical dry forest, Glomalin related soil protein, Sequential extraction, ^{13}C

SI/P-15

Characteristics of Biochar Prepared from *Mentha arvensis* and *Citronella flexuosus* for Soil Fertility Enhancement and Carbon Sequestration

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Biochars have received increasing attention because of their potential environmental applications such as soil amendment and atmospheric C sequestration. In this study, biochar was produced from *Mentha arvensis and Cymbopogon flexuosus.* The biomass and respective biochars were characterized by proximate analysis, ultimate analysis, TGA, organic carbon content and soil analysis. Incubation study of biomass and biochar was set up using loamy sand soil for the evaluation of biochar stability, priming effect and C sequestration potential.

Results showed that biochar enhanced nutrient availability and improve physical and biological properties of the soil. Soil samples were also analyzed for the microbes such as bacteria, actinomycetes and fungi. Beneficial effects of biochar application on microbial activity were observed.

Key words: Biochar, Mentha, Citronella, Carbon sequestration

SI/P-16

An Assessment of Changes in Microbial Diversity of the Soil Exposed to Elevated Carbon Dioxide

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Global agriculture sector depends on climatic conditions for optimal output. In 2012 average annual atmospheric carbon dioxide level reached to ca 394 ppm. It is estimated that by the year 2100, global CO_2 levels would range about 450-600 ppm. Free Air Carbon dioxide Enrichment (FACE) systems provide valuable information about agricultural responses and adaptation strategies of crop under elevated CO_2 conditions. A study was conducted to investigate the plant microbe interaction and it's effect on soil microflora under eCO_2 condition (ca 500ppm). It was found that under eCO_2, bacterial population remained unaffected whereas significant differences were obtained in fungal, actinomycetes and denitrifying bacterial populations. Furthermore, microbes were isolated from eCO_2 and ambient soils, proceeded for screening for abiotic stress (pH, salinity, drought and temperature) tolerance. Three bacterial (PPFEB1, PPFEB2 and PPFEB3) strains isolated from eCO_2 soils were found to be potent and tolerant microbes for abiotic stresses. Carbon source utilization pattern of rhizospheric microbial community of maize, grown under eCO_2 was studied using BIOLOG. Utilization of carbohydrate, amino acid, amines and complex polymers were efficient in eCO_2 rhizospheric microflora in comparison to ambient conditions.

Key words: Microbial diversity, Carbon dioxide, Climate change, FACE, Abiotic stress, Rhizosphere

SI/P-17

CO_2 Affect on Bio-Chemical Parameter of Rhizospheric Soil of *Tectona grandis* and *Butea monosperma* on Different Seasons by Free Air CO_2 Concentration Enrichment (FACE) Facility

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Increasing, Carbon dioxide (CO_2) concentration causes global warming in the world. We know that soil, water and plant have potential to sequester CO_2. In this study, we focused on the effect of microbial biomass carbon (MBC), soil enzyme and chemical parameters related to rhizospheric soil of *Tectona grandis* (Teak) and *Butea monosperma* (Butea) were grown under different atmospheric CO_2 concentrations (394ppm ambient and 490ppm FACE, respectively) in different seasons. Generally, pH plays an important role in the characteristics of rhizosphere soil MBC, enzymes and also nutrient properties against elevation of CO_2. MBC was found higher in rhizosperic soil of both teak and butea plant as compared to Control (Ambient) in all seasons. In pre monsoon, rhizospheric soil MBC, TOC and DHA of Elevated ring was found maximum, whereas it was minimum in autumn in comparison to ambient rings. Alkaline phosphatase was enhanced in post monsoon in elevated and ambient both and lower in pre monsoon. Increased concentration of MBC, TOC and soil enzymes under elevation of CO_2 represents positive effect on teak and butea plant. Both plants have potential to survive under higher concentration of CO_2 and enhanced microbial activity may play a positive role.

Key words: FACE, CO_2 sequestration, MBC, Soil enzyme, Chemical parameters, Teak and Butea

SI/P-18

Protected Cultivation: Ancient India's Foray

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In the backdrop of projected climate change, rise in temperature, CO_2 concentration and precipitation are the main factors likely to impact plant growth and agriculture globally. In response to such projections plant scientists world over are working to meet these challenges. Search for tolerant plants, new or tailored for specific factors are on and genetically modified plants are being projected as major hope. In the past 60-70 years attempts to grow crops at small to medium scale under controlled conditions of temperature, humidity and light have been successful. With the arrival of durable plastics, large poly houses are being made in India for successful commercial cultivation. Thus the possibility of having array of tolerant plants and large scale controlled cultivation is being viewed with hope for future.

In Ancient India the art of controlled cultivation was evolved for growing *Piper betle* one of its most important cultural plants. *P. betle* is a shade loving perennial creeper from the tropical regions which cannot survive under subtropical conditions without protection. Though there is no clear cut evidence, it may be assumed that fully controlled cultivation for *P. betle* was evolved more than 2500 years (pre Buddha) in the subtropical India. These structures are still in vogue and cover more than 20,000 hectares spread over a vast area in several states like Assam (seven sisters), Bengal, undivided Bihar, MP and UP. These structures by default use locally available plant or plant based materials and is in total sync with the environment. These structures have the potential to further improve the available modern controlled cultivation facilities. Such possibilities will be discussed.

Key words: *Piper betle*, Modern controlled cultivation, CO_2 concentration

SI/P-19

Relationship of Tree Species Composition in Soil CO_2 Fluxes: An Overview in Tropical Dry Deciduous Forest Ecosystem in Vindhyan Plateau of Uttar Pradesh

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Carbon (C) sequestration in vegetation and soil is recognized as a mechanism that can mitigate atmospheric CO_2 accumulation. Forest ecosystems

contain a large part of the carbon stored on land, in the form of both biomass and soil organic matter (SOM). Forest soil organic carbon (SOC) is influenced by the complex interactions of climate, soil type, management, and tree species composition. A growing body of evidence has demonstrated that forest species composition will influence soil carbon turnover due to its different microclimates at the forest floor. These effects have been attributed to the fact that tree species could potentially alter amount and physiochemical properties of carbon additions in litter from the above ground and below ground flora and fauna, distribution of the root systems of plants in the soil profile, distribution of carbon within the soil matrix and its interaction with clay surfaces. Soil CO_2 flux measurements were undertaken in 3 different forest communities in tropical dry deciduous forest spread over Vindhyan plateau in Sonbhadra district of Uttar Pradesh, India for comparative measurement of diurnal and spatial patterns of soil CO_2 fluxes in different forest communities to understanding the role of species composition in soil CO_2 sequestration in tropical dry deciduous forest ecosystem.

Soil CO_2 flux in mixed forest was highest while lowest flux were observed in teak plantation. *Hardwickia* dominated forest observed lower soil CO_2 flux in comparison to mixed forest. Mixed forest showed nearly 60% higher flux values as compared to Teak plantation. The diel variation in soil CO_2 emission in the all the forest types coincided well with the variations in soil temperature and moisture indicating their significance in soil CO_2 fluxes. Present study confirms that the mixed forest have a higher SOC stock than the monoculture plantations, and there is an increase in amount of CO_2 sequestered by the soil of mixed species forest compared to monoculture *Tectona* sp. plantations. Therefore, a mixture of varied species could be a better approach for SOC sequestration than monoculture plantations.

Key words: Dry deciduous forest, Soil carbon sequestration, Soil organic carbon

SII/KN-1

Engineering Plants for Detoxification and Phytoremediation of Arsenic and Production of Biofuels and Bioproducts on Contaminated Sites

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Arsenic (As) contamination is widespread and being a potent carcinogen, As affects the health of more than 500 million people worldwide. There is no efficient, cost-effective and environment friendly strategy for As remediation. Previously, we engineered *Arabidopsis thaliana* plants co-expressing the *E. coli arsC* gene (arsenate reductase) in leaves and the *-ECS* (*g*-glutamylcysteine synthetase) genes, constitutively. These plants showed significantly greater arsenic tolerance and accumulation than control plants (Dhankher et al., 2002, Nature Biotech. 20:1140-45). In Roots, plants uptake arsenate (As^V), which is reduced to arsenite (As^{III}) endogenously and thus get trapped belowground. To further enhance As movement from roots to the aboveground tissues, we identified an endogenous arsenate reductase, AtACR2, from Arabidopsis that reduces As^V to As^{III} in plants. Inactivation of AtACR2 by RNAi caused the translocation of 10-16 fold more As from root to shoot tissues when these plants were exposed to As^V (Dhankher et al., 2006, PNAS 103: 5413-18). These results clearly shows that the synergistic activity of these genes could lead to more than a 50-fold increase in the levels of As accumulation in the above ground tissues for later harvest.

In order to transfer this portable As phytoremediation strategy for remediation of contaminated soil and water, the *ArsC* and *-ECS* genes were transferred to high biomass, non-food, fast growing *Crambe abyssinica* and *Brassica juncea* plants. Both C. *abyssinica* and *B. juncea* plants transformed with *ArsC* and *-ECS* genes, exhibited phenotypes and As accumulation similar to those achieved in Arabidopsis. Further, plants expressing -ECS showed strong tolerance to other toxic metals such as Hg, Cd, Pb, and Cr and accumulated significantly high levels of these toxic metals in the aboveground biomass. Additionally, we are exploring the Crambe genome and isolating genes to understand the molecular and biochemical mechanisms of arsenic uptake, tolerance, and detoxification in plants for commercial phytoremediation. Recently, we have identified and overexpressed -glutamyl cyclotransferase (GGCT), which is involved in GSH homeostasis. Overexpression of GGCT not only provided strong tolerance to As and Cd but also improved N use efficiency in plants under stress conditions (*Paulose et al., Plant Cell, 25: 4580–4595)*. Apart for phtoremediation, high biomass, non-food, oil seed crops could be used as feedstock for biodiesel production. These biotechnological approaches in non-food, high biomass oilseed crops will enable these plants to grown on heavy metals contaminated brownfields, abandoned orchards, and superfund sites for biofuel production without replacing the land currently used for food production.

Key words: *Crambe abyssinica*, *Brassica juncea*, phytoremediation, arsenic, heavy metals, biofuels

SII/L-1

Biotechnological Approaches for Conservation of an Endangered Forest Tree Species *Givotia rottleriformis* Griff. used in Toy Making Industry

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Forest trees are in particular renewable sources of food, fodder, fuel wood, timber and other valuable non-timber products. To maintain and sustain forest vegetation, conventional approaches have been exploited in the past for propagation and improvement. However such efforts are confronted with several inherent bottlenecks. Inorder to overcome these, Biotechnological interventions play a vital role for effective rapid multiplication, improvement and conservation of an endangered, medicinal and economically important forest tree species. Hence, we made an attempt to conserve the species *Givotia rottleriformis* which is used in toys making industry. The timber is traditionally used in making *Kondapally*, *Nirmal* and *Etikoppaka* toys. The artisans depending

on this toy making industry for their lively- hood are put to major hardship for want of wood. The poor propagation coupled with over exploitation for toy making industry use has depleted the species and becoming endangered. In view of this, we have developed reproducible regeneration protocols for large-scale production of the species *G. rottleriformis*. *In vitro* seed germination protocol has been standardized. *In vitro* zygotic embryo culture was established and developed the plantlets at 100 mg/L tyrosine. Callus mediated regeneration has been standardized on MS medium fortified with 0.5 mg/L IAA+3 mg/L BAP. The protocol for somatic embryogenesis induction and plantlet formation has been successfully developed. Maximum percentage of somatic embryogenesis was found at 0.5 mg/L NAA+0.75mg/L BAP. More number of bipolar embryos was germinated and converted in to plantlets at 0.2 mg/L NAA + 0.25 mg/L BAP. Efficient protocols have been standardized for micropropagation/clonal propagation by using mericlone technology and nodal culture. *In vitro* rooting was also established from micro-shoots developed through in vitro culture technology. The regenerated plants were successfully acclimatized and transferred to field. Thus, we have achieved the implementation of Lab-to-Land program.

Keyword: *Givotia rottleriformis*, Endangered forest, Micropropogation, Mericlone technology

SII/L-2

Effect of ABA and Salt Stress on Vesicular Trafficking and Root Hair Development

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Increasing episodes of drought stress related to climate change are posing a major threat to global food security due to a negative effect on agricultural productivity in large parts of the world. Therefore understanding the mechanisms that underlie the drought response of plants will be of great use to devise strategies to engineer plants that cope better with drought stress in the future. We are using root hair development and its response to drought stress as experimental model to understand how plants respond to drought stress. Root hairs are extensions of epidermal cells that grow by tip growth. Root hairs serve to increase the surface area of the root and are crucial for acquiring water and nutrients. The importance of root hairs in plant productivity is underlined by the reduced fitness of mutants that lack root hairs especially under limiting water and phosphate content in the soil. Root hairs are highly sensitive to salt and water availability with salt suppressing and water stress increasing the number of hairs. Thus root hair development can be used as a developmental model to investigate how plants cope with water and salt stress. We have characterized root hair development and its response to salt and plant hormone ABA (as a proxy for drought stress) in model plant Arabidopsis. Interestingly, salt stress inhibits whereas ABA promotes root hair growth. Moreover ABA suppressed the effects of salt on root hair development indicating a cross-talk between salt and ABA. Furthermore we have identified several vesicular trafficking mutants with altered root hair development. I will discuss our latest findings on root hair development and how salt and ABA signaling is integrated into the control of root hair development.

Key words: Salt stress, Drought, ABA, Root hairs, *Arabidopsis* mutants

SII/L-3

Recent Advances in Arsenic Accumulation and Metabolism in Rice

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Arsenic (As) contamination of the environment has emerged as a serious problem. Consequently, there is an urge to understand plants' responses to As. Our study suggests that the genetic mechanism regulating the differential As accumulation in different genotypes may not be dependent on gene expression at transcriptional level. We characterized two glutaredoxin (Grx), Cytochrome P450 and metallothionein genes from *Oryza sativa indica sp.* and expressed in *Arabidopsis thaliana*. Transgenic plants were analysed for tolerance towards heavy metals as well as other abiotic stresses, which suggests all these genes have important role in providing tolerance to heavy metal stresses and other abiotic

stress. In an another study, fungal strain, *Westerdykella aurantiaca* isolated from arsenic contaminated agricultural soils from West Bengal, India. This strain showed tolerance and methylation of arsenic when grown in mycological broth enriched with arsenic. Novel arsenic methyltransferase gene identified and and cloned in yeast and ars mutants *E. coli* strains for its functional characterization. In an another study, in order to restrict As in the rice roots as a detoxification mechanism, a transgenic approach has been followed through expression of phytochelatin synthase, *CdPCS1*, from *Ceratophyllum demersum*, an aquatic As-accumulator plant. *CdPCS1* expressing rice transgenic lines showed marked increase in PCS activity and enhanced synthesis of PCs in comparison to non-transgenic plant. This enhanced metal accumulation potential of transgenic lines was positively correlated to the content of PCs, which also increased several-fold higher in transgenic lines. Transgenic lines showed enhanced accumulation of As in root and shoot. However, all the transgenic lines accumulated significantly lower As in grain and husk in comparison to non-transgenic plant. The higher level of PCs in transgenic plants relative to non-transgenic presumably allowed sequestering and detoxification of higher amounts of As in roots and shoots, thereby restricting its accumulation in grain. Our study offers a hope for understanding the molecular basis of arsenic toxicity and accumulation in plant parts. Although measurable success, in terms of application in the ûeld, has so far not been achieved, transgenic research has yielded promising results, which shed light on the approaches to be taken up in future endeavour. This will have tremendous societal impact related to public health consequences.

Key words: Arsenic, Metabolism, Rice

SII/O-1

Production of Polyhydroxybutyrate (Biopolymer) by *Bacillus* Species Isolated from Municipal Waste

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Plastic wastes are considered to be severe environmental contaminants causing waste disposal problems. Widespread use of biodegradable plastics is one of the solutions, but it is limited by high production cost. Municipal waste generates large quantities of organic matter for microbial growth. Only a few reports focus on the potential of utilizing resident *Bacillus* species from municipal waste in polyhydroxbutyrate (PHB) production as well as the production of PHB from food wastes. They have attractive properties such as short generation time, absence of endotoxins, and secretion of both amylases and proteinases that can well utilize food wastes for nutrients, which can further reduce the cost of production of polyhydroxyalkanoates (PHAs). 37 isolate were isolated from municipal waste and out of 37 isolates 13 were found to be PHA producer. Only four strains viz., MW-4, MW-9, MW-26 and MW-34 were found higher producer. Isolation of poly- -hydroxybutyrate (PHB)-producing bacteria, recognition of brightly retractile cytoplasmatic inclusions, lipophilic stains with Sudan Black and Nile blue, and chemical extraction of PHB were used as a culture-dependent strategy for the detection of PHB-producing bacteria. Biochemical analysis showed that PHA producing strains belongs to *Pseudomonas*, *Klebsiella, Escherichia* and *Bacillus* genera. PHA extraction was done by sodium hypochlorite digestion method. Strain MW-4 was showed maximum percentage (54 %). Production of PHA was optimized for different temperature and pH. Thus, in future new PHA producing strains, utilization of renewable materials or industrial waste and culture technology for PHA production can be developed.

Key words: PHB, Biopolymer, *Bacillus*, Pollution

SII/O-2

Naringenin and *Funneliformis mosseae* Facilitated Equilibrium in Redox State Synchronizes Antioxidant Network to Alleviate Oxidative Stress in Salt Stressed *Cicer arietinum* L. Nodules

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Overproduction of reactive oxygen species (ROS) in legume nodules is an inevitable consequence of rising salinity in the rooting medium. Salinity

adversely affects nodule occupancy and N_2-fixing capacity as nitrogenase (N_2ase) enzyme is extremely susceptible to oxygen and ROS. Arbuscular mycorrhizal (AM) symbiosis, in combination with flavonoids, improves redox status and help plants to thrive in saline soils. However, little is known about influence of flavonoids and/or AM in transforming the proficiency of antioxidant machinery in nodules of salt stressed legumes. Study was intended to investigate the potential role of naringenin (Nar, 4 µM) and AM (*Funneliformis mosseae*) in modulating antioxidant network to mitigate salinity (0, 40, 60, 80, 100 mM NaCl) induced oxidative burden on N_2-fixation of two *Cicer arietinum* L. genotypes (PBG 5, DCP 92-3). Despite increase of antioxidants in stressed nodules, ROS build-up increased coupled with lowering of ascorbate/dehydroascorbate and reduced/oxidised glutathione; indicating that upholding redox buffers is a deciding factor for competent antioxidation. Higher Na^+ accumulation had more deleterious effects on growth, N_2ase activity and nitrogen concentration in the nodules of DCP 92-3 which could be associated with higher ROS generation and lower competence of antioxidants. However in Nar treated and/or AM plants, efficient antioxidant machinery attenuated oxidative burdens, with maximum redox stability recorded in +Nar+AM plants. Superior efficacy was related to elevated recycling of reduced ascorbate, thereby facilitating higher H_2O_2 scavenging by ascorbate peroxidase and subsequently higher $O_2^{\bullet-}$ dismutation by superoxide dismutase. Mycorrhization and Nar application ensued recuperation in N_2-fixation due to improved proficiency of antioxidant. Thus, shifting nodule redox towards more reduced form constitutes one of the defensive gears of Nar and/or AM in curtailing salt induced oxidative constraints of N_2-fixation in chickpea.

Key words: Antioxidants, *Cicer arietinum* L., *Funneliformis mosseae*, Naringenin, Nitrogenase, Redox equilibrium

SII/O-3

Overexpression of *Leucaena leucocephala* Phytochelatin Synthase in Tobacco Leads to Enhanced Heavy Metal Tolerance and Accumulation

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Leucaena leucocephala is known to have heavy metal tolerance and is used in revegetation of metal polluted sites. However, the genes related to metal detoxification have not been identified in this species. The present study reports the isolation and characterization of full-length cDNA sequence of phytochelatin synthase gene from *L. leucocephala* (*LlPCS*). Homology modelling of LlPCS predicted binding sites for the substrate glutathione and the metals Cd, Zn, Cu, Fe and Mn. In order to characterize the role of *LlPCS* in metal tolerance and accumulation, it was cloned into pCAMBIA-1302 vector which was later transferred into *Agrobacterium tumefaciens*. The leaf discs of tobacco were infected with recombinant *Agrobacterium tumefaciens* bearing the *LlPCS* construct. The putative transformants were selected on MS basal medium with hygromycin. Later the putative transformants were confirmed by PCR analysis and were later hardened. The 5-week-old *LlPCS* T_0 transgenic tobacco plants were subjected to metal stress by treating them with 150 µM and 300 µM concentrations of zinc, lead, cadmium, arsenic and copper, 50 µM and 150 µM concentrations of mercury for four weeks along with untransformed controls. The *LlPCS* T_0 transgenic tobacco plants exhibited comparatively better growth, relatively higher content of non-protein thiols compared to untransformed control plants. The chlorophyll content was high and MDA content was significantly lower in *LlPCS* transgenic plants as compared to control plants. Under metal stress, non-transgenic plants undergo several anatomical changes related to secondary growth pattern such as less number of cambial cell layers, decrease in radial extent of xylem, thin walled fibres and depletion of reserve carbohydrates. While the transgenic plants developed several adaptive features to tolerate heavy metal toxicity which includes grouping of vessels, thick walled fibres abundant starch accumulation etc. The metal accumulation studies demonstrated that transgenics could accumulate several folds higher content of heavy metals compared to non transgenics. Hence, the present work shows that overexpression of *LlPCS* gene could impart metal tolerance and accumulation in transgenic tobacco. This study also suggests that by using molecular approaches *LlPCS* gene can be used to

develop an efficient phytoremediation technology for clean-up of metal polluted soils.

Key words: Arsenic, Cadmium, Zinc, LlPCS, Tolerance, Accumulation

SII/O-4

Transcriptional Regulation of Rice Sulphate Transporter Gene Family and Functional Characterisation of *Ossul1;1* under Different Metal Stress

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Sulphur is an essential element required by plants for their growth and development. Plants depend on the external sulphur supply in the form of sulphate anion ($SO_4^{"2}$) from the soil and assimilate into the sulphur reductive pathway. Roots predominantly function for the acquisition of sulphur source from the soil environment. In plants, the acquisition of sulphur in the form of $SO_4^{"2}$ occurs via set of transporters encoded by a multigene family. Plant sulphate transporters have been implicated in various abiotic stress responses. Comprehensive analysis of the proximal promoters of members of rice sulphate transporter gene family suggested the presence of various common stress related *cis*-acting elements. In addition, the transcriptional regulation of the arsenic-responsive high affinity sulphate transporter, *OsSul1;1*, was studied through development of *Arabidopsis* transgenic lines expressing reporter gene encoding â-glucuronidase under the control of *OsSul1;1* promoter. The analysis of the transgenic lines suggested differential response of the *OsSul1;1* promoter to various heavy metals as well as other abiotic stresses. Also, *OsSul1;1*, was functionally characterized through complementation of yeast mutant YSD1, in which high affinity sulphate transporter was disrupted. Tolerance was observed in the yeast cells expressing *OsSul1;1* towards different heavy metals suggesting its role in heavy metal stress response. Further, functional characterization of *OsSul1;1* was carried out by developing *Arabidopsis* transgenic lines to understand its role in abiotic stress conditions including heavy metals. It was observed that the expression of *OsSul1;1* in *Arabidopsis* transgenic lines did not affect growth of the plants in homozygous transgenic lines in comparison to WT plants under optimum sulphur concentration. However, significantly enhanced rate of germination and root length of transgenic lines was observed in comparison to WT under sulphur limiting conditions suggesting the role of *OsSul1;1* in plant growth and development under sulphur limiting conditions. Apart from the heavy metals, transgenic lines expressing *OsSul1;1* also showed tolerance towards different abiotic stresses such as salt and drought under sulphur limiting conditions. Therefore, the study suggested the role of *OsSul1;1* in maintaining enhanced sulphur pool inside the cell and thus play a significant role in providing tolerance against various stress conditions.

Key words: Abiotic stress, *Arabidopsis*, Heavy metals, Sulphate transporter, Transgenic, Yeast

SII/O-5

Identification and Characterization of Molecular and Morphophysiological Responses under Excess Phosphate in Arabidopsis

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Phosphorus (P) is an essential macronutrient element, a component of nucleic acids, phospholipids and several energy-dependent biological reactions, plays a vital role in the growth and development of plants. However, extensive application of P fertilizers or animal manures often results into the over accumulation of P in top soil and leaching of P into nearby water bodies posing serious environmental concerns like eutrofication and/or ground water pollution. Unlike the sufficient molecular and morphophysiological information available in plants with respect to phosphate (Pi) deficiency, the effect of excess Pi at various levels such as molecular, biochemical and morphophysiological have not been studied in detail. In the present study, we have carried out a detailed investigation of plant responses under

excess phosphate. Interestingly, high concentrations of Pi adversely affected the growth of seedlings. Root system architecture (RSA) turned shallower somewhat like RSA of -Pi (no phosphate), and root apical meristematic activity has been repressed. Shoot area also decreased but in a less pronounced manner. Nevertheless, the negative developmental regulation of RSA turned out indeterminate because growth of RSA restored in normal Pi concentration. Transcriptomic investigation of excess phosphate response (EPR) phenotype, revealed a highly significant upregulation of an unknown root specific gene possessing a plant hormone responsive domain. It is plausible that this gene may be a component of a signaling pathway operated under high phosphate condition. Moreover, the global gene expression analysis revealed a distinct transcriptome signature of root and shoot under high Pi indicating different regulon operating in source and sink organs. We also observed a specific modulation of ethylene and iron responsive genes in seedlings grown at high Pi. Overall, this study will not only help in dissecting the mechanism of plant responses under excess Pi but also provide the lead in identifying new genes involved in phosphorus homeostasis.

Key words: Excess phosphate, Root system architecture, -Pi (no phosphate), Transcriptomics

SII/O-6

Impact of Salinity Stress on Activity and Gene Expression of Sugar Metabolizing Enzymes in Leaves and Grains of Wheat Genotypes

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An experiment was, conducted to study the effect of salinity stress on the sugar metabolism and transport in wheat. Four wheat genotypes were raised in earthen pots of uniform size (30×30 cm) lined with two layers of polyethylene bags and filled with 10 kg of air-dried soil and farm yard manure in 3:1 ratio. One month old seedlings were given salinity treatment with 2.5 litres water (control) and saline solutions, [S1 100 mM NaCl), S2 (200mM NaCl). Actual salinity levels are expressed as electrical conductivity, ECe determined at vegetative (30 days after sowing and anthesis are 1.21, 8.43 and 13.04 respectively. Salinity stress led to increased accumulation of total soluble sugars and trehalose in leaves of wheat genotypes. There was a sharp rise in total solube sugars and trehalose content in tolerant genotypes, which probably explain their role as compatible solute. Expression of *Trehalose -6-phosphate synthase* gene was also up regulated under salinity stress. Expression of sucrose transporter gene *SUT1* was found to be salinity stress inducible in wheat leaves. Salinity stress also affected the sugar metabolism of developing wheat grains. Salinity stress decreased the expression of AGPase large subunit (AGPase LSU), soluble starch synthase III (SSSIII) and SUT1 in wheat grains.

Key word: Salanity, Gene expression, Wheat

SII/O-7

Salicylic Acid Induced Multiple Stress Tolerance in Plants

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Sustainable economic growth in the next century requires development of new agricultural and industrial technologies in harmony with the global environment. Because of increase in global population, world agriculture must produce a greater yield without changing the variability and richness of biodiversity. Several physiological, biochemical and molecular processes are affected by adverse environmental conditions, particularly plant growth, development and productivity.

Salicylic acid (SA), plant phenolics is now considered as a hormone-like endogenous regulator and its role in the defense mechanisms against biotic and abiotic stresses has been well documented. Number of SA induced PR-proteins are identified against virulent plant pathogens. Exogenous SA application may have a significant practical application in agriculture, horticulture and forestry. The established effects of SA on stomatal function, chlorophyll content, transpiration rate and respiratory pathways raise the assumption that SA might possess another physiological function, most probably

involved in regulation of some photosynthetic reactions and other growth regulatory mechanisms under various stresses in plants. Thus studies suggest that exogenous application of salicylic acid in plants may bring some potential practical utilization. For example, manipulating the tissue level of SA in plants may be a promising area for the importance of biotechnology to crop protection and high yield. Increase in endogenous SA may be achieved via enhancing transcription and translation of the genes for SA biosynthesis or by blocking the expression of genes involved in SA metabolism.

Key words: Salicylic acid, SA biosynthesis, PR-proteins

SII/O-8

miR858 is Critical for Light-Dependent Regulation of R2r3 Myb Transcription Factors Involved in Flavonoid Biosynthetic Pathway in *Arabidopsis*

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Light is one of the most vital environmental factor controlling plant growth and development via array of signalling pathways involving numerous molecular factors causing adjustment in the whole transcriptome. For plants, light is a fundamental source of energy but, it is also an important environmental stress factor. Under light stressed conditions plants accumulates defence-related secondary metabolites, such as flavonoids which also have many health beneficial properties. The regulation of the flavonoid biosynthesis is achieved by combined actions of transcriptional control of the structural enzymes in the biosynthetic pathway by DNA binding R2R3 MYB transcription factors. Recent report showed that a key positive regulator in *Arabidopsis* photomorphogenesis, ELONGATED HYPOCOTYL5 (HY5), could activate the expression of R2R3 MYBs as well as flavonoid biosynthetic genes; however, the impact of microRNAs (miRNAs) on conveying light signals and in regulating secondary plant product biosynthesis is poorly understood. miRNAs are endogenous, non-coding small RNAs which function as regulators of growth, development, signal transduction and adaptation to various abiotic and biotic environmental stresses. In this study, we identified and characterized *Arabidopsis* miR858 which putatively regulate the expressions of R2R3 MYB transcription factors involved in flavonoid biosynthesis. Presence of HY5 binding sites and other light-responsive *cis*-elements in miR858 promoter suggested light-dependent regulation of miR858 expression. We also demonstrate the expression of miR858 is significantly reduced under complete photoinhibition for 5 days in WT, *CaMV35s:promiR858* transgenic lines and *hy5* mutant backgrounds. However, on light induction for different time points the expressions of miR858, MYBs and flavonoid pathway biosynthetic genes is restored. Altogether, our findings explored and established the role of HY5-miR858 module in regulating MYBs and flavonoids biosynthesis in *Arabidopsis*.

Key words: *Arabidopsis*, Human health, Light, miR858, Secondary metabolites, Transcription factors

SII/O-9

Psophocarpus tetragonolobus (L.) DC. - an Underutilized Legume Crop Needing Crop Improvement for Providing Household Nutrition Security

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Winged bean [*Psophocarpus tetragonolobus* (L.) DC.] is a potential underutilized-legume crop of the tropics with high protein content. Analysis of chemical properties of the seed fatty oil and lipid of the seeds were carried out on GC-FID, GC-MS and H1-NMR platform. The study revealed that, fatty oil of fully mature seeds of *P. tetragonolobus* contained higher proportion of unsaturated fatty acids (~75.5%). The unsaponification matter of fatty oil was identified as stigmasterol (~66.4%) and -sitosterol (~25.1%). Total lipids of fully mature seeds were extracted and isolated as neutral and glyco- and phospholipids. The overall investigation of fatty oil of fully mature seeds was found to be enriched with mono-unsaturated fatty acids (~38.6%) and poly-unsaturated fatty acids (~36.9%)

without trans-fatty acids, thus meeting the edible oil standard. Quantification of total polyphenols, flavonoids on HPLC platform revealed the highest percentage occurrence of kaempferol in the seed tissues along with the presence of condensed tannin in the seed-coat. Estimation of genetic diversity among twenty four genotypes of *P. tetragonolobus* by employment of RAPD and ISSR molecular markers revealed a significant level of variation among some Indian and exotic genotypes. The study therefore, provides a significant insight for further genetic improvement of this crop. Promotion of this under-utilized legume and its further cultivation in the region will provide household food security in a sustainable manner to the rural poor.

Key words: *Psophocarpus tetragonolobus* (L.) DC., Underutilized legume, Nutrition security, Fatty oil, Lipid

SII/O-10

Application of Biotechnology for Environmental Cleanup: Engineering Plants for Improved Phytoremediation

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Kuwait has experienced one of the major environmental destructions during the Gulf War. Huge amount of crude oil were released causing massive destruction of the environment with toxic petroleum hydrocarbons and associated heavy metals. Remediation of these sites requires multidisciplinary approach. Plants possess unique mechanisms to detoxify or accumulate harmful pollutants including heavy metals. These mechanisms are governed by a set of genes encoding specialized proteins. Understanding the regulation of these genes in model plants would open innovative ways to improve selected plant species to enhance the efficiency of phytoremediation technology. This requires biochemical characterization and better understanding of these genes and their expression patterns. With this view, we have selected candidate genes in Arabidopsis and examined their expression profile under various heavy metal stress using RT PCR technique. During the course of the study, several stress responsive candidate genes have been successfully identified in Arabidopsis and their response to Vanadium stress has been determined. Arabidopsis thaliana glutathione reductase, glutathione S-transferase, auxin-induced protein IAA9, S-adenosyl homocysteine hydrolase, putative nitrilase 3 genes are upregulated in response to Na_3VO_4 treatment. At the same time, glutathione synthetase, O-acetylserine (thiol) lyase, S-adenosylmethionine synthase 2, putative myrosinase mRNA expression was not altered and remained at a similar level in control and vanadium treated plants. Interestingly, glutathione synthetase and peroxidase expression was down regulated in plants exposed to vanadium treatment. Adenosine triphosphate (ATP) sulfurylase gene is known to be involved in the regulation of metal uptake and metal tolerance in plants. We have cloned the native Arabidopsis ATP sulfurylase gene and also created the synthetic version of the same. This gene will be engineered to improve the phytoremediation efficiency of selected target plant species that can grow in moderately oil contaminated soil under arid conditions.

Key words: Arabidopsis, ATP sulfurylase, Genetic Engineering, Phytoremediation

SII/P-1

Role of Glutaredoxin against Metalloid/ Metal Induced Abiotic Stress in Plants: Minireview

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Glutaredoxins (GRX) are small 12-15 kDa ubiquitous disulfide oxidoreductases known to use GSH as electron donor. It consist of 4 stranded â sheets and 3 flanking á helices, extended by additional N or C terminal á helix. The cellular redox is essential for maintaining protein and other cellular activity under normal conditions, which gets disturbed under oxidative stress due to the formation of ROS or RNS during biotic or abiotic stress. Glutaredoxin/ glutathione/glutathione reductase (GRX/GSH/GR) belonging to TRX family helps in maintaining the thiol

reduced state. GRXs play role in recovery of cellular proteome during or after onset of unfavorable conditions. The role of GRX in arsenic reduction is well established in prokaryotic and mammalian system. Recombinant *E. coli* expressing PvGRX5, extracted from arsenic hyperaccumulating fern, *Pteris vittata* have shown tolerance towards 10mM of As (V). Exposure of pea seeds to cadmium during germination results in the increase of overall GRX activity, about 47% and 136% from controls in cotyledons and embryonic axes, respectively, after 5 days of treatment. However reports about expression of GRX genes in rice plants and more particularly against As stress, are very few. In rice, up-regulation of two GRX genes i.e. Os01g27140, Os02g40500 against As (III) stress, whereas only one (Os02g40500) against As (V) stress were found. In another recent study, expression of two CC type GRX (Os01g27140, Os01g13950), one CPYC Type (Os02g40500) and one GRL type (LOC_Os01g61350) against As(V) (4 ppm) were found to be several folds higher in the sensitive cultivar of rice. Thus it can be concluded that the GRXs play an important role in imparting tolerance to plants towards metal induced stress. GRXs play a crucial role in iron sulfur protein biogenesis.

Key words: Gluteredoxin, Arsenic, *Oryza sativa*, ROS

SII/P-2

Synthesis and Characterization of Silver Nano-Particles using *Adhatoda vasica* Extract

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In this study the synthesis of Plant mediated Nanoparticles of Silver (Ag) was done using aqueous leaf extract of *Adhatoda vasica*. This is first attempt of synthesizing Ag nanoparticles using aqueous leaf extract of *Adhatoda vasica*. The silver nanoparticles were prepared by adding silver nitrate solution (10^{-3} M) and to aqueous extract of *Adhatoda vasica* and incubated at room temperature. The reduction of Ag^+ ions was monitored by measuring the UV-Vis spectrum of the reaction medium. The colour of the mixture changed to deep brown confirming the formation of silver nanoparticles. The control (Only Ag^+ solution) showed no colour change. Further confirmation of formation of nanoparticles in the range of 60 to 120 nm was confirmed by Scanning Electron Microscopic analysis.

Key words: Nano-particles, UV-Vis, SEM, *Adhatoda vasica*, Aqueous extract

SII/P-3

Nitrogen-Mediated Salt Tolerance in Mustard (*Brassica juncea*) Involves Proline and Ethylene

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Nitrogen (N) is an important nutrient required for plant growth and development and affects proline production and ethylene evolution. To assess the role of ethylene in proline-mediated protection of photosynthesis under salinity stress, the effect of N on proline production and ethylene formation was studied in mustard (*Brassica juncea*) cv Pusa Jai Kisan (PJK). Among the N treatments (0, 5, 10, 20 mM N), 5 mM N was low N, 10 mM N was sufficient and 20 mM N was excess N under no stress. Sufficient N under non-saline conditions maximally increased proline production through increase in ã-glutamyl kinase (GK) and decrease in proline oxidase (PROX) activity, leading to osmotic balance and photosynthetic protection. It resulted in lower ethylene evolution than control which was optimum for regulating N-assimilation, proline metabolism and photosynthesis. Excess nitrogen inhibited photosynthesis and growth of PJK and produced higher ethylene evolution and lower proline production than low and sufficient N under no stress. In contrast, under salt stress with increased demand of N, excess N optimized ethylene level, which regulated the proline production and resulted in increased photosynthesis and growth. It resulted in highest proline production due to ethylene formation in the optimum range by inhibiting activity of 1-aminocyclopropane carboxylic acid (ACC) synthase (ACS). The effect of excess N on photosynthesis was further substantiated by the use of ethylene biosynthesis inhibitor, 1-aminoethoxy vinyl glycine (AVG) which inhibited proline production and photosynthesis under salt stress. The results suggest that regulatory interaction exists between ethylene, proline and N for salt tolerance and

N differentially regulates proline production and ethylene formation to alleviate the adverse effect of salinity on photosynthesis in mustard.

Key words: Ethylene, Mustard, Nitrogen, Photosynthesis, Proline, Salinity

SII/P-4

Growth and Phenol Degradation Kinetics in Outdoor Cultures of *Chlorella pyrenoidosa*

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Phenol is a major organic water pollutant that is released in wastewater of various industries as chemical, coal, pharmaceuticals, petrochemicals etc. Phenol being highly water soluble easily reaches downstream water sources causing toxic effects on aquatic flora, fauna and humans. Biodegradation owing to its advantages of complete mineralization and cost effectiveness has been widely accepted for remediation of phenol containing wastewater. Microalgal phenol degradation is much less well studied as compared to that for bacteria as well as fungi. In this study, the phenol biodegradation capabilities of a potent phenol degrading algal strain *Chlorella pyrenoidosa* (NCIM 2738) was characterized under natural day: light cycle in outdoor cultures. Complete phenol degradation was observed in the range of 25-200 mg/l phenol. The biokinetic parameters of growth and degradation obtained by kinetic modeling of the experimental data was used to compare the efficiency of phenol degradation by *C.pyrenoidosa* in outdoor cultures as against phenol degradation efficiency in laboratory experiments.

Key words: Kinetics, *Chlorella pyrenoidosa*, Phenol, Growth, Degradation

SII/P-5

Bioprospection of *Withania somnifera* (Ashawagandha): A Non-Targeted Metabolomics Approach

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Withania somnifera (L.) Dunal commonly known as Ashwagandha, is one of the most valued medicinal plants with a number of pharmaceutical and nutraceutical applications. The plant is recommended in many Ayurvedic recipes and has been employed in the treatment of neurological disorders, geriatric debilities, arthritis and stress- and behaviour related problems. These medicinal values are mainly attributed towards the presence of withanolides in roots and withanamides in fruits of *W. Somnifera.* Non-targeted metabolite profiling has been performed by HR-MAS NMR spectroscopy on leaf, root and fruits from four chemotypes of *W. Somnifera* was carried out using HR-MAS NMR, solution state NMR spectroscopy and GC-MS. HR-MAS NMR of lyophilized defatted leaf tissue specimens clearly distinguishes resonances of medicinally important secondary metabolites (withaferin A and withanone) and its distinctive quantitative variability among the chemotypes. Non-targeted metabolite profiling of polar and non-polar extracts from fruits of *W. somnifera* using GC-MS and NMR spectroscopy and GC-MS techniques identified eighty two chemically diverse metabolites consisting of organic acids, fatty acids, aliphatic and aromatic amino acids, polyols, sugars, sterols, tocopherols, phenolic acid and withanamides from the fruits of *W. somnifera*. Squalene and tocopherol are the most potent naturally occurring compounds with antioxidant properties were identified by us for the first time in the fruits of *W. somnifera*. The qualitative and quantitative variations in the metabolites among different chemotypes of the leaf, root and fruits of *W. somnifera* suggest that specific chemotypes can be used for obtaining substantial amounts of bioactive ingredients for getting the desired pharmacological and nutraceutical activities. The results of the present study also demonstrated an efficient method, which can be utilized for bio-prospection by metabolite profiling of primary and secondary metabolites in medicinally important plants.

Keyword: *Withania somnifera*, Metabolomics, GC-MS

SII/P-6

Identification and Characterization of a Novel Arsenic Methyltransferase from *Westerdykella aurantiaca* Isolated from Arsenic Contaminated Agricultural Soil

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Arsenic (As) is highly toxic to all forms of life. It occurs predominantly in inorganic form as arsenate (AsV), arsenite (AsIII) and some amount of arsenic also present in organic form. Organic form of As comprises of arsenocholine, methylated form (MMA, DMA, TMAO), arsenobetaine and arsenosugars. Water supplies, soils and sediments contaminated with As are the major sources of drinking water and food-chain contamination in numerous countries. Several studies show the high level accumulation of arsenic in food crops such as rice and vegetables grown on As contaminated soil, thus plays an important role in transfer of this toxic element into the food chain. Therefore, developing strategies to reduce As contamination in food chain are highly desirable, this can be achieved by biotransforming highly toxic inorganic As species into comparatively low toxic methylated arsenic species. Several soil fungi and bacteria has the ability to tolerate As in soil, tolerance is may be due to transfer of methyl group to arsenic which convert into less toxic methylated form. Arsenic Methyltransferase (AsMT) is a key enzyme which converts inorganic As into organic methylated form of As. Heterologous expression of AsMT gene from fungus was shown to confer As resistance to an arsRBC operon-deleted *Escherichia coli*. The recombinant AsMT was purified and shown to have arsenic methyltransferase activity. In planta study of AsMT gene was done by transformation of Arabidopsis thaliana by this gene. Transformed lines show tolerance upto 40 ppm of As(V).This study illustrate how fungi show tolerance in arsenic contaminated soil, and methyltransferase gene can be used for the transgenic development which shows high AsV tolerance and low arsenic accumulation in grains.

Key words: Arsenic, Arsenic methyltransferase, DMA, MMA, Methylation

SII/P-7

Arsenate Responsive Rice Glutaredoxins (Osgrx) Play Role in Arsenic Detoxification

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Arsenic is the twentieth most abundant element on earth and ubiquitous in all living systems. Arsenic may enter into the living system either by crops grown on arsenic contaminated soil and water. Thus, there is need of an efficient system to minimize its concentration in the food chain. Arsenate can be remediated by arsenic specific operon (*ars* operon) in bacteria, in higher animals and plant it is done by specific enzymes or oxidoreductase system such as glutaredoxin and thioredoxin systems. Arsenate can be reduced to arsenite non-enzymatically by glutaredoxin (GSH mediated) or enzymatically by specific arsenate reductase. We identified two arsenate responsive glutaredoxin from rice which shows high upregulation in sensitive varieties (low arsenic accumulating rice cultivars) where other arsenic responsive mechanisms such as phytochelatin, metalothionins *etc.* systems are very weak. To further check the arsenic responses we complemented these genes in mutated *E.coli* strains, AW 3110 [ars-1(del) - *ars* operon deleted], JW 3468 [*ars*R757 (del) - arsenic responsive transcriptional regulator], JW 3469 [*ars*B758 (del) - arsenite extrusion protein], and JW 3470 [*ars*C759 (del) - arsenate reductase that reduces As (V) to As (III)]. We find that *OsGrx* recombinants showed tolerance in the absence of whole *ars* operon which is responsible for arsenic metabolism, and also showed the tolerance in partial del of *ars* element (del

ars B) responsible for arsenic extrusion from cell. Our study suggests that the functional role of *OsGrx* in arsenic tolerance was independent of its potential interaction with *ars* operon gene products; *OsGrx* might possibly regulate the arsenate reduction and their extrusion. Thus arsenate may be reduced in arsenite and extrude outside the cells with the help of *OsGrx* and minimized arsenic concentration in plant parts.

Key words: Arsenic, Glutaredoxin, GSH, Ars operon

SII/P-8

Exogenous Ethylene Reverses Metals-Induced Oxidative Stress and Protects Photosynthetic Capacity in Mustard (*Brassica juncea*)

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The influence of exogenously sourced ethylene in the protection of photosynthesis against nickel (Ni) and zinc (Zn)-induced oxidative stress in mustard (*Brassica juncea* L.) was investigated. Plants grown with Ni (200 mg kg^{-1} soil) or Zn (200 mg kg^{-1} soil) without ethephon exhibited increased activity of 1-aminocyclopropane carboxylic acid synthase and ethylene with increased oxidative stress (H_2O_2 content and lipid peroxidation) compared with control plants. Under metals stress, exogenously sourced ethylene (200 µL L^{-1} ethephon) protected photosynthetic potential and growth by up-regulation of sulfur assimilatory enzymes (ATP-sulfurylase and serine acetyltransferase activity) and increased content of cysteine, methionine and reduced glutathione. These ethylene-induced changes in oxidative stress and protection of photosynthesis were associated with increased proline metabolism. Ethephon application lowered stress ethylene by increasing sulfur and proline metabolism and alleviated Ni and Zn-induced oxidative stress. The use of ethylene action inhibitor, norbornadiene (NBD) in the study also confirmed the involvement of ethylene in reversal of Ni and Zn-induced oxidative stress by up-regulation of sulfur and proline metabolism.

Key words: Oxidative stress, Ethylene, *Brassica juncea*

SII/P-9

Molecular Typing of Bacterial Cultures Isolated from Different Ecological Niches by using Different Genetic Markers

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Phylogenetic classification of the various Bacterial Strains into higher taxonomic level has been done. These bacteria belong to different ecological niches and screened for their (bioactive compounds) biological activities. The aim of the project is to identify these bacteria at deeper taxonomic level other genetic marker. Therefore, the gyrB gene, which encodes the subunit B protein of DNA gyrase, was selected as an alternative phylogenetic marker. The pure culture were used to extract DNA by Qiagen DNA extraction kit. Concentration of extracted DNA was measured by Nano-Drop. Based on 16S gene sequencing methodology is a standard procedure to identifying the Bacterial species. The DNA sample was amplified by thermal cycler using 16S rRNA genes. As it is showing interspecific similarity between closely related species it is not concerned as a proved genetic marker. The Bacterial samples for gyrase B genes using degenerate primers was amplified. The amplified DNA was further purified by PEG-NaCl method. The purified product was sequenced by ABI sequencer. Further the ABI files were analyzed using bioinformatics tools and the fasta format of nucleotide sequences were obtained. Those sequences were further used for doing homology searches like BLAST against Genbank database. Phenotypic (morphological, physiological and biochemical) and genotypic (full length 16S rRNA gene, *gyrase* B) characterization would be carried out for the novel isolates showing less homology. *gyr*B nucleotide and translated amino acid sequence similarities for Bacillus strains were 75.4–95.0% and 88.5–99.2 %, respectively, whereas 16S rRNA gene sequence similarities were 98.1–99.8 %. Results showed that *gyr*B gene sequences provide higher resolution than 16S rRNA gene sequences. It has been concluded that the *gyr*B gene is an efficient substitute for the

identification and taxonomic study of members of the Bacillus species.

Key words: *gyr*B marker, 16SrRNA gene, Bacterial cultures

SII/P-10

Evaluation of RAPD Technique to Induced DNA Damage by Heavy Metal to Detect the Genotoxicity Effect in Mung Bean [*Vigna radiata* (L.) Wilc zek] Seedlings

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The toxic heavy metals induce several cellular stress responses to damage different cellular component such as membranes proteins and DNA. In this study, the effect of nickel, lead, copper, cadmium and mercury on seed germination of Mung Bean were investigated, mainly the genotoxicity and phytotoxicity based on morphological such as roots and shoot growth and DNA damage. An RAPD fingerprinting technique was used to detect the DNA damage in mung bean [*Vigna radiata* (L.) Wilc zek] on seed germination treated with different concentration of heavy metals such as 50 mg/l, 100 mg/l, 150 mg/l, 200 mg/l, for one week showed changes in morphological such as radical, coleoptiles, and protein content and DNA profile. A total 12 primers of 60-70% GC content were amplified by RAPD primers produced 156 bands between 110-1148 base pair in agarose gel electrophoresis .The Changes in DNA Profile include variation in band intensity, presence or absence of some bands profile showed significant effect at 150 mg/l to 200mg/l concentration of heavy metals. The results concluded that DNA damage detected by RAPD analysis could be a useful tool for detection of genotoxic effects of different heavy metals on plants.

Key words: RAPD, *Vigna radiata*, DNA damage, UV light, Protein

SII/P-11

Identification of Bacteria from Dye and Industrial Effluent Contaminated Soil through Metagenomic Approaches

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Culture of mirobes and its maintenance is vastly accepted problem as near about 98% culture of microbes is not feasible even today. This problem exists due to the diverse and multifarious environment of microbial species. To overcome this geniunine problem a noval approach is of metagenomics has taken birth. Metagenomics can be defined as culture-independent sequencing and analysis of microbial DNA extracted directly from an environmental raw sample.Current study is being planned to dig out the chareterization of unknown bacteria from the sample collected from the dye and industrial effluent contaminated soil, with the help of in silico based metagenomic studies. The Industrial dyes and effluents are released into waste water and soil without any pre-treatment and thus polluting water and soil environment on large scale. Such soil, contaminated with dye and industrial effluent is vast reservoir for a large number of microorganisms and has diverse range of bacteria present in it. Analysis of such bacterial reservoirs may be very essential as they play an important role in degradation processes. In the present study, proceeding towards the protocol, DNA isolation was done by using 10% SDS then qualitative and quantitative determination of the isolated DNA was done by Gel Electrophoresis and UV Double Beam Spectrophotometer respectively. Isolated DNA was further amplified by PCR under given temperature-time cycles. The amplified product then separated by electrophoresis and then sequenced using Sanger's Method of sequencing. Obtaining the result of isolated sample in silico analysis of genomic sequence was performed. Through different alignment and phylogenetic analysis of sequence it was observed that processed bacterial sample from dye and effluent contaminated soil showing high similarity indexes with

enterobacter genus This unique metagenomic approaches can be applied for analysis and characterization of any unknown species in less time and low cost experimentation

Key words: Meta-genomics, Dye and industrial effluent, PCR, *Enterobacter,* Phylogenetic tree

SII/P-12

Transformed Yeast (Schizosaccharomyces pombe) Overexpressing Rice Tau Class Glutathione S-transferase (OsGSTU30 and OsGSTU41) Shows Enhanced Resistance to Hexavalent Chromium

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Extensive use of hexavalent chromium [Cr(VI)] in leather tanning, stainless-steel production, wood preservatives and electroplating industries has resulted in widespread environmental pollution and poses a serious threat to human health. A plant's response to Cr(VI) stress results in growth inhibition and toxicity leading to changes in components of antioxidant systems. In a previous study, we observed that a large number of glutathione S-transferase (GST) genes were up-regulated under Cr(VI) stress in rice. In this study, two rice root-specific Tau class GST genes (OsGSTU30 and OsGSTU41) were introduced into yeast (Schizosaccharomyces pombe). Transformed yeast cells overexpressing OsGSTU30 and OsGSTU41 had normal growth, but had much higher levels of GST activities and showed enhanced resistance to Cr(VI) as compared to control cells (transformed with empty vector). Also, a higher accumulation of chromium was found in the transformed yeast cells as compared to the control cells. Manipulation of glutathione biosynthesis by exogenous application of buthionine sulfoximine abolishes the protective eûect of OsGSTs against Cr(VI) stress. These results suggest that Tau class OsGSTs play a significant role in detoxification of Cr(VI), probably by chelating and sequestrating glutathione–Cr(VI) complexes into vacuoles.

Key words: Glutathione S-transferase, Hexavalent chromium, Rice, Yeast

SII/P-13

Characterization of Rice Metallothionein Class-1 Gene Family during Heavy Metal Stress

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Heavy metal ions, such as cadmium (Cd), arsenic (As), chromium (Cr), lead (Pb), zinc (Zn) and mercury (Hg), are highly reactive and toxic to living cells Plants like all living organisms, have evolved mechanisms to control and respond to the uptake and accumulation of these toxic heavy metals. Metallothioneins (MTs) are a family of cysteine rich low molecular weight polypeptides and have affinity to bind with heavy metal ions. MTs particularly class-1 MT gene family play an important role in heavy metal detoxification and homeostasis of intracellular metal ions in plant. Though MT genes from few other plants have been characterized with respect to their protein sequences, kinetic properties and tissue-specific localization, no detailed study of this family from rice has been carried out. Here, we present genome-wide identification, structural and expression analyses of rice class-1 MT gene family. In this study, we also report presence of eleven Class I MT genes through genome-wide analysis (Release 7 of the MSU Rice Genome Annotation Project) in rice genome which are differentially expressed during growth and development, in various tissues and during biotic and abiotic stresses. We identify and transform two MT genes in yeast (*schizosacromyces pombe*) for futher characterization in response to heavy metal stress. Our study provides a very useful framework and starting point for revealing the function(s) and regulation of rice class-1 MT gene family. Genes showing high expression in response to a particular stress and showed significant stress tolerance when expressed in yeast can be exploited for improving stress tolerance in plants.

Key words: Arsenic, Heavy metal, Rice, Stress, Metallothionein, Cysteine

SII/P-14

Quantification of Bioactive Phytochemicals and DNA Damage Protection Activity of *Solanum melongena* Leaf

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Solanum melongena is a plant of the family Solanaceae, also known as the nightshades. Various parts of the plant are useful in the treatment of inflammatory conditions, ulcers of nose, cholera, bronchitis, asthma and hypolipidemia. In present study an attempt has been made to quantify antioxidant and DNA damage protective activities of SM leaf and fruit extracts. Quantification of bioactive phytochemicals such as vitamin C, carotenoids, total phenolics, protein and carbohydrate content were done in leaf and fruit extracts. Free radical scavenging activity by DPPH, SOD and LPO method, reducing power and Calf thymus DNA damage protection activity has been monitored in SM leaf extract only. SM leaf extract showed higher content of total phenolics, ascorbic acid, -carotenoid and protein in comparison to the fruit extract. SM leaf extract showed lower IC_{50} for DPPH (IC_{50}=0.410±9.70 mg/ml), SOD (IC_{50}=0.67±4.77 mg/ml), lipid peroxidation (IC_{50}=0.813±10.36 mg/ml) and higher reducing power (20.26±1.56 ASE/ml). DNA damage protective activity of leaf extract showed significant inhibition of hydroxyl radical dependent DNA damage at 1.0 µg/ml. Results showed that the phytochemicals present in SM leaf extracts may be responsible for antioxidant and DNA damage protective activity.

Key words: *Solanum melongena,* Total phenolics content, Antioxidant, Phytochemicals

SII/P-15

Synthesis of Copper Oxide Nanoparticles and its Effect on Cabbage Seedlings

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In recent decades nanotechnologies are growing multidisciplinary way of scientific interest in the whole world. In this era the large scale production of metal oxide nanoparticles (NPs) is due to wide range of their applications. The extensive release of metal NPs into environment causes threat to our natural ecosystem. Copper oxide nanoparticles (CuO NPs) were prepared by simple and cost effective chemical precipitation method using precursors $CuCl_2$ and NaOH. In the present work we have studied the impact of CuO NPs on seed germination and seedling growth of cabbage (*Brassica oleracea* var. capitata). In this experiment 100, 200, 300, 600, and 900 ppm suspensions of CuO with 105 nm crystalline size were used. The biophysical and biochemical parameters were studied. The germination percentage increased with increasing concentration while length of radicle and plumule decreased in dose dependent manner. The significant reduction in sugar and protein content was reported under CuO NPs treatment. The total antioxidant enzyme activities increased with increased concentrations of CuO NPs to avoid the oxidative damage caused by NPs. The cabbage seedlings have strong defense system against oxidative stress imposed by CuO NPs.

Key words: Antioxidant, Cabbage, Crystalline size, Nanoparticles, Oxidative stress, Protein

SII/P-16

Assessment of Genetic and Morphological Variability for Managemnt of *Lantana camara* L.

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Lantana camara is a notorious weed, it will out compete with other desirable species, leading to reduction in biodiversity. It can also cause problem if it invades agricultural areas as a result of toxicity to livestock as well as its ability to form dense thickets which if left unchecked can greatly reduce the productivity of farm land. Present study was planned

to check variability in the available germplasm of Lantana so that a proper strategies could be planned for management of this weed. Variability was evaluated in Lantana germplasm available in the part of North-Central India, on the basis of flower colour. Total six flower colours viz. orange, red, orange red, pink, orange yellow, yellow bearing plants were reported from this region. Correlation of flower colour with morphological variations was estimated. And yellow flower bearing plant showed maximum variability. To confirm the above data, variation was also estimated at genetic level. RAPD and RFLP were done by using random primers and different restriction enzymes respectively. At genetic level also yellow flower bearing plant showed variability. Besides that pink and red flower bearing plants also found different from other plants. Amplification pattern of red and orange flower bearing plants were same.

Key words: *Lantana camara*, Genetic variability, RAPD, RFLP

SII/P-17

In Silico Identification and Construction of Microbial Gene Cluster Associated with Biodegradation of Undesired Toxic Materials

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Xenobiotic compounds are defined as chemical substances which are not present within a biological system. These wide groups of agents may or may not be accepted by our environment. The concentration in which they occur determines the extent of their effect on ecosystem. Such compounds can also cause a range of health hazards. Human exposure to these notorious compounds can range from mild skin irritation to birth defects, tumours, genetic changes, blood disorders, neurogenerative disorders, endocrine disruption and even coma and death. Hence their proper degradation is major issue of concern for research. Sustainability of our environment is very important as the toxic xenobiotic compounds which are not accepted by our ecosystem require the process of biodegradation. Biodegradation is defined as the process of breaking down organic compounds into smaller substances so as to reduce the complexity of the compounds through different biological species. No doubt microbial world is leading ahead in this area but still there is much scopes for other species those who can also contribute in this area. Current study is being focused for identification of such species which can also lead a positive direction for degradation of different xenobiotic compounds. Through homology searches by various *in silico* approaches it was found that different species of algae and fungi have great potential regarding the same, as same gene clusters of existing microbial world those which are already reported, were monitored in the species of algae and fungi . Study later on signifies that fungus. *Aspergillus niger* and algae *Chlamydomonas reinhardtii* have much similar zones or genes with bio degradation capability as with was *Pseudomonas putida* which was taken as a reference. It was found during the intensive data mining that *Pseudomonas putida* has potential for degrading maximum compounds. These findings may give a new outcome in terms of much cheaper and eco-friendly source in the area of biodegradation of specified xenobiotic compounds. Establishment of correlation through cluster analysis signifies that *Pseudomonas putida*, *Aspergillus niger* and *Chlamydomonas reinhardtii* can have combined traits which can be used in finding out actual evolutionary relationship between these species.

Key words: *Aspergillus niger*, Biodegradation, *Chlamydomonas reinhardtii*, *Pseudomonas putida*, Xenobiotic

SII/P-18

Metagenomics: Tool to Study Environmental Microorganisms

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Metagenomics is "the application of modern genomics techniques to the study of communities of microbial organisms directly in their natural environments, bypassing the need for isolation and lab cultivation of individual species". it includes study of microorganisms from exotic and ordinary environments—ocean surfaces, deep sea vents, hot springs, soil, animal rumen and gut, human oral cavity and intestine. Initially metagenomics studies focused on 16S ribosomal RNA sequences, which were directly

taken from the environment further due to advancement of high throughput sequencing techniques cDNA is isolated directly and sequenced. In 2003, Craig Venter led the Global Ocean Sampling Expedition (GOS) to unlock the secrets of the oceans by sampling, sequencing and analyzing the DNA of the microorganisms living in these waters. Once sequences are binned, it is possible to carry out comparative analysis of diversity and richness utilizing tools such as Unifrac. Data integration is done through Genomes On Line Database (GOLD), Metagenomics Rapid Annotation using Subsystem Technology server (MG-RAST) and The Integrated Microbial Genomes/ Metagenomics (IMG/M). MEGAN (MEta Genome Analyzer) tool performs both taxonomic and functional binning. Bioinformatics plays crucial role in metagenomics for Gene Prediction based on homology search by simple a BLAST search, which is implemented in the program MEGAN4, and that based on ab initio approach uses GeneMark and GLIMMER. Species diversity is done through Binning. Similarity-based binning uses BLAST and PhymmBL. MetaPhlAn and AMPHORA are methods based on unique clade-specific markers for estimating organismal relative abundances with improved computational performances. This paper summarizes recent advances in metagenomics, bioinformatics tools and databases. Illustration and compilation of such basic to advance information in relation with application in wide fields of environmental studies may be used further in evolutionary studies, medicine, biofuel, environmental remediation, biotechnology, agriculture and ecology, identification and characterization of environmental organisms.

Key words: Metagenomics, GOS, Environmental samples, Microbial organisms, IMG/M, MEGAN

SII/P-19

Identification of Conserved and Novel MicroRNAs in Two Contrasting Flower Color of *Canna* Cultivar by Deep Sequencing

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Canna is one of the most important ornamental plants in tropics and subtropics due to large attractive foliage and colors. A better understanding of important genes and its regulation that contribute to floral development and color patterning will lead to the development of improved *Canna* cultivars. MicroRNAs (miRNAs) are endogenous small non-coding RNAs which play a critical role in gene regulation in plants and animals. Here we report, for the first time the analysis of miRNAs from petal tissue of two contrasting *Canna* cultivars, Tropical Sunrise and Red president differing mainly with respect to color. Sequencing of two sRNA libraries made from Tropical Sunrise and Red President yielded 28 million and 18 million reads, respectively. From these sRNAs, 271 miRNAs belonging to 68 miRNA families and 282 miRNAs belonging to 61 miRNA families were identified from Tropical Sunrise and Red President, respectively. One hundred and ten miRNAs were differentially expressed and 239 miRNAs were conserved between the two cultivars, whereas 16 miRNAs were identified as novel. The miRNA families that showed most significant differential expression were miR397, miR398, miR528, miR827, miR170, miR390 and miR828. Gene ontology term enrichment analysis of the target genes of differentially expressed miRNAs reveals that these miRNAs mainly affect the flower development, color development, metabolic process, biological process, cellular process and transcription factors. This study will enrich the knowledge about the involvement of miRNAs in color and flower development of *Canna*.

Key words: MicroRNAs, *Canna*, Floral development, Color development

SII/P-20

Role of GSNOR In Detoxification Mechanism Against Abiotic Stress In Plants

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Abiotic stress is known to cause disturbance in redox homeostasis by formation of reactive oxygen species (ROS) and reactive nitrogen species (RNS). RNS includes nitric oxide (NO) and peroxinitrite

($ONOO^-$), which are formed through the condensation reaction of NO with O_2^-. Peroxynitrite causes depletion of SH groups, oxidation of lipids, deamination of DNA bases (guanine), nitration of aromatic amino acid residues (F, M, W, Y) in proteins and oxidation of methionine to its sulfoxide. S-Nitrosoglutathione (GSNO) is an S-nitrosothiol which is formed by the reaction of NO with reduced glutathione (GSH) and it functions as a mobile reservoir of NO bioactivity. Under stress conditions, GSNO is detoxified by activity of GSNO reductase (GSNOR), which catalyses the NADH dependent reduction of GSNO to GSSG and NH_3, thus playing a key role in the NO metabolism under physiological and stress conditions. Several studies highlight the contradictory role of GSNOR in countering the abiotic stress in plants. GSNOR activity increased by 40% when *Arabidopsis* seedlings were grown in 500 µM arsenic; on the contrary Pea plants (leaves) exposed to 50 µM cadmium has shown reduced GSNOR activity by 31%. Similarly, Pea seedlings exposed to high temperature showed increased GSNOR activity; on the contrary sunflower seedlings exposed to high temperature (38°C for 4 h) reduced GSNOR activity by 25%. Overall, it appears that GSNOR activity varies from plants to plants in different tissues and under different abiotic conditions. Hence, the role of GSNOR under abiotic condition remains to be explored for specific stresses in a particular plant.

Key words: ROS, RNS, NO, GSNO, GSNOR

SII/P-21

Study of Bacteriophages P1 as an Biocide for the Control of Biofouling Agent *Pseudomonas aeruginosa*

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Microbiofouling damage is a major cause of environmental concern in the marine industry, industrial production setup involving water coolant piping as well as in water quality managements systems. Biofouling poses significant health risks and financial losses in the medical, marine and industrial fields. The use of toxic antibiofouling paints and chemicals creates its own set of environmental toxicity issues. *Pseudomonas aeruginosa*, a gram negative bacteria is an opportunistic pathogen that can cause a number of diseases. Furthermore, biofilms formed by *Pseudomonas* sp. are particularly difficult to eradicate as the organisms show high degree of resistance to biocides and antimicrobial chemotherapeutic agents. An alternative form for the control of biofilm forming biofoulants includes the use of their natural parasites-bacteriophages. We present herein the isolation and characterization of bacteriophage P1which selectively inhibits the biofilm forming environmental *Pseudomonas aeruginosa* ATCC 15442 strain. Bacteriophage P1, was isolated from Ganges river and has the potential to eradicate upto 80% of biofilm forming *Ps. aeruginosa*. We present data regarding the isolation, characterization and biofilm eradicating ability of Bacteriophage P1.

Key words: Biofouling, *Pseudomonas aeruginosa*, Bacteriophage, Antimicrobials, Biofilm

SII/P-22

Green Synthesis of Gold Nanoparticles using *Usnea* sp., a Fruticose Lichen from Manipur, North East, India

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The green chemistry approach for synthesizing biocompatible gold nanoparticles (AuNPs) has become one of the most active areas of research in modern material sciences. The present study reports the biosynthesis of pure metallic gold nanoparticles by reducing aqueous gold chloride solution via dried biomass of a fruticose lichen, *Usnea* sp. Rapid reduction of gold ions was observed leading to the formation of gold nanoparticles in solution. The synthesized nanoparticles were characterized by UV-visible spectrophotometer. The surface plasmon resonance of the synthesized gold colloids was found at around 535 nm in the UV- visible spectrum. The study also reveals a gradual decrease in intensity of the absorption of the synthesized nanoparticles with

reaction time. From the study, it can be highlighted that lichen biomass are nanofactories for facile production of raw materials for nanomedicines.

Key words: Gold nanoparticles, Green synthesis, Fruticose, Lichen, *Usnea sp.*

SII/P-23

Arsenite-Sulfur Interaction Modulates Amino Acids Biosynthesis in Rice: Reflections from Proteome, Amino Acids and Thiolic Metabolites

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Arsenic (As) contamination is a global concern due to its repercussion on human health and rice is the largest source of As in human diet, predominantly in Asia. Arsenic affects nutritional quality of rice in terms of protein and amino acids (AAs). Sulfur (S) is involved in di-sulfide linkage in many proteins and plays crucial role in As detoxification. Present study was designed to explore the modulation of proteome, AAs profile and non protein thiols of rice leaves with variable S regimes during arsenite (AsIII) stress. Analysis of 282 protein spots on 2-DE gel revealed 113 differentially expressed proteins, out of which 80 spots were identified by MALDI-TOF-TOF. The identified proteins were mostly involved in various cellular and metabolic processes including glycolysis, TCA cycle, AA biosynthesis, photosynthesis, protein, stress and energy metabolism. Among these, glycolytic enzymes play a major role in AA biosynthesis. Sulfur supplementation positively skewed glycolysis towards ATP generation and AA accumulation under AsIII stress. Modulation in expression of various genes encoding proteins with differential accumulation including ATP synthase during S and AsIII interaction is also validated by gene expression studies. This study, for the first time, also reports induction of 2Fe-2S cluster binding and IAP 100 proteins in response to high S and AsIII condition. The involvement of various proteins during As-S interaction, provide platform to further comprehend the probable management strategy of cellular As toxicity, and bestow new insights toward AA biosynthetic pathway occurring in the As tainted rice.

Key words: Arsenic, Amino acids, Rice

SII/P-24

Mycosporine Like Amino Acids Biosynthesis in Cyanolichens: An Adaptation to UV Radiation

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Continuous emission of green house gases and CFCs has significant impact on the UV protecting ozone layer. The depletion of ozone layer has enhanced the exposure to solar ultraviolet (uv, 100-400 nm) radiation reaching the earth's surface. Various component of uv radiation, especially UV-B degrades organic molecules, which directly induce structural changes that affect their biological function while ultraviolet-A (UV-A; 315–400 nm) which is not absorbed by the native DNA molecule, can still induce DNA damage either by inducing secondary photoreactions.

In order to protect cellular structure from UV induced damage various organisms including lichens produce UV screening compounds especially Mycosporine-like amino acids (MAAs). MAA are typically a group of more than known 20 compounds having absorption maxima between 310 and 362 nm. Structurally MAAs is comprised of either cyclohexinone or cycloheximine units substituted with amino acids or amino alcohols which provides higher stability to the conjugated ð- bonding electrons.

In lichens the unique composition of alga and fungi not only results in conferring differential sensitivity towards range of environmental factors but also makes them physiologically adapted and chemically diversed to combat various abiotic and biotic environmental stresses including rising UV radiation. Cyanobacterial lichens are also known to synthesize Mycosporine-like amino acids (MAAs). In view of its uv protecting potential, applicability of

mass spectral fragmentation using LC-MS/MS for characterization of MAAs and its precursors, gadusol and deoxygadusol in lichens was explored. MAAs were characterized in three cyanobacterial lichen species belonging to genus *Peltigera a*nd *Lobaria* along with a tripartite collected from higher altitudes of Himalaya (Tungnath in Garhwal Himalaya, 3400 m) from an exposed locality having high light intensity. Result revealed occurrence of 11, 10, 17 and 18 MAAs respectively out of the 21 known MAAs tested. It was observed that *L. retigera* had highest diversity of MAAs followed by *S. foliolosum*, *P. rufescens* and *P. polydactylon*. Intensity peaks obtained by LC-MS/MS spectra indicates that Palythine-serine, Mycosporine Serinol, Asterina 330, Palythine-serine-sulfate, Mycosporine-glutamic acid-glycine and Collemin A are the major MAAs present in all the four lichen species.

Key words: Lichens, Cortical compounds, LC-MS/MS, Spectrometric characterisation

SII/P-25

Analyses of Genetic Diversity and Population Structure in *Bergenia ciliata* using Molecular Markers

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Genetic variability and population structure of *Bergenia ciliata* (Wall.) Engl. (Saxifragaceae), commonly known as "*Pashaanbheda*" (Stone-breaker) were estimated using two single primer amplification reaction (SPAR) methods *viz.*, directed amplification of minisatellite DNA (DAMD) and inter simple sequence repeats (ISSR). The cumulative data analysis carried out for these markers showed 86.05% polymorphism. The intra-population genetic diversity analysis revealed the highest values of Nei's genetic diversity (0.25), Shannon information index (0.37) and polymorphic loci (68.90%) in BNSR population, while lowest values of genetic diversity (0.14), Shannon information index (0.21) and polymorphic loci (38.95%) in PTRH population. The pair wise Nei's genetic distances were calculated for all the populations. The maximum inter-population average genetic distance (0.28) was between PTRH and NNTL populations, whereas NNTL and RNKT both populations showed least genetic distance (0.08) to BNSR population. Analysis of molecular variance (AMOVA) showed highest percentage of variation within individuals of populations (73%) followed by 26% among populations. Clustering of the different populations of *B. ciliata* in bar plots of STRUCTURE and PCoA plot were in congruent, and supported the admixture of individuals in inferred as well as in geographical populations. The data strongly suggests that low genetic flow, geographic isolation and to some extent genetic drift are the major factors responsible for high genetic differentiation. Preservation of genetic diversity of *B. ciliata* is important, both to promote adaptability of the populations to changing environment as well as to preserve a large gene pool for future prospection. The present study using DAMD and ISSR markers provide the means of rapid characterization of accessions within the populations, and thus enable the selection of appropriate accessions for further utilization in conservation and prospection programs.

Key words: *Bergenia ciliata*, DAMD, Genetic diversity, ISSR, Population structure

SII/P-26

Assessment of Genetic Variability and Relationship among *Gladiolus* L. Cultivars

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Gladiolus L. (Iridaceae) is one of the important ornamental crops valued for its cut flowers in the floriculture industry. In the present study, we analyzed genetic variability and relatedness in 62 *Gladiolus* cultivars using two DNA fingerprinting methods *viz.*, Directed Amplification of Minisatellite DNA (DAMD) and Inter Simple Sequence Repeats (ISSR). The cumulative (DAMD+ISSR) genetic distance calculated by Jaccard's coefficient method showed a distance range from 0.14 - 0.46 with an average value of 0.36 amongst the *Gladiolus* cultivars. The maximum inter-cultivar average genetic distance was (0.46)

between Tiger Flame and Snow Flower cultivars, while the corresponding least genetic distance (0.14) was between Friendship Pink and Friendship White cultivars, respectively. The cumulative (DAMD+ISSR) analysis carried out for the data generated with DAMD and ISSR methods showed 84.52 % polymorphism across all the *Gladiolus* cultivars. This level of polymorphism resulted in the present investigation revealed that the amount of genetic variability in the *Gladiolus* genome is relatively high. The Jaccard's similarity coefficient and clustering of genotypes in the Unweighted Pair Group Method with Arithmetic Mean (UPGMA) dendrogram revealed that some of the cultivars are closely related whereas others were found quite distinct from each other. The UPGMA dendrogram resulted in the identification of five major clusters. The present study further demonstrates that DAMD and ISSR are useful DNA fingerprinting methods to elucidate the genetic variability and relationships amongst *Gladiolus* cultivars, and is a prelude for further utilization of promising and genetically divergent materials in the breeding programmes. Furthermore, DAMD and ISSR markers have the potential of being used as diagnostic tools for cultivars identification, or could be developed into cultivar specific Sequence Characterized Amplified Regions (SCAR) markers.

Key words: DAMD, Genetic variability, *Gladiolus*, ISSR, UPGMA

SII/P-27

Role of Mathematics in Environmental Biology: An Expanding Field

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Environmental Science has followed a 'holistic' approach in bringing together traditional disciplines like biology, meteorology, hydrology, chemistry and physics to understand the workings of the environment as a whole. After a long reluctance of mathematicians to take up biological issues, the last decade has witnessed substantial growth in the area of mathematical biology around the world. Environmental issues can provide an excellent way to bridge the gap between mathematics and biology. Statistics has been effectively and intensively used to analyze and interpret the increasing flood of vast data from environmental areas, which are often of heterogeneous nature and show high variability. The scientific approach to any environmental issue requires the correct application of statistical methodology to ensure well-conducted data collection, analysis and interpretation. Mathematical modeling aims to describe the different aspects of the real world, their interaction, and their dynamics through mathematics. Mathematical modeling and scientific computation has played a key role in the analysis of qualitative and quantitative analysis generating from environmental sciences. Traditional mathematical models given in ecology, epidemiology, evolution, and related areas have not only shed new information but also solved some of the most intricating problems. Properly addressing burning environmental issues will not only require new mathematical ideas but also deep coordination between researchers who analyze models (mathematicians) and those who pose questions, formulate models and link model to data (biologists). The coming decades would certainly witness the beginning of a golden age of connection between the mathematical and biological sciences.

Key words: Environmental issues, Computational biology, Mathematical modeling, Simulation

SII/P-28

Microarray Analysis of Indian Mustard (*Brassica Juncea*) Under Arsenate Stress

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Arsenic (As) is a non-essential toxic element. The need exists to elucidate in detail the mechanisms of As stress perception by and response of plants vis-à-vis As accumulation. It is of further importance to

understand the dynamic nature of response mechanisms. In this study, time dependent (4 h to 96 h) transcriptome changes in roots and shoots of *Brassica juncea* were analyzed under arsenate (AsV) stress through microarray approach by using Agilent platform. Transcriptome data were validated by real-time RT-PCR analysis. A total of 1285 genes showed significant change in expression pattern upon arsenate (AsV) exposure, which were arranged in different profiles according to their time-vise expression changes by using the short time-series expression miner (STEM) tool. The genes belonged to various signaling pathways including hormones (jasmonate, abscisic acid (ABA), auxin and ethylene) and kinases. Significant effects were also noticed on genes of metabolic pathways including sulfur, nitrogen, CHO, and lipid metabolisms along with photosynthesis. In addition, various transposons also constituted a part of the altered transcriptome. Biochemical assays were conducted using specific inhibitors of glutathione (GSH) and jasmonate biosynthesis, and kinases. These studies indicated interconnections among sulfur metabolism, jasmonate and kinase signaling pathways. The present results of microarray and biochemical analyses highlight that signaling and metabolic pathways work in a dynamic coordination to perceive and respond to the stress.

Key words: ABA, Arsenic, Jasmonates, Sulfur metabolism, Transcriptome

SII/Special Lecture

Illustration from a School Environment Project

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This talk will describe a school environment project and discuss how scientists can help in environmental awareness raising and technological changes.

SIII/L-1

Reducing Stress Induced Damage in Crops: Role of Microbes

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Ethylene may be either positive or negative to the plants as at lower concentrations it supports seed germination and root initiation while at above optimal levels it substantially damages the plant. Increased concentrations of ethylene in plant tissues, which are triggered by various biotic and abiotic stresses, weakens the plant defense against the stressors. All types of stresses in the plants whether abiotic or biotic lead to increase in its endogenous ACC level resulting in considerable increase in stress ethylene causing plant damage. ACC deaminase-containing PGPRs have been shown to express substantial tolerance to stresses by protecting a plant from the deleterious effects of environmental stress by reducing the concentration of stress ethylene via deamination of ACC. In the studies conducted in our laboratory it was clearly demonstrated that ACC deaminase-containing rhizobacteria *Achromobacter xylosoxidans* (Fd2) isolated from waterlogged soil reduced water logging induced yield losses in *Ocimum* plants via lowering stress ethylene levels. We also investigated if chemical nitrogen application affects the efficiency of ACC deaminase-containing rhizobacterium *A. xylosoxidans* in protecting the plant from water logging and whether it protects tomato plant via lowering stress ethylene levels by consuming ACC (precursor of ethylene) or utilizes chemical nitrogen for its growth under nitrogen rich waterlogged soil. Our study is the first report suggesting that chemical nitrogen applications do not affect ACC deaminase activity but to some extent may help in improved plant growth under waterlogged conditions. A significant reduction in the activities of ACC synthase and ACC oxidase, key enzymes in the main pathway of ethylene generation, was observed in Fd2 pre-treated stressed plants. These ACC deaminase-containing bacteria could also delay flower initiation and fruit ripening under field conditions in tomato through reduction in ethylene generation. The ACC deaminase enzyme-producing bacteria *Bacillus subtilis* (LDR2) acted as sink of ACC (immediate precursor of ethylene) under drought stress thereby lowering plant stress ethylene levels and ameliorating the plant damage. It also improved colonization of beneficial microbes like *Ensifer meliloti* (Em) and *Rhizophagus irregularis* (Ri) under drought stress in plants resulting in improved nutrient uptake and plant growth. An ACC deaminase-containing endophyte *Burkholder iacepacia* (ART 7) isolated from *Artemisia annua* enhanced plant stress tolerance under both drought and salt stress conditions. The salt + drought (both stress at the same time) abiotic stress ameliorating effects of ART 7 were evaluated through RSM (Response Surface Methodology) and the substantial protection of *Artemisia* plants was noticed against both the stresses.

Key words: ACC deaminase, *Achromobacter xylosoxidans*, *Ocimum*, *Artemisia*, abiotic stresses

SIII/O-1

Test of *In vitro* Antagonism of Some Strains of *Paenibacillus polymyxa* Towards Strain of *Microdochium nivale* Agent of the Fusariose of the Durum Wheat

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Wheat is very important crop in Algeria, not only for being cultivated over large areas but also for providing one of the main sources of food for human consumption there. The culture of this plant is threatened by *Microdochium nivale*. Infection of wheat by the agent leads to a reduction in quantity and quality of grain, and the contamination of the latter by deoxynevalenol (DON), a mycotoxin harmful to livestock and human health (Tisserand, 2009). Biological control represents an attractive alternative for the future because of many concerns about the pesticides use. Ideally, an agent of biological control of fungal root pathogens should exert a sufficient amount of antagonistic activity in the rhizosphere to significantly reduce root disease symptoms. The *Paenibacillus polymyxa* species is among micro-organisms naturally antagonists of plant pathogens. The effect of *Paenibacillus polymyxa* (syn. *Bacillus*

polymyxa) on control of *Microdochium nivale* was investigated. Among the collection of 111 strains of *P. polymyxa*, we selected with a criterion of diversity, twenty two strains for the test of antagonism. *P. polymyxa* strains were isolated from the rhizosphere of different soils cultivated with durum wheat by an immuno-enzymatic method *immuno-trapping*. The strains had been identified and their diversity searched using the various methods API, RFLP and gene sequencing of ARNr16S. The results of the test of *in vitro* confrontation to the darkness enabled us to conclude that the inhibition of the growth of this fungus by the bacteria tested on PDA medium and King B could be due to the conjunction of several molecules (antibiotics, hydrolytic enzymes and siderophores). The inhibiting effect observed only on the King B medium, could be a result of production of bacterial siderophores. Alternatively, direct competition for food is a plausible scenario. We noted that the inhibition of *Microdochium nivale* could remain over time on the PDA media and King B. This result can be explained by the stability of the substances produced by *P. polymyxa*. Finally, it seemed to us interesting to underline the great reproducibility of the results. These results open serious perspectives in the development biological control against this fungus. *P. polymyxa* studied in this work could be good candidates for tests *in vivo*.

Key words: Food, *Paenibacillus polymyxa*, Test of *in vitro* antagonism, *Microdochium nivale*, Durum wheat, Fusariose.

SIII/O-2

Influence of Ambient and Enhanced Solar UV-B Radiation (285-325 nm) on *Pseudomonas syringae* (Bacterial Brown Spot) Induced Pathogenicity in *Vigna radiata* L.

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Bacterial Brown spot disease caused by *Pseudomonas syringae* is a great menace to a wide variety of crops including pulses. The bacteria is commonly found in the infected seeds and hence transferred from plant to plant and nearby fields by wind driven and splashing rains, sprinkler irrigation, surface-drainage water, insects, birds, large animals, humans, farm machinery, tools and other agencies. The bacteria survive for 6 to 18 months in plant refuse. Long-distance spread is generally through seed. The most important factors of bacterial brown spot disease are a cloudy damp weather and relatively high air temperature (28° C - 32°C) which normally prevails during the cultivation time. Stratospheric ozone depletion due to increased atmospheric pollutants has received considerable attention because of the potential increase in UV-B (285-325 nm) radiation that reach the earth's surface. Numerous studies have demonstrated the impact of increased UV-B irradiation on the growth, physiology and yield of important crop plants. However, there have been relatively few investigations of the effects of increased UV-B irradiation on the severity of plant diseases. Many environmental factors affect disease and plant's ability to resist diseases, including light intensity, temperature, humidity and nutrition. Hence, we aim to find whether ambient as well as enhanced UV-B radiation affects the pathogen and alter the degree of pathogencity.

Key words: Pathogen, Pathogenicity, UV-B, Vegetative growth, Yield

SIII/O-3

Differential Impact of Native and Exotic Arbuscular Mycorrhizal Fungi on Nutrient Uptake and Yield in Two Genotypes of Salt-Stressed *Cajanus cajan* (L). Millsp.

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Salinity stress drastically affects crop productivity throughout the world and legumes have been known to be either sensitive or moderately tolerant to salinity. In recent years, use of arbuscular mycorrhizal (AM) fungi as bioameliorators has gained importance as they form association with most crop plants and help plants survive under adverse environmental conditions. However, plant-growth responses to AM fungi vary with the host plant, endophyte and soil. A pot trial was conducted to investigate the effectiveness of a native inoculum sourced from saline soil (SMix) and two exotic single isolates, *Funneliformis mossseae* (F1) and

Rhizophagus irregularis (F2) (single or combined inoculations) in two pigeonpea genotypes (Paras, Pusa 2002) grown under salt stress (0-100 mM NaCl). While salinity reduced plant biomass in both genotypes, mycorrhization improved plant biomass and productivity at all salinity levels alleviating salt-induced reduction of N, P, K^+ and Ca^{2+} uptake while preventing excess uptake of Na^+ ions. Pusa 2002 was more salt tolerant and ensured higher AM colonization, plant biomass and nutrient content with favourable ion status under salinity. Significant variability was displayed amongst the AM fungi; F2 displayed higher efficiency than SMix or F1 under salt stress, resulting in highest biomass, nutrient uptake, and yield. Higher effectiveness of F2 corresponded to high colonization indicating that the symbiosis formed by *R. irregularis* exhibited a more stable viability and efficiency under salt stress. No synergistic effects were observed in dual inoculation (FMix) suggesting that increasing AM species in the inoculum does not necessarily increase the functional efficiency of the symbiosis. The study thus underlined the higher effectiveness of *R. irregularis* in ameliorating salt stress and suggests its usage in increasing productivity of pigeonpea under saline conditions.

Key words: Arbuscular mycorrhiza, *Cajanus cajan*, Functional diversity, Ion homeostasis, Nutrients, Salinity

SIII/O-4

Plant Growth Promoting Rhizobacteria as a Tool for Sustainable Agricultural

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During the past few decades increasing use of chemical fertilizers caused several negative effects, on agriculture i.e., development of pathogen resistance, adverse effect on non-target species and reduction in crop yield due to detrimental effects of chemicals on soil quality parameters. Thus, search of eco-friendly approach has been emphasized in the past few years. In this respect soil bacterial species burgeoning in plant rhizosphere which grow in, on, or around plant tissues stimulate plant growth by a plethora of mechanisms are collectively known as PGPR (plant growth promoting rhizobacteria). PGPR performs various functions as (i) biofertilizers (increasing the availability of nutrients to plant), (ii) phytostimulators (plant growth promotion, generally through phytohormones), (iii) rhizoremediators (degrading organic pollutants) and (iv) biopesticides (controlling diseases, mainly by the production of antibiotics and antifungal metabolites). Various PGPR including *Pseudomonas fluorescens, P. putida, P. aeruginosa, Bacillus subtilis* and other *Bacillus* spp have been identified as a source for crop improvement. PGPR have been found to be responsible for the increased health and productivity of different plant species both under normal and stressed conditions. Hence, PGPR can serve as a natural alternative against chemical fertilizers for crop improvement to provide eco-friendly agro-ecosystem.

Key words: PGPR, Rizhosphere, Biofertilizers, Rhizobacteria, Ecosystem

SIII/O-5

Exploring Inoculation Protocol for the Improved Effectiveness of Beneficial Microorganisms in Biocontrol for Sustainable Agriculture

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Biological control, through the use of microorganisms offers an alternative, attractive approach, without the negative impact of chemical control measures. Several microorganisms have been obtained in the last decades showing biocontrol properties, such as *Bacillus*, *Pseudomonas* and *Trichoderma.* In addition, biocontrol formulations using viruses, amoebae, nematodes, arthropods, fungi and bacteria have been illustrated as possible biocontrol agents. However, even though the inoculation of plants with these microorganisms is a well-known practice, the formulation of inoculum with a reliable and consistent effect under field conditions is still a bottleneck for their wider use. The choice of the technology for inoculum production and of the carrier for the formulation is the key to their successful application. The use of biofilms has been an effective means to produce effective plant inoculum. A large-scale *in vitro* production of mycorrhizal fungi is feasible for implementation on a commercial scale. The application of bionanotechnologies could also

provide new avenues for the development of carrier-based microbial inoculum. The biofabricated silver nanoparticles using culture supernatant of *Serratia* sp. reduced *Bipolaris sorokiniana* infection in wheat plants against Spot Blotch disease in wheat.

The present investigation was aimed to optimize the percent inoculum of cyanobacteria for amending different carrier materials. Different concentrations of inoculum was amended with different organic and inorganic carrier materials. The fungicidal activity was tested against different phytopathogenic fungi such as *Fusarium oxysporum lycopersici* and *Pythium debaryanum*. The pot experiment was set up to evaluate the efficacy of the selected cyanobacterial amended compost formulations against phytopathogenic fungi in tomato. A significant result was observed with the higher inoculum of cyanobacteria amended compost formulations. Further work is in progress to study the different inoculation strategies including mixed consortia of microbial inocula under field trials.

Improvements in the production process for microbial inoculum and optimization of application devices for their successful application in field conditions require further research for implementation and the efficient use of microbes in agriculture. Such an approach can be helpful in improving performance of beneficial organisms and used as a tool for enhancing their biocontrol potential.

Key words: Biocontrol, Microorganisms, Biofilms, Bionanotechnologies, Cyanobacteria, Carrier

SIII/O-6

Role of Antioxidants in the Growth and Heavy Metal Uptake from Tannery Sludge in Microbe Assisted Phytoremediation under Field Conditions

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This study investigates the modulation of antioxidant defense system in *Typha angustifolia* and *Hemarthria compressa* after 90 days exposure in sludge containing toxic metals. Both these plants showed a high tolerance for heavy metal toxicity with no visual symptoms when exposed to tannery sludge they even showed increased plant height and biomass especially in the highest concentration. A significant increase in superoxide dismutase (SOD) and catalase (CAT) activities were recorded in the plants. Interestingly, the amount of antioxidant enzymes showed a positive correlation with the amount of sludge. The results indicate that enzymatic antioxidants and metal uptake were important for heavy metal detoxification in the plants. Exposure to sludge stimulated antioxidative enzymes that could partially explain the tolerance and increased metal uptake.

Key words: Antioxidants, Pollution, Environment, Sludge, Hydrophytes, Microbes

SIII/O-7

Microbial Contribution to Carbon Sequestration by Oxalate-Carbonate Pathway with the Help of Biomineralizing Tree

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During the last century, the main gas responsible for the elevation of the greenhouse effect and its consequent climatic changes is the carbon dioxide. To address this one of the best approaches is to adopt rhizosphere systems of carbon sequestering tree. A number of plants, including trees, accumulate important concentrations of calcium oxalate, a low-soluble salt. After plant death, fungi cause decay which results in the release of oxalate crystals inside the soil or litter from plant tissues and expose them to bacterial attack. This plant oxalate pool is a widespread and abundant carbon source for oxalate consumers. Oxalotrophic bacteria occurring as well in environments of oxalate, having frc gene, a gene coding for formyl-CoA transferase and characteristic of oxalate catabolism by oxalotrophs, was shown to be significantly higher in soils under a biomineralizing

tree. For the current study, samples were taken from different levels of soil profile below the selected biomineralizing tree. Bacteria having efficiency of fixing carbon dioxide in soil by utilizing calcium oxalate deposition were isolated and tested for the presence of frc gene. Amongst the screened bacteria, by sequencing 16S rDNA region two of the oxalotrophic bacteria were identified as *Ralstonia sp*. and *Stenotrophomonas sp*. Presence of higher number of oxalotrophic bacteria under the tree demonstrated the role of bacteria in utilization of oxalate through mineralization. Thus, these biomineralizing trees could well be utilized in agroforestry/social forestry system. Further studies might be useful to demonstrate the independent role of oxalotrophic bacteria in carbon sequestration, which will be useful as bioinoculant for trees.

Key words: Rhizosphere, Oxalotrophic bacteria, Frc genes

SIII/O-8

Synergy Between Mycorrhiza, Plant and Bacteria in PAH Dissipation

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Interaction of mycorrhiza, bacteria and soybean plants to reduce polycyclic aromatic hydrocarbons (PAH) in spiked soils was investigated. The effectiveness of indigenous AMF isolates from disturbed soils and non-indigenous isolates from culture collection on PAH removal was investigated. Anthracene and pyrene spiked soils (150 mg/kg) were amended with identified soil bacterial flora isolated from rhizosphere of i) contaminated soil (SM1), ii) agricultural soil (SM2). Indigenous arbuscular mycorrhizae (AM) were isolated from PAH contaminated soils and trap cultured after molecular identification. Soybean seeds were inoculated with trap cultured inoculums of the indigenous arbuscular mycorrhizae and AM from culture collection and sown in soils spiked with anthracene and pyrene. Results showed that mycorrhizal colonization was not signiûcantly inhibited by PAH. At 8 weeks after sowing, bacterial population increased in spiked soils and was higher in soybean rhizosphere than unplanted SM1 and SM2. Bacterial population further increased with AM inoculation, with highest population in mycorrhizal SM1 soils. Root biomass, leaf chlorophyll, chlorophyll a/b ratio of the uninoculated plants were adversely affected by PAH, but significantly increased with SM1 and AM inoculations. Anthracene dissipation was higher than pyrene dissipation. PAH content reduced in autoclaved soils due to abiotic loss, with further reductions under SM1 and SM2. Higher PAH removals were observed in SM1 and SM2 soybean rhizosphere, than autoclaved planted soils. The most effective treatment for PAH removal was that of indigenous mycorrhiza with that of SM1 bacterioflora. This highlighted the effectiveness of particular indigenous isolates of bacteria and mycorrhiza in remediating the polluted soils. The application of selected mycorrhiza along with highly efficient bacterial flora can immensely improve our biotechnological pursuits in improving our environment.

Key words: Bacteria, Bioremediation, Mycorrhiza, Polycyclic aromatic hydrocarbons, Soybean

SIII/O-9

Plant-Microbe Interaction for Enhancing Soil Carbon Sequestration in Degraded/ Marginal Lands

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Microorganisms existing in the rhizosphere can have a neutral, pathogenic or beneficial interaction with their host plant. Plant-microbe interactions in the rhizosphere are still not fully understood. Microorganisms can stimulate rhizodeposition and boost exudate turnover rates. Microorganisms also contribute to the stability of aggregates in soil via the synthesis of new compounds from root exudates and decomposition of SOM. Plant roots release a variety of different compounds such as sugars and sugar alcohols, amino acids, fatty acids, phenolics, organic acids, phytosiderophores, vitamins, plant growth regulators, purines, nucleosides, proteins and peptides, poly-amines, inorganic ions and volatile molecules

such as CO_2 and H_2 into the rhizosphere. The release of root exudates into the rhizosphere is known to enhance soil biological activity and alter microbial community structure. Fast turnover of exudates and microbial biomass C in the rhizosphere may lead to local changes in the rate of microbial decomposition of various C pools, dead plant residues and SOM. However, Mycorrhizae are key beneficial microbes, which allow plants to grow efficiently in sub-optimal environments by obtaining nutrients and water and supplying them to plants. In this context, the present paper briefly describes the importance of Plant-microbe interaction for benefits of soil carbon sequestration in degraded/marginal soils and the way forward.

Key words: Root exudation, Soil carbon sequestration, Rhizosphere, Root exudate

SIII/O-10

Multifactorial Plant Growth Promoting Attributes of Stress Tolerant *Paenibacillus lentimorbus* NRRL B30488

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A plant growth-promoting *Paenibacillus lentimorbus* NRRL B30488 (B30488) was isolated from cows' milk. The strain was characterized for its plant growth promoting attributes and stress tolerance under *in vitro* and *in vivo* conditions. One of the most important traits for any plant growth promoting rhizobacteria is rhizosphere colonization or competence has also been reported to B30488 in rhizosphere and phytosphere of many agricultural, horticulture, medicinal, floriculture crop plants in gnotobiotic and live soil conditions. *In vitro* interaction between B30488 and pathogenic fungi such as *Fusarium oxysporum* f. sp. *Ciceri* and *Alternaria solani* showed that B30488 have biocontrol ability against the phytopathogenic fungi by reducing the radial growth through the degradation of the fungal hyphae. B30488 has ability to tolerate Cr under *in vitro* conditions and produced the plant growth promoting substance indole acetic acid in the presence of Cr. Biofilm forming ability of B30488 was also found to get enhanced by the supplementation of sodium alginate and $CaCl_2$. Abiotic and biotic stress amelioration assays using chickpea showed that bacterization of B30388 on chickpea seeds significantly improves seed germination, plant height, number of pods/plant, and seed dry weight. The strain B30488 was also found to have the ability of reducing the early blight disease caused by *Alternaria solani* in tomato through foliar application and reduced the disease incidence significantly as compared to control. Role of B30488 in minimizing the drought stress effect evaluated using chickpea as a host plant showed improved plant growth promotion due to the biofilm formation under water-limiting conditions. The chickpea seed bacterisation with B30488 along with sodium alginate and $CaCl_2$ caused an increase in germination percent and increased colony-forming units of B30488 in rhizosphere resulting in amelioration of drought stress by positively influencing the dehydration-induced physiological responses. The plant growth promoting effects caused by the B30488 biofilm in rhizosphere of chickpea under Cr(VI) stress also suggests phytoprotective role of B30488 biofilm. Study reflects the multifarious role of strain B30488 and presents it as a potent plant growth promoting and bioremediation agent. The draft genome sequence of B30488 showed that it contains gene clusters involved in nonribosomal synthesis of secondary metabolites involved in antimicrobial activities and provides the genetic basis for application of this bacterial strain in plant growth promotion, plant protection and degradation of organic pollutants.

Key words: *Paenibacillus lentimorbus*, Rhizosphere and phytosphere, *Fusarium oxysporum*, Organic pollutants

SIII/O-11

To Unravel the Survival Strategies of *Bacillus licheniformis* under Different Stress by Assessment of Physiological and Biochemical Parameters

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Arsenic a metalloid, is considered as most significant potential threat to human health even in the rural areas due to its ubiquity and toxicity. Two arsenic tolerant bacteria isolated from rhizosphere of *A. viridis* have been identified as *Bacillus licheniformis DAS-1 and DAS-2* by 16S-rRNA gene sequencing technique, from arsenic contaminated region located at 85º 32' E longitude and 25º 11'N latitude on the Earth. Potential of removal of arsenic species [As(V) and As(III)] and reduction of As(V) to As(III) by both the strains of *Bacillus licheniformis* have been assessed. The MIC for As(V) and As(III) was determined as 10 and 7 mM, respectively in DAS-1 strain and 8 and 6mM, respectively in DAS-2 strain. The survival strategies in the form of growth, uptake/ removal, transformation of arsenic species and biochemical characterization of bacterial cell under different concentration of arsenic stress has been carried out. Arsenic removal efficiency by both the strains was found to be 100% at lower concentration of arsenic species [As(V) and As(III)]. Like at 3 mM As(V), 100% of As(V) was removed from growth media followed by the liberation of 42 % of As(III) into the medium, whereas at 6 mM As(V), 76% of it was removed from the media and up to 56% was reduced to As (III). At 2 mM supplied As(III), bacteria removed up to 100%, whereas at 6 mM, the As(III) removal was only 40%. The role of pH was significant for toxicity of arsenic, which has been measured as the variation in growth, removal, reduction and content of total cell protein. Both As(V) and As(III) was most toxic around neutral pH, toxicity changed with pH. Variation in total cell protein level was observed in different level of stress. As(V) stressed bacteria has shown the positive response to arsenate reductase enzyme assay.

Keywords: Arsenate [As(V)], Arsenite [As(III)], Tolerance, Uptake/removal, Transformation

SIII/O-12

Piriformospora indica Enhances Plant Biomass and Phosphorus Nutrition in Spinach

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Spinach (*Spinacea oleracea* L.) is an important vegetable crop and is rich in proteins, iron, vitamins and minerals. The possible health benefits of consuming spinach include improving bone health as well as blood glucose control in diabetics, lowering the risk of cancer, lowering blood pressure and more. Root endophyte *Piriformospora indica*, mimics arbuscular mycorrhiza-like-fungus (AMF) in many morphological, functional and growth promotional aspects and functions as a bioregulator, biofertilizer and bioprotector. It acts against several root pathogens, help in phosphorus acquisition, overcomes water stress and heavy metal toxicity and also enhances secondary metabolite production. In contrast to arbuscular mycorrhizal fungi, *P. indica,* can be easily grown on synthetic media and hence allowing for large-scale propagation of plants and hence sustainable use in agriculture.

The present study was undertaken to evaluate the effect of *P. indica* on growth of spinach plants and it's phosphorus nutrition. The fungus *P. indica* promoted overall growth of the spinach plants. Thus this study indicates use of symbiotic fungus *P. indica* for better growth of spinach plants for sustainable agriculture.

Key word: *Piriformospora indica*, *Spinach oleracea*, Sustainable agriculture, Endophyte, Phosphorus nutrition

SIII/P-1

Assessment of Plant Growth Promoting Rhizobacterial Strains from Rice Agrofield

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The aim of this study was to understand of diversity and activity of dominant bacterial populations in the rhizosphere of rice. Rhizospheric microorganisms are well known Plant growth promoting rhizobacteria. 10 sites at distict Durg were selected for present study.140 Bacterial strains were isolated from Rice rhizosphere. 10 Strains were isolated and characterized on the basis of their morphology, biochemical tests. Strains were isolated on LB agar media. The spread plate technique was used to isolate and purify all the isolates. The characteristics of the bacterial strains were determined

using the colony morphology, gram staining as well as biochemical properties. All isolates were screened for plant growth promoting activities such as siderophore production, indole-3-acetic acid production and phosphate solubilizaton.

Key words: Biochemical test, IAA, Temperature

SIII/P-2

Deterioration of Chemical Constituents of *Tectona grandis* Seeds Stored at Different Relative Humidities Due to Spoilage Fungi

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Herbal plants serve as a commendable source of medicines.The use of medicinal plants as therapeutic agents is continually expanding worldwide. In the process of production of herbal drugs, storage of crude medicinal plant produce is an important part. During storage, microbial and insect pest contamination can badly affect the performance of the medicinal product due to disruption of the stability of the formulation, modification of physical characteristics and appearance and lead to biodeteriotaion of their chemical constituents. Therefore, the quality and safety of herbal preparations are also of great concern today. *Tectona grandis Linn*. is commonly known as "teak" is a medicinal plant with versatile nature, apart from possessing high value of hardwood, it is also the unique source of various types of compounds having pharmacological effects. Its wood is acrid, cooling, laxative, sedative to gravid uterus and useful in treatment of piles, leucoderma and dysentery. Flowers are useful in bronchitis, biliousness, urinary discharges etc. Roots are useful in treatment of urinary system related troubles and seeds are astringent, emollient, diuretic, demulcent and useful in miscarriage, calculus and gravels, strangury, skin diseases and pruritus.

Post harvest and storage spoilage of unprocessed herbal drugs by moulds is one of the most important threats associated with their quality deterioration and mycotoxin contamination. In the present study, seeds of *Tectona grandis* were analyzed for quantitative changes in carbohydrates, proteins and phenols content of seeds due to spoilage fungi under different relative humidity viz., 10%, 34%, 56% and 74% RH for 30days of incubation. Fungi isolated from the seeds of *T. grandis* under different relative humidity were *Aspergillus sps*. The seeds stored at higher relative humidity (56% and 74%RH) favoured for maximum deterioration of carbohydrates, proteins and phenols in the present study. Carbohydrate content (mg/g) was reduced to 5.084±0.565 and 4.049±0.413 at 56% and 74% RH, respectively after 30 days of incubation in comparison to control where the carbohydrate content (mg/g) remained to be 8.592±0.481 even after 30 days of incubation. Values of protein and phenol content (mg/g) of the seeds were reduced to 4.946±0.546 and 7.403±0.379 at 56% RH and 4.328±0.607 and 6.90±0.214 at 74% RH, respectively in comparison to protein content (5.314±0.510) and phenol content (8.753±0.172) in control after 30 days of incubation.

Key words: Deterioration, Protein, Phenols, Carbohydrate, RH, Incubation days

SIII/P-3

Arbuscular Mycorrhizal Colonization in *Psidium guajava* L. and in its Surrounding Herbaceous Community

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Arbuscular mycorrhizal (AM) fungi are ubiquitous symbionts existing in any ecosystem and colonizing in over two-thirds of vascular plant species (Koide and Mosse, 2004). AM fungi stimulate uptake of plant nutrients, such as P, Zn, cu and Fe in deficient soils. Also, mycorrhizal hyphae can significantly improve N, P and K uptake (Chen and Zhao, 2009). The objective of this study was to analyzed AM fungal colonization and diversity of *Psidium guajava* L and its surrounding herbaceous community growing in Azamgarh northern India. Roots from five plant species, *Viz, Psidium guajava* L, *Achyranthese aspera* L, *Dhatura melet* L, *Adhatoda Vasica Ness, Ocimum, basilicum* L. Were collected from Budhanpur area, Azamgarh U.P. Root samples were collected using to trowel to dig a constant maximum depth of 10cm. The rhizospheric soil, at depths of 10cm, surrounding the

roots of the *Psidium guajava* L was collected from eight different points. The rhizospheric soils from the roots of the five herbaceous plants were also collected.

The percentage of arbuscules is highest in *Psidium guajava* L and lowest in *Adhatoda vasica*. The percentage of vesicle was highest in *Dhatura melet* L. and lowest in *Ocimum basilicum* L. Arbuscular vesicular and hyphal colonization were found in all the species. The percentage of mycorrhizal colonization showed a variation from 4.96 per cent to 89.85 per cent. Seven different AM fungal species were found in the soil samples. These were Glomus fasciculatum, Claroideoglomus etunicatum, Glomus sp1, Glomus sp2, Glomus sp3, Glomus sp4 and Acaulospora sp1. Out of the seven species, the genus Glomus was found to be predominant.

The present study showed that the multiplication of indigenous AM fungi associated with *Psidium guajava* L and herbaceous plants may possibly help in the sustained growth of *Psidium guajava* L.

Key words: Arbuscular mycorrhizae (AM), Mycorrhizal colonization, Rhizospheric soil

SIII/P-4

Isolation and Characterization of Stress Tolerant Bacteria and their Utilization for Sodic Soil Reclamation

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Drought and salt stress are most abundant globally. High salt contents in soils make the soil sodic and affect crop cultivation in a large area of both developed and developing countries. A sodic soil contains too much sodium content associated with the negatively charged clay particles. Abundance of Na^+ and Cl^- ions decreases the activity of other essential elements in the soil and can lead to reduction in accessibility and uptake of growth support elements by the plants. The direct effects of salt stress on plant growth involves plant nutrient deficiency caused redundant growth and yield. To overcome the problem of the lack of fertility in sodic soils, microbes could be used to replenish the nutrients and create a balance between soil components. Soil bacteria support and protect plants against abiotic stresses and enhance yield both directly and indirectly. Use of salt tolerant bacteria is a definitely a boon for the reclamation of sodic soil to provide unstressed environment for plants. This would also help to increase in crop cover area, root biomass and litter which in turn effect restoration of salt affected soil.

Key words: Sodic soil, Salt tolerant bacteria, Reclamation, Abiotic stress

SIII/P-5

Occurrence and Distribution of Vesicular Arbuscular Mycorrizal Fungi in Soil Polluted with Sewage and Industrial Effluents

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In this investigation soils polluted with industrial and swage effluents were tested for the occurrence of VAM fungi. Both the control and soil polluted with industrial effluents were of red sandy loam type while the soil polluted with sewage was black clay loam soil. The soils were analysed for pH, temperature, moisture, N, P, K, Cu, Zn, Mn and Fe. The pH of the control soils ranged from 6.3 to 7.5 while that of the polluted soils ranged from 7.2 to 8.5. Both the non-polluted soil and the soil polluted with industrial effluents were deficient in phosphorus. The number of VAM propagules ranged from 44 to 740. The Non-polluted soil was rich both in VAM propagule number and species abundance. In polluted soils the number of VAM propagules were less. The number of VAM propagules was more in soil polluted with industrial effluent than the soil polluted with sewage. There was an impact of season on the distribution of VAM propagules.

The number of mycorrhizal propagules was more in monsoon and summer in non-polluted soil and in soil polluted with industrial effluents which may be due to dilution of nutrients/accumulation of nutrients and optimum moisture levels/water stress. The VAM propagules were more during monsoon in soil polluted with sewage. The variation in soil pH and temperature seems to be the decisive factors in semi-arid tropical soils influencing distribution.

Increased levels of Cu, Zn and Fe were noticed in polluted soils compared to non-polluted soils. However lower values of Mn were recorded in soil polluted with industrial effluents when compared to sewage polluted soil and non polluted soil. Increased levels of Cu and Zn in polluted soils caused reduction in the number of VAM propagules.

Key words: Vasicular arbuscular mycorrhizae (VAM), Mycorrhizal propagules, Polluted and non polluted soils, Industrial effluents.

SIII/P-6

Antimicrobial Potential of Acetonic extract of *Coriandrum sativum*

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Coriander (*Coriandrum sativum*) is an exceptionally rich source of many valuable compounds and it has been a very important part of traditional Indian food and medicine. Coriander is reported to be strong antimicrobial agent and terpenoids are found to be the major contributor to antimicrobial activity. In the present work antimicrobial properties of coriander leaf extract were explored, analyzed and studied. The fresh coriander harvested leaves were used for making extract, the antimicrobial activity of coriander acetonic leaf extract was evaluated against *Bacillus cereus* and *Staphylococcus epidermis* by an agar diffusion test. The potency was quantitatively and qualitatively measured by the ability to make the presence or absence of the inhibitory zones and zone diameters by the minimum inhibitory concentrations values by coriander leaf extract. Experimental results confirm the antibacterial activity of Coriander extract against pathogenic bacteria. The antimicrobial properties of coriander leaf extract are of great interest to the food, pharmaceutical, and cosmetic industry. The enhanced use of Coriander as a natural additive ingredient could replace the synthetic and artificial antimicrobial agents, successfully hindering the health and skin problems. Exploring the unique potential of coriander as a rich source of nutraceuticals has great applications in the field of cosmetics and pharmaceuticals.

Key words: *Coriandrum sativum,* Antimicrobial agent, *Bacillus cereus* and *Staphylococcus epidermis*

SIII/P-7

Heavy Agricultural Inputs and its Effect on Soil Microflora with Special Respect to Nitrogen Fixers

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Agriculture in India is getting intensified day by day. This intensification was achieved by heavy input of chemical and mechanical means. The heavy input of chemical and mechanical means have adverse effect on soil and water, which is visible to us now. The most adverse effect of chemical and mechanical input is on the diversity and population of soil microbes, which play a key role in functioning of soil.

The present work is an attempt to observe the effect of agricultural intensification on soil microbes particularly nitrogen fixers. Experiment was performed to observe the effect of agricultural intensification on free living nitrogen fixer ie *Azotobacter chrococcum* for two consecutive years. The wheat crop fields were selected for the experimental purpose from in and around Allahabad district of Uttar Pradesh. Fields were selected randomly according to degrees of intensification and by intensive questioning with farmers. Bacteria were isolated from rhizosphere and non-rhizosphere soil. Per gram poplation was computed out and was compared for the effect of agricultural intensification on population dynamics of *Azotobacter chrococcum*. The nitrogen fixing potentiality of *A. chrococcum* was also determined for rhizospheric and non rhizospheric and compared.

The result shows that maximum population of bacteria was obtained from the less intensified fields where use of FYM was promoted, while minimum population was observed in highly intensified fields. Similar trend was observed with the nitrogen fixing potentiality of bacteria.

Key words: Heavy agriculture input, Wheat, Nitrogen fixing bacteria

SIII/P-8

Isolation and Characterization of Plant growth promoting and Bioprotecting Rhizobacteria from Organically Cultivated Fodder Grasses

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In the present scenario increased agricultural productivity is achieved by indiscriminate and excessive application of agrochemicals which lead to health and environmental hazards. Extensive research in developing eco-friendly strategy to reduce or replace the application of agrochemicals revealed Plant growth promoting rhizobacteria (PGPR) as potential candidate. The PGPR are a group of bacteria that can actively colonize plant roots and help to improve the overall plant performance under various adverse biotic and abiotic conditions. PGPR produce plant growth-promoting compounds, including phytohormones (auxins, cytokinins and gibberellins), siderophores, antibacterial compounds and peptides that inhibit pathogenic strains. Hence, use of these rhizobacteria in low-input agriculture has been addressed in several investigations. In the present study experiments were carried to isolate and screen effective PGPR for the improvement of quality and quantity of perennial grasses (*Panicum maximum and Pennisetum purpureum*) as these grasses having fodder and fuel value. Two hundred and seventy three rhizobacterial strains were isolated from the rhizosphere soil of *P. maximum* and *P. purpureum* which were organically grown at IGFRI (Indian Grassland and Fodder Research Institute) and farmers field in and around Jhansi (U.P). Isolated strains were characterized for their beneficial traits such as, indole acetic acid (IAA) production, phosphate solubilization, Biofilm formation and Antagonistic activity. Among them 43 and 73 isolates were positive for IAA and Biofilm formation respectively. 62 isolates had the ability to solubilize the inorganic phosphate. Dual culture assay revealed that 35 isolates were able to inhibiting the growth of *Aspergillus flavus* and *Fusarium monilifome*. Evaluation of other mechanism through which they promote plant growth like siderophore production, phytase activity, Nitrogen fixation, suppression of abiotic stress by producing ACC-deaminase enzyme, and greenhouse studies to analyze the ability of these bacteria to induce systemic resistance against drought and salt stress is under progress.

Key words: Fodder Grass, Plant growth promoting rhizobacteria, Indole acetic acid, Biofilm

SIII/P-9

Screening of Rhizobia Based Bioformulation for Plant Growth Promotory Efficiency

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The irrational use of chemical fertilizer and pesticide increase the production but they are deleterious to environment indirectly directly. So there is utmost need of alternate method or fertilizer to combat the fertility problem of soil and crops. In environment there is presence of microorganism which can increase the soil fertility as well as production of some inhibitory substance which inhibit the growth harmful phytopathogens.

In the present investigation five carriers- sawdust, charcoal, rice bran, wheat bran and sugarcane bagasse were evaluated for the production of bioinoculants. The bacterial population was determined up to three month storage, other parameter includes shoot length, root length, number of nodule, fresh weight and dry weight was also evaluated. Out of tested carrier sawdust was proved to be the best carrier in maintaining the bacterial population and also useful in enhancement of the growth of *Cicero arientinum* compared to control after the addition of inoculants. The finding of this study suggests that sawdust based mono inoculants was much better than any other carrier based inoculants taken in the study.

Key words: Bioformulation, *Cicer arientinum*, Carriers

SIII/P-10

Effect of Endophytic Fungi on the Growth of Tissue-Cultured Plants of *Centella asiatica* (L.) Urban

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Endophytic fungi outlay assistance to plants and vice versa as this alliance is mutualistic one, beneficial to both the partners. Endophytes colonizing inside plants get nutrition and shelter from the plants. In return, endophytes profoundly enhance the health of the host plant by improving nutrient uptake, producing a variety of bioactive metabolites, plant growth promoters, enzymes, anticancer, anti-microbial, anti-diabetic and immunosuppressant compounds etc. Such properties are encouraging for synthesis of novel chemicals and provide reason to strengthen the need for targeting fungal endophytes for bioprospecting. The present study inspected an approach to use endophytic fungi for promoting plant growth. During the present investigation a total of eight foliar endophytic fungi were isolated from *Centella asiatica* (L.) Urban belonging to apiaceae family. The fungal isolates were screened for extracellular enzymes such as amylase, laccase, lipase, pectinase and protease on solid media. Out of the eight isolates, one of the isolate (CAF1) was able to produce all the enzymes in ample amounts. Also, Indole acetic acid (IAA) was found in the fermented broth of CAF1 which was confirmed by GC-MS analysis. The morphological, physiological and biochemical assessment of *C. asiatica* was done *in vitro* following inoculation with endophytic fungal strain (CAF1). The results showed that the plants treated with CAF1 exhibited significant increase in biomass, thickening of the leaves and total length of the plants. Replacement of auxin in MS medium with CAF1 and its extract suggested that CAF1 extract could be an alternative to auxin to increase the plant growth. Superoxide dismutase (SOD), catalase (CAT), peroxidase (POX), phenylalanine lyase (PAL) and tyrosine ammonia lyase (TAL), DPPH radical scavenging activity and total phenolic content (TPC) also exhibited significant increase. This clearly indicated growth promoting potential of CAF1 for *C. asiatica*, the host plant. The method used in this study could be applicable to similar studies on the relationship between endophytic fungi and their host plants.

Key words: Bioprospecting, Endophytic fungi, *Centella asiati*ca, Asiaticoside, Tissue culture

SIII/P-11

Potential of Fungi Isolated from Pulp and Paper Mill Soil Sludge for the Production of Ligninolytic Enzymes

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Wood, grasses and most of the plant litter represent the major part of the biomass in nature and are collectively called lignocelluloses. Lignocellulose is mainly composed of cellulose, hemicellulose and lignin. Lignin, a major recalcitrant compound, is one of the main components of wood. The organisms principally responsible for lignocellulose degradation are aerobic filamentous fungi, and the most rapid degraders in this group are Basidiomycetes. They have ability to degrade complex and recalcitrant organic molecules. White-rot fungi (WRF) have been widely studied because of their efficient lignin degradation mechanism and possible applications in the pulp and paper industry. The ligninolytic enzymes of WRF are unspecific, and thus are considered to be potential microorganisms for bioremediation of broad range of pollutants. These enzymes includes lignin peroxidase (LiP), mangnese peroxidase (MnP) and laccase. In the present work, 35 fungi were isolated from soil sludge of Century pulp and paper mill, Lalkuan and were screened for the production of the ligninolytic enzymes, both qualitatively and quantitatively. Experiments were carried out for the production of lignin peroxidase, mangnese peroxidase and laccase. Out of the 35 isolates, 5 fungal strains showed the positive test for the ligninolytic activities. The importance of this study is to screen and select the potential of lignocellulose decaying fungi for large scale ligninolytic enzyme production, which will be very useful in degradation of pulp and paper mill waste, dyes from the textile industry and many other xenobiotic compounds and this might be an

environmental friendly way that can replace the used chemical processes.

Key words: Lignocellulose, White rot fungi, Lignin peroxidase, Manganese peroxidase, Laccase

SIII/P-12

Antimicrobial Ability of *Cuscuta reflexa* with *Acacia nilotica* Host Plant in Respect to its Petroleum Ether and Benzene Extract

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Cuscuta reflexa is a parasitic weed plant belongs to the Convolvulaceae family. *Cuscuta reflexa* grows in a holoparasitic manner over the host body. It makes haustorial connection with the vascular tissues of the host plant and draws nutrients from the host plant. *Cuscuta reflexa* sucks nutrients from the host plants so the medicinal properties of the *Cuscuta reflexa* also depend on the properties of host plant. The present study was performed to screen antimicrobial efficacy of *Cuscuta reflexa* with *Acacia nilotica* host plant. Antimicrobial activity of petroleum ether and benzene extract was performed against selected test microbes. Petroleum ether extract shows maximum activity against *Enterobacter aerogenes (IZ= 0.9; AI= 0.06) and benzene extract shows maximum antimicrobial activity against Staphylococcus non Haemolysis (IZ= 2; AI= 0.13). Therefore in the present research work attempts were made to screen antimicrobial ability of Cuscuta reflexa* with *Acacia nilotica* host plant to identify therapeutic potential of parasitic weed plant to evaluate parasitic plant as potential source for the identification of new drugs to cure various diseases.

Key words: *Cuscuta reflexa,* Parasitic plant, Antimicrobial activity, Medicinal plants

SIII/P-13

Microbiological Assessment of Ganga Water at Kanpur, Varanasi and Allahabad, U.P., India

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Ganga river is awarded as National river of India. The Gangaes is a trans-boundary river of India and Bangladesh. The 2,525 km river rises in the western Himalayas in the Indian state of Uttarakhand, and flows south and east through the Gangetic Plain of North India into Bangladesh, where it empties into the Bay of Bengal. By discharge it ranks among the world's top 20 rivers. The Ganges basin is the most heavily populated river basin in the world, with over 400 million people and a population density of about 1,000 inhabitants per square mile. A possible risk of infection is directly propotional to demonstrable faecal contamination . Total coliform, faecal coliform and faecal streptococci are widely used indicators of faecal contamination of water pollution. Faecal contamination originating from human or animal intestinal tracts is one of the most serious hazards in water .In the present paper microbiological assessment of Ganga water was done at Kanpur, Varanasi and Allahabad and discussed briefly with special reference to Human Health.

Key word: Toatal coliform, Ganga, Water quality, Indicator bacteria

SIII/P-14

Role of Bacteria for Arsenic Detoxification in Rice

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Arsenic is a class one carcinogen present ubiquitously in the environment. Mining activities, use of arsenical herbicides and insecticides and irrigation with Arsenic contaminated ground water results in Arsenic accumulation in paddy soil. Rice is particularly efficient in Arsenic accumulation compared to other cereal crops because of anaerobic conditions in paddy soil and due to sharing the highly efficient Silicon pathway. Uptake of arsenic by rice plants and accumulation in rice grains would present a food safety problem. A number of studies have shown that consumption of rice contributes a large proportion of the intake of inorganic arsenic for the population whose staple food is rice. A recent study has identified

bacterial strains capable of oxidizing toxic arsenic into less toxic forms, offering a feasible and affordable solution to the problem of Arsenic in soil and water. While both forms of Arsenic occur in nature ,the removal of Arsenite from environmental systems is difficult due to its relatively higher solubility ,whereas Arsenate is less water-soluble and less bio available. Oxidising bacteria deployed in paddies can reduce Arsenic uptake into the rice grain and these strains have found to be more effective than any bioengineered strains so far. The bioremediation method is cheaper than the metal decontamination technologies currently used worldwide. However further studies are to be done before their deployment in the paddy fields.

Key words: Arsenic, Arsenite, Arsenate, Paddy, Bioremediation

SIII/P-15

Co-Application of Bacteria and Algae to Promote Plant Growth and Mitigation of Arsenic Stress

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The accumulation of Arsenic (As) by rice (*Oryza sativa*) is of great interest considering the dietry intake of As through rice and yield reduction of rice. The present study was aimed to analyze the effect of *Pseudomonas putida* (NBRI1313) and *Chlorella vulgaris* and its combinatorial interaction on As accumulation and detoxification system. Exposure of Rice plant to 50M arsenate (AsV), and inoculation with NBRI1313 and *Chlorella vulgaris*, resulted in a significant increase in root length, shoot length and root and shoot biomass in comparison to AsV exposure as well as control. Accumulation of As was more decreased in the plants in the presence of dual inoculants. Plants inoculated with these inoculants showed increased levels of Non protein thiols (NPTs) and cystein content which is considered as the first line of defence against As toxicity. Rice plant inoculated with dual inoculants did not show any significant effect on antioxidative enzymes, indicating that oxidative stress was minimum.

Thus, it is concluded that colonization of NBRI1313 and *C.vulgaris* around the roots, synergistically promote the growth of rice and decreased the accumulation of As by using differential detoxification mechanism(s).

Key words: PGPR, Arsenic, Bacteria, Rice

SIII/P-16

Role of *Trichoderma* spp. in Modulation of Arsenic Induced Phytotoxic Changes in Gene Expression, Stem Anatomy, Arsenic Speciation and Accumulation in Chickpea (*Cicer arietinum* L.)

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Exploitation of beneficial plant-microbe interactions offers promising environmentally friendly strategies for conventional and organic agriculture. Plant microbial interactions enhance plant growth and affect elemental uptake in crop plants including heavy metals. Present study demonstrated the role of plant growth promoting and As tolerant *Trichoderma reesei* NBRI 0716 in countering the As induced stress in chickpea (*Cicer arietinum* L.) plants. Arsenic exposure significantly hampered the growth, uptake of mineral nutrients and antioxidant activity in chickpea resulting in poor pod setting and limited seed yield. Inoculation of chickpea with NBRI 0716 significantly enhanced plant growth, yield and mineral nutrients both in absence and presence of As. It also restored stem anomalies like reduced trichome turgidity and density, deformation in collenchymatous and sclerenchymatous cells induced by As stress. Upregulation of drought responsive genes (DRE, EREBP, T6PS, MIPS, PGIP) enhanced proline content and shrinked cortex cells in presence of As suggests that it creates water deficiency in plants and were modulated by NBRI 0716 providing protective role. In addition, inoculation of NBRI 0716 lead to reduction of grain As_i by ca 3.5 fold and enhanced dimethylarsenic acid (DMA) and monomethylarsenic acid (MMA) content in soil and seed as well, indicated

that NBRI 0716 probably has a role in methylation of As as the possible mechanism for maneuvering As stress in chickpea. Thus, this study suggests that *Trichoderma reesei* strain NBRI 0716 is a suitable bio-agent, for application in As contaminated agricultural soils for improved growth, yield and mineral nutrient composition of the edible crops, besides reducing the high As load in edible grains.

Key words: *Trichoderma reesei*, Arsenic, Chickpea, Water deficiency, Mineral nutrient

SIII/P-17

Dynamic role of *Trichoderma* spp. in Food Security and Altering Soil Microbial Community in Diesel Fuel-Spiked Soil using Sole-Carbon-Source Utilization Profiles

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Bioremediation is a potentially important option for restoring of oil-polluted environments by exploiting the degradation capabilities of the plant and microbes. In present study *Trichoderma* spp. was isolated from Jamnagar soil , Gujarat India, having a great potency to promote the growth of plants along with the controlling the growth of different fungal phytopathogens such as *A. solani, R. Solani* and *F. oxysporum* (63%, 68% and 70% respectively). Selected *Trichoderma* spp. also able to produce Chitinase (0.39 U ml^{-1}), Siderophore (150.38µg/ ml^{-1}), IAA (19.9µg per ml^{-1}), Gibbrellic acid (4.82 µg per $25ml^{-1}$) and solubilize Phosphate (26.80 µg per ml^{-1}) with the great ability to tolerate the 50% concentration of PEG (Polyethylene Glycol). *Trichoderma* spp. was proven as potent tool for bioremediation of diesel contaminated soil. Diesel contaminated soil treated with *Trichoderma viride*, efficiently increased the dehydrogenase activity (1.93 mg-TPF/g),heterogenous bacterial population (4.84 log_{10} unit) and plant biomass after 30 days of inoculation. Drastic differerence was observed in community structure pattern in presence and absence of *Trichoderma* spp. The structure based study of microbial community in rhizosphere was analyzed through the sole-carbon-source utilization profiles using ECO Biolog microplates. Significant differences were found among the diversity and evenness indices on effect of diesel on chickpea rhizosphere microflora in presence and absence of *Trichoderma* spp.

Key words: *Trichoderma*, Diesel, Microbial diversity, BIOLOG, Plant growth promotion

SIII/P-18

Plant Growth Promoting *Pseudomonas putida* Mediates Stress Amelioration

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Ubiquitous *Pseudomonas* has been reported as an efficient plant growth promoting rhizobacteria. However, tolerance for high temperature is one of the most critical limiting factors for its commercialization. After screening of 2500 *Pseudomnas* sp. strains, an abiotic stress tolerant strain of *Pseudomonas putida* MTCC5279 (MTCC5279) was isolated from the drought-exposed chickpea rhizosphere. MTCC5279 has ability to tolerate high temperature drought and salt stress along with multiple PGP attributes. Rhizosphere colonization and biofilm formation was significantly enhanced by addition of $MgSO_4$ and glycerol supplementation its tolerance to high temperature. The draft genome sequence of MTCC5279 reveals a number of genes whose products are possibly involved in plant growth promotion and abiotic stress tolerance. The strain was found to promote plant growth of different host plant. Plant growth promotion is a multigenic process under the influence of many external and internal factors. Therefore, to understand the processes and the functions regulated by this rhizobacteria, a microarray analysis of *Arabidopsis thaliana* plants inoculated with MTCC5279 was performed through the gene expression changes, represented by oligonucleotide array (24652 genes). MTCC5279 induced upregulation of *Arabidopsis thaliana* genes involved in maintenance of genome integrity, growth hormone, amino acid synthesis, abcissic acid signaling and

ethylene suppression, Ca^{+2} dependent signaling and induction of induced systemic resistance. The drought ameliorating effect of MTCC 5279 on the chickpea plants grown under watered and drought conditions demonstrated the stress ameliorating property of MTCC5279 by changing the expression pattern of drought responsive genes. The complex multilevel regulatory process for the adaptation of *P. putida* MTCC5279 to high temperatures was evaluated through the over-expression of stress sigma factor S (RpoS) at higher temperature. Micro-plot and multi-locational field trial studies using different crops showed that MTCC5279 has a potential to be used as commercial bioinoculant.

Key words: *Pseudomonas putida*, Rhizobacteria, *Arabidopsis thaliana*, RpoS

SIV/KN-1

Fate of more than 480 million inhabitants living in arsenic and fluoride endemic districts of India: Health, socio-economic effects & approaches for mitigation

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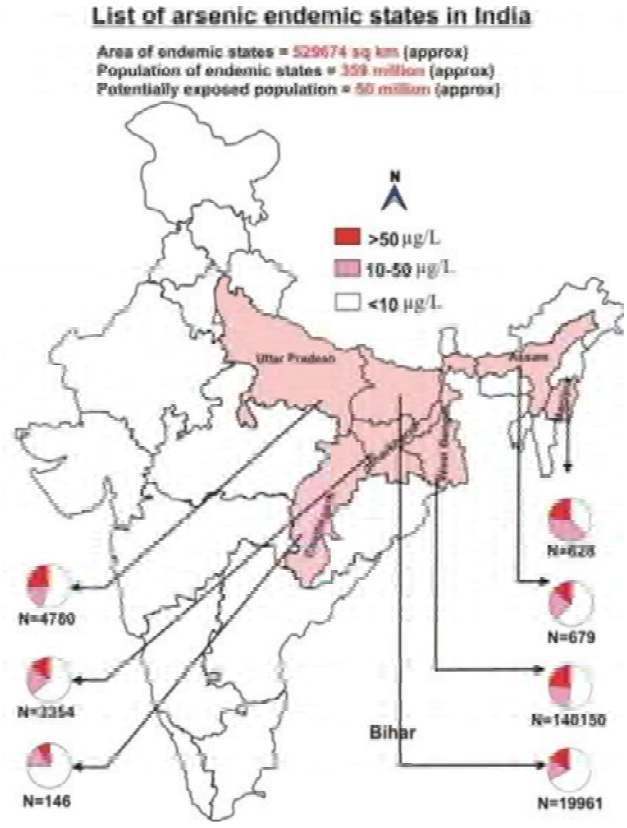
Arsenic & Fluoride Contamination in India: India is considered to be the worst groundwater arsenic affected country in the world. The population of the 37 districts so far we have identified potentially at risk with groundwater arsenic contamination in seven states of India (6 states in the Ganga-Brahmaputra plain) is 70.4 million **(*Figure.1a*)**. Recently we discovered groundwater arsenic contamination in the Allahabad-Kanpur Track of the Upper Ganga Plain is evidence of the fact that these surveys are by no means complete. Even after working for last 25 years we consider we have seen a small portion of the real problem. Flourosis, a crippling disease, is the most prevalent groundwater-related disease in India. Total population in fluoride endemic 201 districts in India is 411 million (40% of Indian population). India is also the most fluoride–affected country worldwide. In India alone, more than 66 million people are estimated to be suffering from fluorosis, including 6 million children below 14 years of age. Our research has found that 20 of 28 Indian states have some degree of groundwater fluoride contamination, impacting 85-97% of districts in some states **(*Figure.1b*)**. Even now, we continue to identify additional affected districts & habitations affected by groundwater fluoride in these districts.



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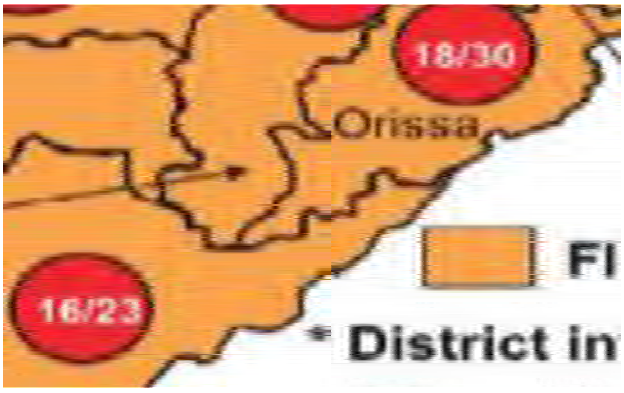

D.Chakraborti. Environ. Sci. Technol. 2011, 45, 27–33

The Health Effects of Arsenic & Fluoride Poisoning: The effects of chronic arsenic exposure are first manifested on skin. With substantial cumulative exposure, these non-malignant dermatological manifestations can progress to skin cancers, such as Bowen's Disease, squamous cell carcinoma, and basal cell carcinoma. Furthermore, epidemiological studies have found that with increasing arsenic consumption the risk of internal cancers notably of the lung and bladder also increases in severe cases, this can lead to gangrene of the fingers,

toes, and even entire limbs. ***Fig.2a*** shows the common arsenical skin lesions. Clinical effects of fluoride included abnormal tooth enamel in children; adults had joint pain and deformity of the limbs and spine, along with ligamentous calcifications and exostosis formations. Fluorosis is a crippling disease **(*Fig.2b*)**.

D.Chakraborti et.al. Clinical Toxicology, 2009, 47, 292-295
D.Chakraborti et.al.,Clinical Toxicology, 2009, 47, 355-356

Socio-economic Implications of Groundwater Arsenic & Fluoride Pollution: Arsenicosis & fluorosis have an economic impact that feeds back through health and human well-being of both the individual and the family. The people affected by arsenic and fluoride poisoning suffer from health hazards and economic barriers, unhealthy and strained "within" family relations and also confront severe mental stress at the social front. WHO points out that social problems arising from arsenic & fluoride pollution create pressure on the economy of the affected areas. There is a social cost of arsenic & fluoride pollution. With the symptoms of arsenicosis becoming evident more often various agonizing social issues arise, such as, affected persons are sacked from their jobs, arsenic affected children are sometimes debarred from school, the affected girls are denied of marriage and often married women face problems in their marital life and even divorce ensues. Affected people are quite often debarred from social functions. The arsenic affected persons are being boycotted socially mistaking them as patients infected with contagious diseases and their condition precludes the most simple social interactions that often leads to depression and suicide.

Mitigation Strategies for Groundwater Arsenic & Fluoride Contamination: Our recommendations are the following: (1) Emergency field surveying to identify arsenic & fluoride affected areas. These efforts should be coupled to education and awareness campaigns. Even during recent field surveys, we have met arsenic and fluoride affected individuals who were unaware of the nature of their disease and its threat. Some believed that their lesions were the result of sins of a past life; others thought that they had been cursed by God.(2) Regular monitoring of tubewells for arsenic & fluoride, due to the observation that tubewells, even deep ones, that were previously identified as safe can become contaminated over time. (3) The provision of immediate clean water supply in affected areas. An intermediate stage, if necessary, should be the utilization of arsenic removal technologies coupled with local community involvement and education. More permanent solutions should be the utilization of holistic and location-specific plans. These should include treated abundant surface water resources, dug-well water, and harvested rainwater whenever possible as well as the employment of arsenic removal technologies whenever other options are not available.

Conclusion

We fear that the current status of groundwater arsenic and & fluoride in India is not completely known. With increasing groundwater withdrawal of arsenic & fluoride contaminated water for agriculture and the latency of arsenic and fluoride related disease, the amount of suffering may continue to escalate, especially if surveying and mitigation efforts aren't given sufficient priority. Moreover, arsenic and fluoride are not the only groundwater contaminant. The presence of other toxic elements e.g. U, B, Ni, Cr, Pb & Mn has already been reported in the groundwater from some parts of India. In India basin areas are commonly known as the land of rivers; it is home to numerous ox-bow lakes and flooded river basins and receives average 2000 mm of rainfall annually. Furthermore, large-diameter dug-wells, once the primary source of water for communities, can still serve as a safe water resource with proper treatment and management. We have both largely abandoned these abundant resources and are currently utilizing our groundwater resources with reckless abandon. The education and mobilization of local communities is also vital to our efforts to find effective and local solutions to the arsenic problem. In arsenic & fluoride affected areas crisis is not always having too little water to satisfy our need, it is the crisis of managing the water.

SIV/KN-2

Food Security: Challenge and Opportunity

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According to the UN projections the global population is expected to grow from 7 billion in 2012 to 9.3 billion by 2050. In spite of growing economic prosperity and technological progress approximately 870 million people remain undernourished even today. The question of food security, hunger, malnutrition, poverty and parity are high on global agenda.

India with a population of 1.2 billion is the second largest populous country of the world and likely to touch 1.6 billion by 2030, surpassing China. Despite economic growth and self-sufficiency in food grain production high level of food insecurity and malnutrition persists in the country. At the same time loss of food grains during pre and post-harvest stages, storage, distribution, at retail outlets and at individual household level are quite substantial. Demand for food quantity and quality in the country is rapidly increasing with rising affluence and growing middle class. Can India feed itself in the long run, say to 2030 and beyond? It is going to be a real challenge to produce enough food for the growing population from the limited resource base. Deforestation, loss of biodiversity, soil degradation, and growing competition for agricultural land, water and energy, overexploitation of fisheries and increasing pollution of land, air and water seriously threatens food security. Rapid urbanization and industrialization are competing for limited land and water resources. In addition, climate change further intensifies the threat and ability to produce.

There is no simple solution for feeding the growing population, especially in face of prevailing poverty, resource constraints and lack of policy coherence. The desperate scenario presented by these challenges can be reversed and turned into opportunity, provided urgent actions are taken simultaneously on multiple fronts, for effective use of ecosystem services. An all-out effort to promote renewable energy sources can liberate food production and processing systems from "plow to plate" from its dependence on fossil fuels. Solar and wind energy is increasingly attractive both on-farm and off-farm operations and even economically viable in many locations. Appropriate policies and incentives can help to promote these renewable grid free energy sources for most agricultural operations. Recent scientific and technological developments pertaining to enhancing photosynthetic efficiency, water use and nutrient conservation are to be actively pursued to make agriculture ready for climate change. Food security is an important prerequisite for reducing poverty, hunger and malnutrition and can effectively contribute to inclusive economic and social development.

Key words: Food security, Malnutrition, Biodiversity

SIV/L-1

Innovative Rain Water Harvesting: Model for Water Conservation, Recharging and Development

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Rain water harvesting (RWH) is a method of collection and storage of rain water at surface or in subsurface aquifers, before it is lost as subsurface run offs. The harvested water may be utilized for artificial recharge of groundwater reservoirs to augment them at higher rate than the reduced anthropogenic or natural replenishment. The focus of RWH system is to manage the problem of water scarcity and declining ground water level, improving the ground water quality and protection for future use.

The salient features of the presentation will be as the following (i) Invented ways to have clean rooftop rainwater direct to home. (ii) Innovated ways to save land while recharging rainwater. (iii) How to save money input for recharging rainwater into the ground. (iv) How to level up the groundwater level fast. (v) Innovated design of MAHA INDRA KOOP. (vi) Innovated cover of recharge cum irrigation well to save evaporation of water. (vii) Innovated design for plateau area or Bundelkhand and any such area. (viii) How to make rainwater recharging as an effective and fast tool of development (ix) How to arrest excess heat on roads and how to beat the heat of global warming for warm conservation of a healthy environment and especially

water. More than one dozen designs have been invented by me.

Key words: Rain water, Groundwater, Rainwater

SIV/L-2

Sustainable Crop Production with Increasing Population, and Diminishing Natural Resources

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Population, poverty and affluence each contribute to different forms of environmental degradation. With adequate funds, and strict enforcement, affluent counties have mitigated the environmental harm to some extent. Innovations have augmented the scarce natural resources and stabilized populations. In the developing countries like India, overall poverty, lack of purchasing capacity for food, water, clean fuels for cooking, sanitation, health care, and education, take a heavy toll due to environmental problems. Enhancing plant productivity can reduce poverty in rural areas, leading to higher incomes, better nutrition, health care, education and skill development for higher wage employment. Plant productivity is an energy conversion process that requires additional inputs of water, energy, plant nutrients and pesticides, besides arable land. Population growth as well as affluence enhances demand of energy fixed by plants, as food. Sustainability requires balance between the energy fixed and consumed. Interventions identified for sustainability are: (i) freezing agricultural foot prints, (ii) producing more from the limited farm land, (iii) increase the use efficiencies for water, energy and crop nutrients, (iv) change what people eat and (v) reduce wastage. This implies that sustainable agriculture and green economy are possible only for a population within the carrying capacity of the land.

Impact assessment, ex *post facto* and *ex Ante,* provide excellent appraisal of productivity and environmental enhancement methods. They respectively provide actual and anticipated returns from the funds invested, and help in setting priorities. Environmental botanist must use these tools both for research and interventions. Reclamation of degraded farm lands, water harvesting and storage in village ponds show high social and economic returns. However, measures for reducing population growth rate, that has no adverse environmental effects, could provide higher benefits than increasing productivity. Environmental scientists can be most convincing to put across the message that finite resources can not support an infinite population. They have to master the art of persuasion for adapting sustainable use of resources and simple, energy saving life style.

Key words: Sustainability, Population, Carrying capacity, Natural resources

SIV/L-3

Vetiver Grass Model: Ideotypes for Sustainable Environment

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Vetiver grass [*Vetveria zizaniodes* (L) Nash. syn. *Chrysopogon zizaniodes* (L.) Roberty; family Poaceae], common name ''khus", a perennial C_4 grass supported with tufted roots has traditionally been used for extraction of essential oil, and its deep penetrating fast growing root system has attracted world attention as a natural means for multifarious environmental applications, including carbon sequestration in subsoil horizon likened to forest trees, conservation and detoxification of degraded soil and water, flood and landslide disaster mitigation. However, to make the vetiver plantations ecosystem sustainable and globally acceptable, it is desirable to identify ideal plant type(s) for specific applications and accordingly develop designer genotypes that promise: (a) ideal root-physiography for soil binding and fast penetrating growth, (b) utilization of upper ground vegetative biomass as fodder, (c) non-invasive characteristics, (d) as a short duration crop with quality essential oil, (e) termination of plantations at will by excising the proliferating crown, and (e) cyto-morphological and molecular characterization that can help facilitate IPR protection of identified genotype(s) vis-à-vis species and genotypic diversity. India, being the primary centre of origin and dispersion of vetiver, is endowed with repertoire of genetic diversity and offers opportunities to tap its genetic resources to isolate ideal plant type suiting to specific applications. An ideal clone for carbon sequestration in subsoil horizons has been

developed by the author's group, and significant progress is under-way to isolate a dual purpose vetiver that may confer high soil binding potential facilitating slope stabilization for its webbing roots and also serve as source of fodder for its leaf shoots with reduced silicification.

Key words: Vetiver grass model, Tufted roots, Non-invasive vetiver, Carbon sequestration, Root-web, Plant ideotype

SIV/O-1

Estimation of Toxic Metals in Respirable Dust near E-Waste Burning Sites in Moradabad, India

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Moradabad is an important city of North India as it is famous worldwide for the exporting and manufacturing of brassware items. Present investigation was carried out to assess the concentration of toxic metals (Pb, Cd, Cu, Zn, Cr and Ni) in respirable dust (PM_{10} and $PM_{2.5}$) at various sites near the bank of river Ramganga where the E-waste burning is carried out in an illegal way. Traders estimate about half the circuit boards used in appliances in India end up in Moradabad, also called *peetal nagri* — brass city. A control site in remote area was also selected to compare and find background level of these toxic metals in respirable dust. Samples of PM_{10} and $PM_{2.5}$ were collected from all the sites through RDS (APM - 460NL) and FDS (APM - 550) and were analyzed by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES), Midland, UK. The results indicate that the concentrations of heavy metals were observed at very high level as compared to maximum allowable limit in various countries at polluted sites. Risk assessment predicted that Pb and Cu originating from circuit board recycling have the potential to pose serious health risks to workers and local residents of Moradabad, and warrants an urgent investigation into heavy metal related health impacts.

Key words: Respirable dust, E-waste burning, Peetal Nagari, Toxic metals, Health risk

SIV/O-2

Does Eutrophication in Waterbodies Affect the Ramet Generation Potential of Small Fragments of an Invasive Plant, *Alternanthera philoxeroides*?

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Alternanthera philoxeroides is considered to be one of the world's worst invasive plants. Rapid regeneration potential of *A. philoxeroides* through vegetative reproduction is regarded to be a primary reason for its successful invasion. Fragmentation of *A. philoxeroides* is frequently observed due to many natural or human caused disturbances and the ability of small clonal fragments to survive and generate ramet is a major factor for its successful spread. With increasing levels of eutrophication prevalent in our aquatic resources, a question of interest is whether higher nutrient levels affect the survival and growth of these fragments.

An experiment was, therefore, conducted in the greenhouse to explore whether increasing the nutrient level had any effect on ramet generation potential and growth of *A. philoxeroides*. Small fragments (two noded) were grown in six different nutrient mediums (tap water and five different concentrations of Hoagland solutions) and emergence of new ramets were recorded for a period of seven days. Ramet generation was very fast with 72 % of the total ramets having generated within two days, under any type of nutrient medium used. Additionally, the possibility of a second ramet appearing from the same node seemed likely from the fifth day onwards thus,-exhibiting its ability to generate two new plants from a single node. Though statistical analysis revealed no significant difference in ramet generation among plant fragments growing in different nutrient solutions, however the growth of ramets observed through emergence of new leaves appeared to be faster with increasing nutrient levels. The study highlights the rapid regenerative ability of small fragments of *A.philoxeroides* even under minimal nutrient conditions thereby showing its high adaptability and potential to spread in any type of water body thereby raising concerns.

Key words: Ramet, Nutrient, Clonal, Fragments, Node

SIV/O-3

Microbial Activity in Soil with Organophosphate Pesticides Application in Talwandi Sabo, Bathinda, Punjab

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The injudicious and indiscriminate usage of highly toxic and persistent pesticides deteriorated the environmental quality. Organophosphorus pesticides are widely used in crop protection against various pests. The microbial activity is an indicator of fertility of the soil and it is directly affected by the pesticide application. Soil samples from five different villages of Talwandi sabo block of Bathinda district, Punjab which has cotton based cropping system was studied to investigate microbial activity in response to application of organophosphate (OP) pesticides. The heterotrophic total bacterial count and phosphorus solubilizing bacterial (PSB) population ranged from 4.2 - 10 x 10^8 cfu/g of soil and 1.7 - 5.5 x 10^3 cfu/g of soil respectively. The total bacterial population was comparatively lower in pesticide stressed soil. The proportion of PSB population was higher in soil with regular and repetitive application of organophosphate pesticides relative to other group of pesticides. The phosphorus solubilizing microbes has genes for phosphatase and is an indirect measure of microbial activity towards biodegradation of OP compounds. The phosphatase activity was higher than dehydrogenase and urease activity in soil samples with OP pesticide application which confirms the growth of PSBs by making nutrients available for microbial growth. The microbial biomass carbon content was lower in soil with immediate pesticide application and content improved with the time. The native bacterial strains play an important role in biodegradation of toxic OP pesticides to non- toxic compounds by biochemical transformation. Hence play an important role in bioremediation process.

Key words: Organophosphorus pesticides, Phosphorus solubilizing bacteria, Phosphatase, Biodegradation

SIV/O-4

Allelopathy as an Alternative to Synthetic Herbicides

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Allelopathy is the phenomenon of plant-plant interaction mediated through the release of chemicals (better known as allelochemicals). It plays an important role in regulating plant diversity. Of late, the allelopathy is being proposed as a tool for sustainable weed management since the commercially used herbicides have many adverse effects on environment and human health. *Pinus roxburghii*, a forestry tree has been investigated for allelopathic weed suppressing activity. The aqueous extracts from green needles and litter show inhibitory effect on the germination and early growth of some weed species based on studies conducted under laboratory bioassays. In soil medium also, similar inhibitory effect of was observed. The extracts of litter and soil collected from Pine forest and needle amended soil under pot culture experiment showed the presence of phenolics, the known potent allelochemicals. The findings suggest that the needles and litter of *P. roxburghii* can serve as an important bioresource for management of weeds by utilizing the principles of allelopathy.

Key words: Allelopathy, Herbicide, Pine

SIV/O-5

Pharmacological Activities and Potential uses of *Cyperus rotundus*: An Updated Review

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Cyperus rotundus (Cyperaceae), a medicinal herb, is being traditionally used as a home remedy for the treatment of various clinical conditions like diarrhea, diabetic, pyretic, inflammation, malaria, and for treating stomach and bowel disorders. Its current status is one of the most widespread, troublesome, and economically damaging agronomic weeds, growing wildly in various tropical and sub-tropical regions of the world. Tuber and rhizomes of *Cyperus rotundus* possess a higher concentration of active ingredients in the form of essential oils, phenolic acids, ascorbic acids and flavonoids, responsible for its remedial properties. Exploitation of any medicinal plant application depends upon the crucial and comprehensive information about the therapeutic potential of a plant. Researchers have evaluated and characterized the significance of *Cyperus rotundus* as an anti-androgenic, anti-bacterial, anti-cancerous, anti-convulsant, anti-diabetic, anti-diarrheal, anti-genotoxic, anti-inflammatory, anti-lipidemic, anti-malarial, anti-mutagenic, anti-obesity, anti-oxidant, anti-uropathogenic, hepato-, cardio-, and neuro-protective, and nootropic agent. This paper comprises a broad review on chemical constituents and potential therapeutic aspects of *Cyperus rotundus* to summarize the current state of knowledge that will aid in the development of modern herbal medicine through latest technologies that will promote the ability of this plant in the cure of many clinical disorders.

Key words: Purple nutsedge, Chemical composition, Phenolic acid, Therapeutic Values, Future directions

SIV/O-6

Natural Herbicides from Essential Oils: Prospects and Constraints

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Unlike synthetic herbicides, use of natural plant products provides an environment-friendly and safer method of weed control. Besides, these are generally non-toxic and exhibit chemical and structural diversity and possess novel target sites. These also help in finding novel and useful scaffoldings for the development of new herbicides using cheminformatics and synthetic techniques. The studies have shown that essential oils of plants like *Tagetes minuta, Anisomeles indica* and *Eucalyptus* species are promising source of bioherbicides. These help in effectively controlling noxious weeds of paddy crop like *Echinochloa crus-galli* and *Cyperus rotundus* and that of wheat crop like *Phalaris minor*. Application of these essential oils at ecologically relevant concentrations provides a practical solution for the weed control without affecting the growth and yield of crops. These not only reduced weed emergence but also had a detrimental effect on their growth with signs of visible injury. At higher concentrations, these even caused weed mortality. Their effect can be comparable to synthetic herbicides. Moreover, their effect on weeds can further be improved by adding adjuvant or surfactants and their solutions/formulations with other natural products. However, there are certain constraints such as their economic viability and commercialization, which can be overcome by conducting suitable focused studies. The present paper discusses various issues related to the use of essential oils as herbicides.

Key words: Essential oils, Bioherbicides, Natural weed management, Oil-based formulations

SIV/O-7

Fly Ash Utilization in India: A Current Perspective

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In India, around 75% of energy comes from the thermal power plant (coal/lignite/gas), out of total installed thermal power capacity of 2, 00,000 MW by 2012. Government has planned for its enhancement to 3, 00,000 MW by 2017 that generate nearly 15 million ton's of fly ash per year. The quantum of fly ash generation is huge and the available methods for its management appear to be inadequate.

Over the past few decades there has been avid interest in developing the strategies to utilize fly ash in different sector, due to its specific physical and chemical properties, which is beneficial for its further use. In contrast fly ash also contains a number of toxic metals and natural radionuclide materials, which creates problem for its further use. In India, mainly

fly ash is used in number of sectors like, Cement and Asbestos sheet (49%), Bricks/partition/tiles/panel manufacturing, Road Construction (5%), Agriculture sector (2%) etc., but still most of the fly ash remains in the ash pond, causing many deleterious effects on the environment, resulting in the degradation of land and subsequent ground water and water bodies. Attention should be given in exploring new opening for its use, and strict regulation and its implementation in above mentioned sectors for better sustainable environmental management of fly ash to minimize the environmental problem.

Key word: Coal, Ash pond, Industry, Nutrients, Heavy metal

SIV/O-8

Ecotechnology of Biocompost and its Application in Sustainable Agriculture: Vision 2030

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Sugar Industries (571) produced billion tons of press mud cake per annum. Molasses based distilleries (319+) generate ethyl alcohol and spent wash (@ 15 litre per litre) which is imbalancing the ecosystem and threatened the human life. Ecofriendly technology of early decomposition of compost from press mud cake, distillery spent wash (DSW), sugarcane trash (dried leaves) by bioinoculant *Trichoderma viride* and was mixed in 3 treatments over control. Microbial succession of temperature based phases (Psychrophilic, Mesophilic, Thermophilic, Stabilization and poikilothermic), pH and C/N ratio were investigated.

Seeds and *Triticum aestivum* L. were sown in polybag culture with compost treated soil. Germination relative index (GRI), root and shoot length, chlorophyll contents and net primary productivity (N.P.P.) attributes were significantly increased in biocompost treated soil than control. Physicochemical analysis of treated soil revealed higher N.P.K. organic matter and moisture content but lower pH, E.C., C/N ratio over control.

Environmental challenges of arid ecosystem are sandy/saline soil with poor organic matter and high evapotranspiration. Degraded land (32.7) could be amended by biocompost and has discussed for sustainable agriculture. Smarter management of DSW into biocompost has enhanced the soil fertility. Bioresource has cascading effect on food security and tiger economy reducing urea and agrochemicals. Infact it not only curbs price inflammation and trigger of Ecological Time Bomb but will have pave the way to increase GDP and youth employement to fulfill the **VISION 2030** of **"Developed India'**.

Key words: PMC, Sugarcane trash, Distillery spentwash, C/N ratio, *Trichoderma viride*, Sustainable agriculture

SIV/O-9

Effect of Climate Change on Temperate Agriculture: A Scenario of Weather and Crop Yields of Past Three Decades

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The potential global environmental problem which poses an eminent threat to all life forms is that of the climate change which is being mainly attributed to human induced factors. J and K State of northern India has been facing multifarious environmental manifestations for the last 30 years (erratic weather behavior, untimely rain fall, extreme temperature conditions, droughts and floods etc). The weather data of the last three decades recorded at Shalimar campus shows that average maximum autumn and winter temperature have shown slight increase. However, duration of the winter period has exhibited a decreasing trend. Moreover, average precipitation (rain and snowfall) also shows a declining trend. The yield of some of the important crops of Kashmir Himalayas like apple, pear, cherry, walnut, maize and wheat during the last 30 years have exhibited significant increase which might be attributed to technological interventions like integrated nutrient and disease management, availability of better and climate resilient varieties and other scientific inputs like better agro-advisory services. However, decline in their yields in some years is mainly attributed to unfavorable and extreme climatic conditions (high/low temperature, outbreak of diseases, drought, water logging) particularly in critical growth periods of the crops. On the other hand, almond exhibits fluctuating trends

during past three decades because the crop is sensitive to variations in weather particularly during its flowering season in spring. Moreover, the crop area is declining due to rapid urbanization and low remunerative benefits. Rice and pulses also exhibit low production as well as area under their cultivation. The prized crop of Kashmir Himalayas viz., saffron also shows varied trends depending upon the various micro-climatic conditions favourable for flowering, vegetative growth and multiplication of corms as well as other anthropogenic pressures like urbanization with the result area under crop cultivation is exhibiting declining trends. The paper presents a detailed and holistic scenario of the yield and productivity as well as area under cultivation of different temperate crops in the past three decades with information on the trends of different weather parameters (temperature, precipitation, relative humidity).

Key words: Climate change, Kashmir Himalayas, Temperate agriculture, Apple, Walnut, Saffron

SIV/O-10

Mine Spoil Subsurface: A Potential Sink for Atmospheric Carbon

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Huge quantities of earth's stored carbon are lost due to coal mining and the debris left after mining pose severe environmental issues. Further, the demand for fossil based power and the associated rise in atmospheric carbon dioxide concentration has raised the need for carbon sequestration in the mine spoil. Since reclaimed mined lands are essentially devoid of soil carbon, these areas provide an excellent opportunity to sequester carbon in both soils and vegetation. Reforestation of mine spoil adds to net carbon storage in the terrestrial ecosystem. Here we demonstrate the higher subsurface carbon storage potential in reclaimed coal mine soils through carbon accumulation index (CAI).

The study was carried out in the reclaimed coalmine overburden dumps of Jharia Coalfield, situated in the Dhanbad district of Jharkhand, Eastern India and a nearby agricultural soil was used as reference. From each tree species, ten replicates of soil samples were collected separately for 0 - 0.15 m and 0.15 - 0.30 m depth. The proportion of labile carbon (LC) varied from 20 to 28 % of total C (TC) in the mine soil, whereas it was 11 - 15 % for the reference soil. This indicates the rapid turnover of organic matter in mine soil. LC is a sensitive indicator than TC alone. Carbon pool index calculated as the ratio between the TC in the mine soil and the reference soils was higher for the unplanted soils. However, the final CAI calculated after incorporating the lability and microbial indices was higher for *C. siamea* followed by *D. regia* and *D. sissoo*. The index provides a sensitive measure of the rate of change in soil C dynamics of systems relative to a reference soil. CAI of different tree species growing on reclaimed mine soil showed significant carbon storage potential in the subsurface. Storage of C in deeper layers of minesoil may be beneficial as the turnover time and chemical recalcitrance of soil organic matter increases with depth.

Key words: Mine soils, Subsurface carbon storage, Total carbon, Labile carbon, Carbon accumulation index

SIV/O-11

Evaluation of the Role of Genco Biloba in Alleviating Thiodicarb-induced Impairment of Male Reproductive Function in Western Albino Rats: Biochemical and Histological Study

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Alteration of the male reproductive functions and infertility is an important factor for social frustration and marginalization especially in developing countries. This could be attributed to many factors including exposure to agropesticides. Thiodicarb is a carbamate insecticide and pesticide that widely used to protect agricultural crops. The aim of the present study was to access the protective effect of Ginco Biloba in alleviating Thiodicarb induced impairment of male reproductive function in western albino rats. The animals were treated with vehicle, given Thiodicarb

orally at two doses (7 and 21 mg/kg) body weight daily for 60 successive days. They were given Thiodicarb plus Ginco Biloba orally in a dose of 200mg/kg body weight. Fertility index, weight of sexual organs, semen profile, serum testosterone and cholesterol and histological study of the testes were the parameters used to evaluate the efficiency of the reproductive system of the experimental rats. It was found that Thiodicarb significantly decreased Fertility index, semen volume, counts and percentage of motile sperms while the percentage of abnormal forms was insignificantly altered. The weight of the testes and epididymis was significantly reduced. Significant decrease in serum cholesterol and testosterone levels. On the other hand there was a significant increase in the serum levels of follicle stimulating hormone (FSH), luteinizing hormone (LH) and prolactin. The histological results revealed variable degenerative changes of the seminiferous tubules with arrest in spermatogenesis. The administration of Genco Biloba with Thiodicarb significantly reversed these toxic effects in the male reproductive system, indicating its protective effect. In conclusion the environmental and health concern regarding the exposed humans and animals must be taken in consideration in case of use of Thiodicarb.

Key words: Thiodicarb, FSH, LH, Prolactin, Testosterone, AChE, Seminiferous tubules, Spermatogenesis

SIV/O-12

Improvement of Sugarcane for Quality Traits and Cane Yield through Recurrent Selection

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Sugarcane breeding programs in India have aimed to improve sucrose content a top priority because a short growing season limits cane yield, using a recurrent selection strategy, the cultivars with the highest sucrose content are crossed, and a new generation of cultivars is selected from the progeny. This study was designed to determine how selection primarily for sucrose content has modified physiological characters, and impacted sucrose content and yield. Five cultivars were randomly selected from each of the seven generations of recurrent selection and planted in two experiments. The plant and first stubble crops were harvested late from each experiment. Cane yield and juice quality were determined. Cultivars from the last three generations were superior to cultivars from the first three generations for Brix %, sucrose % in juice, purity, cane yield and sugar yield. The application of recurrent selection in a population with high sugar content and early maturity was effective for increasing its cane yield potential, without reducing the sugar content. Selection primarily for sucrose has increased brix % from 17% to 20%, sucrose % in juice from 15% to 17%, purity from 85% to 90%. The implications of the finding has been discussed in the improvement of sugarcane for quality traits along with cane yield into the breeding program in order to increase disease tolerance, cold tolerance and ratooing ability has diluted the effect of recurrent selection for sucrose.

Key words: Sugarcane, Recurrent selection, Sucrose, Juice quality, Yield

SIV/O-13

Assessment of Soil Fertility Status for Improving Soil Health and Sustainable Crop Productivity of Tea Plantation in Assam

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Intensive conventional farming practice and prolonged tea crop cultivation give a lot of negative impact such as organic matter depletion, adverse changes in soil pH, soil compaction, impairment of environmental quality. Though fertilization is an important approach to balancing nutrient cycling to improve plant growth and crop yield however excessive use of fertilizers, the inefficient use of residues and wastes and lack of proper management practice result in losses of plants nutrients which ultimately lead to low productivity of this crop and will also mean an economic loss for the farmer. In this

context, a field experimental study was conducted in Rosekandy Tea Estate, in Cachar district, Assam, North East Indiato assess the status of soil and plant nutrients. Soil samples were collected using stratified random sampling from six different sections of the tea estate at four different soil depths i.e., 0-20, 20-40, 40-60, 60- 80 cm. The plant leaf samples were collected separately. Physico-chemical properties i.e., texture, moisture content, bulk density, water holding capacity, total nitrogen (N), total phosphorus (P), total potassium (K), soil organic carbon (SOC), soil organic matter (SOM), pH, electrical conductivity, of the soil, were determined from these soil sample. Total nitrogen, phosphorous and potassium were determined from plant samples. The results revealed that soil of the tea garden is sandy clay and silt loam in texture with slightly acidic which is under optimum range. The SOC, SOM content and total N average values were found (0.91-1.83) (1.57-3.15) and (0.30-1.20) percentage, respectively. However, average value of total K and total P of the soils were found (0.88-1.39) g/kg and (8.60-11.90 respectively. Total nitrogen, phosphorous and potassium content of the leaf were determined as 20.40 g/kg,1.44g/kg and 26.30g/kg respectively. The overall values of nutrient contents have been observed as declined from the critical level. So, a proper soil nutrient management practice under tea cultivation is required to be planned for improving soil health and crop productivity. This study may help to maintain or enhance soil productivity through a balanced use of mineral fertilizers combined with organic and biological sources of plant nutrients and improve the stock of the plant nutrient in soil to sustainable production of tea.

Key words: Conventional farming, Fertilizer, Plants nutrients, Sustainable

SIV/O-14

Environment and Bird Diversity at Bhima-Pedgaon Region in Shrigonda Taluka of Ahmednagar District (M.S.), India

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Regional ecological studies are very important. It can be acheived by intensive exploration of smaller areas.It gives information about climate and biololgical diversity. The average rainfall in this area is about 450 mm. The temperature ranges between 12°C to 42°C. Pedgaon is historical place. The ancient fort Bahadurgad is located here at the bank of Bhima River. Because of continuous availability of water in river; the area became habitat biodiversity of many plants and animals. Several types of phytoplankton, zooplankton, fishes, aquatic and marginal hydrophytes, marginal trees were found abundantly. It formed good food chains. Many birds were attracted to this region.

The present paper include the observation's record of bird diversity during the study period January 2011 to December 2013.The bank of river was rich with vegetation of trees, shrubs and herbs. It had provided good hides to birds. The shallow water near bank contained large number of fishes, mollusks and many zooplanktons. It is good nutritional feedings for birds. Because of well-protected nesting places, hide, and abundant feedings, large number of local, local migrant and migrant species of bird were attracted to this area. They were observed and recorded by frequent visits during study period. The binocular was used to observe them. Photographs of them were taken with the use of zoomed lens camera. The bird species were identified by using relevant literature.

There were 92 species of bird recorded, out of which 10 species were migrant, 28 species were local migrant and 49 were local. The migrant birds came in winter and went back in summer season. Local migrants and local birds formed nesting in this area. The climatic conditions, abundance of food availability and safety are the main causes of bird diversity in this area.

Key words: Bhima river bird diversity, Pedgaon, Historical

SIV/O-15

Sabarmati Riverfront Project a Eco-Friendly Sustainable Role Model for Other States in New Millennium

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Sabarmati Riverfront is a waterfront developed along the banks of Sabarmati River in the city of

Ahmadabad (India). It has been developed by Sabarmati River Front Development Corporation Limited (SRFDCL). The proposal for developing the Riverfront was given in 1961 by the prominent citizens of Ahmadabad and the French architect Bernard Kohn. The project has encountered several delays due to concerns regarding water level, flooding, rehabilitation of displaced slum dwellers and met with severe opposition from the activists involved with the slum rehabilitation. However, the process of obtaining land for the development, through clearance and reclamation was completed. It is also the largest slum displacing project of the city till todate. In the first phase, EPC identified a 20 km stretch of the Riverfront extending from Subhash Bridge to Vasna barrage and proposed to reclaim 162 hectares of the riverbed.

SRFDCL planned to sell or lease out a part of it to finance the project. In 2003, it extended the project to cover a 20 km stretch from the Narmada main canal to Vasna barrage. Project was undertaken with a prime objective of environmental improvement and provision of housing for the poor people, who were living in the life threatening conditions along the river bed. The project has been planned as a self-financing project. The revenues have been generated from the sale of proclaimed land. The project includes walkway development, road development along the river, promenades, garden and construction of 4000 houses under slum rehabilitation, amusement parks, golf course, water sports park. 10.4 km stretch of walkway is open for the public use. Water amusement rides including speed boat and motor boat are working between Nehru Bridge and Gandhi Bridge. Both walkway and rides were inaugurated by the then Chief Minister Shri Narendra Modi on 15 August 2012.

The entire world on the 17th Sept. 2014 was a witness to the monumental Sabarmati River Front first of its kind when the PM of India Shri Narandra Modi and Chinese President met on the dining table. RF is a testimony to the fact that only good governance and political will can make our dream of prosperous India come true. The success story of the RF will prove to be role model for the entire country for developing sustainable heath and eco-friendly eco-tourism in the cities situated on the river bank in other state too.

Key words: Sabarmati River, Rehabilitation of slum dwellers, Water front, Eco-friendly, Eco-tourism, Good governance

SIV/O-16

Green Tea Extract: Its Potential Protective Effect on Diazinon Induced Lung Injuries in Rats

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The widespread use of organophosphate insecticides (OPIs) has long been shown to exert deleterious effect on the living organisms. .The risk of using such chemical compounds have been accentuated with the sharp rise in their consumption by agriculture and householders. They may cause immediate danger to the user if applied without sufficient knowledge of their toxic effects. . Potential future hazards to human health and wild life can be created by residues from some pesticides that may build up in food chain and cause widespread contamination of the environment. Lung fibrosis is a side effect of the OPIs , diazinon. Current evidence suggests that reactive oxygen species may play a key role in the development of lung fibrosis. The present work studied the effect of green tea extract on diazinon-induced lung fibrosis in rats. Animals were divided into three groups: corn oil control group; diazinon group rats received diazinon 10mg/kg in corn oil once /day, p.o for 2 months; diazinon and green tea group in which green tea extract was given to rats (100mg/kg/day, p.o) a week prior to diazinon and daily during diazinon administration for 2 months. Diazinon-induced pulmonary injury and lung fibrosis that was indicated by increased lung hydroxyproline, elevated nitric oxide synthase, myeoloperoxidase (MPO), platelet activating factor (PAF), tumor necrosis factor (TNF_), transforming growth factor 1 (TGF1) and angiotensin converting enzyme (ACE) activity in lung tissues. Diazinon induced a reduction in GSH and a severe histological changes in lung tissues revealed as lymphocytes and neutrophils infiltration, increased collagen deposition and fibrosis. Co-administration of diazinon and green tea extract reduced diazinon-induced lung injury evaluated by the significant reduction in hydroxyproline, nitric oxide synthase, levels of MPO, PAF and TNF- and ACE in lung tissues. Green tea extract ameliorated diazinon-induced reduction in GSH concentration. Histological

evidences supported the ability of green tea extract to attenuate diazinon-induced lung fibrosis and consolidation. The finding of the present study provide that green tea may serve as a novel target for potential therapeutic treatment of lung fibrosis.

Key words: Diazinon, Lung fibrosis, Green tea, Oxygen species, TNF- , TGF1

SIV/O-17

Biochar: A Hope for Sustainable Agriculture and Food Security in India

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The biochar is thermally carbonised biomass in absence or deficient condition of oxygen. Biochar prepared at 300-500°C for 30 min to several hours were more suitable for soil applications. The property of biochar fully depends on biomass type, pyrolysis temperature, time and atmosphere. The soil type and climate condition also play important role on performance of biochar. The slow pyrolysis is suitable for biochar preparation because it support higher concentration of stable organic matter without compromising with char yield. Fast pyrolysis or higher temperature pyrolysis burns maximum labile organic carbon present in the biomass. Here we aimed for achieving goal of sustainable agriculture and food security which were possible by proper management or utilisation of land, water and energy resources. The agricultural land degraded because of excess use of organic and inorganic fertilizers. The fertilizer like herbicides, insecticides etc. disturbed and ruined the microbial population which play principal role in relation between plant and soil nutrient cycles. Microbial population reduction affects nutrient cycle, which automatically reduced crop and food productivity. In India around 91 - 141 X 10^6 kg/yr of superfluous crop residue generated, which possibly will be an option of biomass for biochar production for soil applications. The terrestrial and aquatic weeds biomass also preference because of their invasive nature. For example, *Parthenium hysterophorus* infested around two million hectare of land in India. It is hypothesized that use of weeds biomass for biochar preparation may a sustainable option for weed management. It was investigated by researcher's biochar having the capacity of improving soil quality as well as crop productivity. Biochar have the capacity of adsorbing organic and inorganic pollutant because of their surface chemistry. This property of biochar reduced the immobilization of soil pollutant. The biochar incorporation increases cation exchange capacity, water holding capacity, soil enzymatic activity, soil respiration, nutrient retention capacity, net primary productivity etc., and reduces the green house gases emission from crop fields. Thus, authors advocated for the biochar may adopt as a sustainable agriculture and food security option in India because of their properties and scope for future.

Key words: Biochar, Biomass, Sustainable agriculture, Food security, Soil property

SIV/O-18

Effect of Different Down Stream Processing Techniques on Microalgal Metabolite Production

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Due to the high cost of upstream and downstream processing, such as culturing, harvesting, lipid extraction and trans-esterification, microalgal biofuels are neither economically feasible nor environmentally sustainable. The biorefinery concept has attracted much attention to exploit other aspects of microalgal biomass in order to improve the feasibility of biodiesel production. Lipid extracted algae (LEA) is the residual biomass, obtained after lipid extraction from microalgal. LEA contain significant amounts of metabolites such as carbohydrates, proteins and lipids that can be used source of energy in the form of feed for aquaculture, poultry, livestock as well as energy production such as bio-methane and biohydrogen generation etc. The use of different drying and cell disruption methods have examined widely for lipid production, however the literature on the effect of different downstream processing on LEA (lipid extracted algae) metabolites is scanty. This study evaluated the effect of different downstream process

on LEA metabolite of *Scenedesmus* spp. grown on BG11 medium in the raceway pond (300000L). The biomass was harvested on late log phase and the effectiveness of different lipid extraction processes on LEA qualities was observed. The result revealed that the microwave assisted cell disruption of microalgae shows highest lipid production followed by sonication, autoclave and osmotic shock (10% NaCl), which was 19%, 18%, 10% and 6.8 % (% DW) respectively. Freeze dried biomass yielded highest lipid, whereas there was no significant difference in lipid yield was noticed in sun dried and oven dried. The carbohydrates in sun dried, oven dried and freeze dried whole cell microalgal biomass was 14.6 %, 14 % and 12.84 % respectively. The results revealed 0.18-5.6 % increase in carbohydrates; in sun dried, microwave assisted LEA and oven dried, autoclaved LEA respectively. Interestingly, we observed that the percentage of total carbohydrates (as reducing sugar) increased in LEA. This may be due to repeated cell disruptions, causing the microalgal cell to become fragile. and thus better percentage of carbohydrates were achieved in LEA in comparison of whole cell algae.

Key words: Microalgae, Lipd extracted algae, Metabolities, Carbohydrates

SIV/O-19

Application of Mathematical Modelling in Conservation of Forestry Biomass

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The term 'forest' applies not only to trees but also to vegetation and grassland. Forests perform irreplaceable ecological services as an integral part of our biosphere. They assist in the global cycling of water, oxygen, carbon and nitrogen, as well as forming the habitat for many wildlife species. In relation to human needs, forests supply wood that is made into housing, paper and furniture etc. All the natural resources and forest resources in particular, are being exploited continuously in the name of economic development. Cutting of trees without regeneration can change a forest into a desert. In a general sense, one cannot deny that all people have some dependence on forests, at least for products such as timber and paper. However, many people rely heavily on forests for their livelihoods. India with its intense population pressure is one of the worst affected countries due to over exploitation of forest resources among various countries of the world.

Now-a-days, accelerated deforestation is done in the name of industrialization and development activities, resulting in rapid depletion of the biological resources of the country. Being a developing country attempts should be made to look into the issue by considering three important aspects namely, increasing population pressure and exploitation of forest resources in the name of economic development. Conservation and intensive management of forests has become necessary for the protection and improvement of the quality of the environment, the deterioration of which has caused considerable harm. Several researchers have investigated the depletion of forestry biomass by overgrowing population, toxicants and industrialization. In this talk, mathematical modeling for the effects of population, industrialization and pollution on forestry biomass and conservation of forestry biomass with using technological effort, alternative resources is to be discussed.

Key words: Forest, Mathmetical modelling, Biomass

SIV/O-20

Ambient Aerosols in the Coal Capital of India: Dhanbad

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Air quality of Dhanbad has been assessed with particular reference to the aerosols. In the year long assessment (2012) of shoot particles, the highest concentration of 8.74 ìg m^{-3} was observed in December. Diurnal data analysis shows two peaks in whole study period where the maximum mass concentrations of Black Carbon (BC) occurred within in a day at 0500–1000 Hrs LT (7.97 ìg m^{-3}) and in nighttime in between 1700 - 0400 Hrs LT (7.47 ìg m^{-3}). The observed diurnal variation of BC is mainly attributed to the dynamics of the local atmospheric boundary layer (ABL), though the urban and local human activities might be contributing to the nocturnal peak. BC data from mine sites were compared with that of controlled site (CIMFR) and observed that the 95^{th} percentile values is 4 15.0 ìg m^{-3} for mine sites

and 14.42 ìg m^{-3} at CIMFR site. It means that the relative concentration of BC mass increases at mine sites. There were observed drastic changes in the meteorological conditions during different time period in study as well as mass concentrations of BC. Especially the impact of temperature in mass concentration of BC is clearly indicated and a significant correlation between BC and relative humidity (RH) was also seen. Particle number and mass concentration has been observed in nucleation mode and accumulation mode. Analysis of particle number in the range of 0.007 µm to 10 µm aerodynamic diameter, shows that particle number concentration in stages with particle diameter d" 1 µm were from identical sources and follow same pattern of seasonal variation. Combustion aerosols dominate the d" 1 µm fraction of particle number. The mean particle number at < 0.1 µm size was measured as 78.67% in summer and a relatively higher 83.39% in winter. In the size range of 0.1-1.0 µm it is 21.18% in summer, which decreases in winter to 16.56%. In the next higher particle size range 1.0-10 µm the higher values were obtained in summer than the winter. The proportion of granulometric slides ($PM_{0.1}$; $PM_{0.1–1}$ and PM1–10) is following the same trend in both the seasons.

Key words: Aerosols, Black Carbon (BC), Particle size, Particle number, Meteorology, Coal mines

SIV/O-21

Sea Vegetables; Nori (Laver) - New Health and Functional Ingredient: the Inside Happening-Taurine Factor

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The word Nori is Japanese term which is also called Laver in English literature. Nori is also associated with redigious rituals and offered to the spirits of ancestors. Traditionally it is a part of diet of Chinese, Korean, Japanese and other oriental countries with believe that it protects them to stay away from various alignments and is vital of longevity and good health. Its food benefits are so high that today it has crossed mountains and sea to reach all the continents; from European Union, America, Oceania and to Arab world. Taxonomically it belongs to genera porphyra with about 50 species of which half of them found in Japan itself. The wide acceptability of Nori is due to its taste and health benefits. Nori contains almost all essential molecules for sound health, from minerals to protein, fatty acid to amino acids. It also contains vitamins A, B1, B2, B3, B6, B12, C, E and the fighting nucleotides to valuable fibres.

The use of this weed as component of food is consequence of its valuable health benefits and literature has ample supporting evidences; for lowering of blood cholesterol levels, anti coagulant, anti cancer with lowering rate of breast cancer, prevention of the occurrence of gallstone, prevention of gastric shay ulcer, intestinal carcinogenesis, anti-inflammatory, anti oxidant, fat liver infiltration, anti allergy, reducing arsenic toxicity as well as promoter of hair growth, eye sight to increase life span. All these beneficial actions of Nori is seems to be because of the molecules present in it; while going through its various chemical component, besides others, the presence of large number of bound and free amino acids are surprising events and is believe to be responsible for taste, texture and flavour. The presence of very high amount of sulphur amino acid; taurine, the highest among the free amino acid found, is a matter of thought, as such a huge amount must have marked utility. In fact, what's ever the nori showed its functionality, taurine also has; and it is quite possible that nori beneficial activities many be monitor through taurine.Taurine, chemically; 2- Amino ethane sulfonic acid is endogenous substance in human body with about 0.1% but its concentration decline with ageing hence external supplementation is essential. Taurine is now regarded as functional agent and has been patented; for various disease prevention, for brain to heart, eye to lever, and diabetic to bone loss. It is also promoter of well being, hair growth and is part of longevity agents like Nori. Thus it seems that Nori beneficial properties are because of presence of high amount of taurine.

Key words: Nori, Tourine, Lever

SIV/O-22

Sustainable Agriculture and Society: Reflections on and from the *Crystal Waters Permaculture Village* in Queensland, Australia

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Permaculture philosophy maintains that agriculture is the centre of culture and society. It follows that permanent agriculture is necessary to build permanent society. Building communal permaculture villages has been suggested as a pathway to permanent society, where social, environmental and economic dimensions of sustainability are simultaneously achieved. In communal permaculture, the agricultural land is held in common as a foundation of organismic society. At the *Crystal Waters Permaculture Village* (*Crystal Waters* in short) in Queensland, Australia, 80% of the whole village was set aside for prospective agricultural production. The communal land is managed by the body corporate of the village. The land can be leased out to individual households or a cluster of households. Nevertheless, *Crystal Waters* is not a village where agriculture is the centre of their livelihood. Communal permaculture in the way it is practiced at *Crystal Waters* cannot become a model for sustainable living for the rest of the world. Thus, an alternative form of permaculture villages needs to be conceptualised and operationalised. This paper argues that the 'communal' management of agricultural land should not be a necessary condition for a permaculture village. It is quite possible to redesign existing rural villages and turn them into permaculture villages rather than creating new intentional villages from the scratch. In other words, traditional rural villages need to be and can be redesigned to be permaculture villages. Many developing countries in Asia are in transition to agricultural industrialisation. Large-scale mechanised farms with heavy reliance on agrochemicals have deteriorated the soil fertility on farms, threatened the health and quality of agricultural produce and eventually resulted in destroying the sense of belonging to local rural communities. Thus, it is timely to push forward the permaculture village movement in the context of rural development in developing countries.

Key words: Ecovillage, Communal permaculture, Food production, Village-making

SIV/O-23

Advances in Atomic, Nuclear and Mass Spectroscopic Analytical Techniques for Monitoring the Environment

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Ever since the start of the industrial revolution, most of our, top soils, ground and surface waters and atmosphere have been polluted with several types of toxins due to extensive agricultural, industrial and mining activities. Common environmental toxins include hydrocarbons, inhaled toxins, pesticides and heavy metals. A major area of concern is the safety of public drinking water, especially with respect to certain trace and ultra-trace elements in drinking water. Although the main threats to human health are associated with exposure to elements such as Pb, Cd, Hg and As, other groups of elements such as REE and PGE can be very potential as they are being used currently very extensively in the high technology applications. These elements are also finding their way into different compartments of the environment. The toxic metals, such as As, Se, Cd, Cr, Hg, Pb, Th, U, etc., enter the human body via the food chain, ambient air or drinking water, and often lead to health problems. It is essential to monitor the various compartments of the environment to get information about the present levels of all harmful or potentially harmful pollutants. It is also well recognized that very often total element concentration does not provide adequate information to understand the toxicity, bioavailability, physiological and metabolic processes, as the mobility and fate are greatly dependant on the specific chemical form of the element. Elemental speciation is yet to be developed to its full potential for biochemical, clinical and environmental investigations, especially, in India. Furthermore, the application may have specific requirements such as rapid response time, ultra-sensitivity, multi-pollutant capability, or capability for remote measurements. For these reasons, no single spectroscopic technique appears to offer a panacea for all monitoring needs. However, due to advances in analytical instrumentation, and especially with the advent of different forms of inductively coupled plasma mass spectrometry (ICP-MS, HR-ICP-MS and ICP-TOF-MS), several studies are currently in progress to understand the toxicological effects of even elements like Pt, Pd, and Rh on humans. Spectacular developments have taken place during last two decades in the field of instrumental analytical techniques in atomic, nuclear and mass spectrometry areas leading to very high sensitivity, selectivity, limited interference effects and multi-element/isotope/speciation capability with extremely high throughputs.

Key words: Environment, Instrumental analytical techniques, Speciation, Pollutants, Heavy metals, Toxicity

SIV/O-24

Antifungal Activity of Rhamnolipidbiosurfactant Against *Colletotrichumfalcatum*-the Causal Organism of Red Rot of Sugarcane

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This investigation was carried out to study the effect of biosurfactant against *Colletotrichumfalcatum* - the causal organism of red rot disease of sugarcane. For the investigation, a total of 12 biosurfactant producing bacterial strains have been isolated from hydrocarbon contaminated soil and the inhibitory ability of the biosurfactants produced by these isolates against *C. falcatum*were tested. Preliminary investigation revealed that the biosurfactant produced by the bacterial strain*Pseudomonas aeruginosa* DS9 identified from the analysis of the 16S rRNA gene sequence was found as the effective inhibitor of the fungus. Further investigations were conducted in vitro to study the efficacy of the biosurfactantpresent in whole culture (WC), cell-free culture supernatant (CCS), crude extract (CE) and column purified extract (CPE) against the tested fungus. CPE exhibited highest (86.6%) inhibition of the mycelial growth of *C. falcatum*. Thin layer chromatography (TLC), fourier transform infrared spectrometry (FTIR) and liquid chromatography-mass spectrometry (LC-MS) analysis confirmed that the biosurfactant recovered from *P. aeruginosa* DS9 is rhamnolipid in nature.The results of the present study suggest rhamnolipidbiosurfactant to be a suitable candidate for its use against *C. falcatum* to control red rot of sugarcane.

Key words: *Pseudomonas aeruginosa* DS9, Rhamnolipidbiosurfactant, Antifungal agent, *Colletotrichumfalcatum*,·Red rot

SIV/O-25

Simulation Modeling for Forest Fire: A Geospatial Approach towards Fire Disaster Management

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Forest fire models are generally used in different aspects of fire management. Simulation modeling is an adequate tool to estimate risk when actual risk data are limited or unavailable. Fire modeling is helpful in understanding and prediction of fire behavior without getting burned. Fire models are used in different aspects of fire management; before fire, for risk factor calculation and this would help fire fighters to focus on area with higher risk and develop better infrastructure, before fire for fire fighter training purposes and developing a scenario for training, during fire, for planning fire fighting strategies and this would help fire crews position equipment on the ground so that they can minimize damage and stay safe. There is a need to model fire in ground, crown, and surface fuel. Current research indicates the Fire risk estimation as the proportion of simulation runs that burned a particular point and accumulated over the entire area of Taradevi Forest (Shimla) India. This helps fire fighters to focus on an area with greater risk and to develop better substructure for fire fighter training and ultimately to plan fire-fighting policies to minimize damage and stay safe. Satellite remote sensing datasets in conjunction with topographic, vegetation and other parameters like road settlement etc. Spatial data on all these parameters have been aggregated and organized in a GIS (Geographic Information System) framework. Results from the current study were quite significant in identifying potential active-spots of fire risk, where forest fire protection measures can be taken in advance.

Key words: Forest fire risk, Modelling, Simulation, Extended fire zone

SIV/O-26

Phytobiotic Evaluation of *Eclipta alba* on Fish Pathogenesis

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The economic expansion of intensive aquaculture practices has led to an understanding of various fish

diseases both for prevention and treatment. It is widely demonstrated that the occurrence of diseases in fish farm is due to several factors concerned with the rearing methods, environmental conditions and variations. Consequently, cultivated fish can become more susceptible not only to pathogenic but also to opportunistic bacteria. *Eclipta alba* (L.) Hassk (Asteraceae) is a branched herbaceous plant well known as curative against various tropical and sub-tropical diseases. Morphologically, the plant bears soft and sessile stem. The extensive growth of the plant in moist areas of varied topology indicates its invasiveness and signifies its intense allelopathic activity. In view of this allelopathic potential, the roots of the plants are considered as a vital biochemical mediator to the environment which could possibly be used as an antimicrobial agent against fish pathogen. This perspective is supported with the fact that root exudates of a plant could serve as better in an aquatic ecosystem. Following the liquid-liquid extraction procedure, the root exudates were fractionated with major solvents, amongst which the methanol fraction was found to possess significant antimicrobial activity against broad spectrum microbes dwelling in diverse environmental conditions. The experimental findings inferred statistical significance at 0.001 levels and thus validate practical implication.

Key words: Allelochemical, Antimicrobial activity, *Eclipta alba*, Root exudates

SIV/P-1

Quality Evaluation and Validation of Traditional Claims of Indian *Evolvulus* Species with Respect to Phenolic Content, Caffeic Acid and Antioxidant Potential

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Free radical-mediated oxidative stress is the major cause of neurodegenerative disorders and plants are traditionally being used for the treatment of several degenerative disorders. It is evident that polyphenol based antioxidants play a significant role as neuroprotective agents. *Evolvulus alsinoides* L. (EA) and *E. nummularius* L. (EN) (Convolvulaceae), are traditionally being used as nerve tonic. Present communication provided the quality standards of EA and EN by standard pharmacopoeial methods and TLC/HPTLC analysis; evaluation of polyphenols especially caffeic acid; antioxidant potential using *DPPH* radical scavenging, -carotene bleaching, hydroxyl radical scavenging and reducing power assays to validate the neuroprotective effect. The identifying macroscopic characters were flower colour i.e. blue in EA and white in EN; leaf shape i.e. lanceolate in EA and round in EN. The characteristic microscopic features were - anisocytic stomata in EA while diacytic to paracytic stomata in EN; simple and glandular trichomes in EA and stellate trichomes in EN; tenniniferous cells in EA and calcium oxalate crystals in EN. Further, pith was parenchymatous in both stem but embedded with spindle shaped deposition of starch grains and calcium oxalate crystals only in EN. The chemical markers viz. caffeic acid, ferulic acid, lupeol, â-sitosterol were identified using TLC/HPTLC in both species with varying concentration. However, phenolic content (968mg GAE/100g w/w) and caffeic acid (415.9±0.003mg/100g w/w) were three times high in EN. Similarly, antioxidant potential was significantly high with lower IC_{50} in EN as compare to EA. Therefore, it may be concluded that macro-microscopy and TLC profiles may be utilized for proper identification and quality evaluation of EA and EN. EN may lead to potential antioxidant and neuroprotective drugs.

Key words: Macro-microscopy, *Evolvulus alsinoides*, *Evolvulus nummularius*, TLC, Antioxidant, Polyphenols

SIV/P-2

Effect of Rainfall on Nutrient Release through Weathering of Rocks

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Global food security is directly related with the crop production. The availability of land for agriculture

and the nutrient content of the soil need to be guaranteed to meet food requirements of the increasing population of the world. Assured supply of nutrients, keeping in view the preservation of quality of land looks like to be an unattainable task. Nature has its own means of providing nutrients required by the plants. However, changing environmental conditions and rainfall patterns have brought a challenging responsibility. In the present study, the release of nutrients through weathering is studied under different rainfall conditions in the Cauvery catchment area, Southern India. Two different kinds of rocks, amphibolites and granites, were studied to understand the pattern of release of elements. The chemical forms of the elements were studied through seven different fractions for each identifiable stage of weathering. It was found that required nutrients are released in available forms by natural weathering process and readily available nutrients are lost in high rainfall areas. Most of the trace elements such as Ni, Co, Sr, Zn etc are associated with organic fraction in larger proportions. Al was strongly concentrated in the organic fraction irrespective of the rainfall received by the area. The presence of active pool of organic matter in the weathering profile is expected to actively participate in the biogeochemical cycling of the elements during weathering. Different rocks are source of different nutrients, and hence play a role in increasing fertility of land. Areas with scanty rainfall are found to be rich in soil nutrients, water being the limiting factor. Weathering of rocks is a natural process of adding nutrients to the floodplains. Thus this can be inferred that changing rainfall patterns of the world will slowly bring a change in availability of nutrients.

Key words: Weathering, Speciation, Nutrient availability, Rainfall, Cauvery catchment

SIV/P-3

Oat: An Important Crop for Utilizing Wastelands for Nutritional Security

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Neglected and underutilized crops are domesticated plant species that have been used for centuries or even millennia for their food, fiber, fodder, oil or medicinal properties, but have been reduced in importance over time owing to particular supply and use constraints. With modernization of agricultural practices, many of these crops have become neglected. As the demand for plant and crop attributes changes (re-appraisal or discovery of nutritional traits, culinary value, adaptation to climate change etc.), neglected crops can overcome the constraints to the wider production and use. In the current scenario, just three crops - maize, wheat and rice - account for more than 50% of the world's consumption of calories and protein. With ever-increasing population pressure and fast depletion of natural resources, it has become extremely important to diversify the present-day agriculture in order to meet various human needs in a sustainable manner.

Oat (*Avena sativa*) is a hardy cereal grain, able to withstand poor soil conditions and important as food, medicine and for industries. The cultivation and consumption of this crop may be helpful in overcoming the nutritional deficiencies, predominant in many rural areas of the country and boost the socio-economic condition of the society. Since it is consumed directly as a food, it is prerequisite to produce top-quality food and, additionally, to protect the natural environment by applying eco-friendly agricultural practices and abandoning synthetic fertilizers and pesticides. Keeping all these facts in consideration, few nutritional experiments had been conducted at CSIR- National Botanical Research Institute, Lucknow to standardize the crop production techniques to provide high quality food from the marginal/degraded sodic soil condition without disturbing the main agriculture land. The finding of these experiments revealed that seeds treated by PSB and *Trichoderma* with application of half dose of recommended fertilizer produced economically higher grain and straw yield. In another experiment, among the inorganic treatments, 100 % STR (dose applied on the basis of soil testing report) with 10 kg/ ha $ZnSO_4$, produced economically higher grain yield.

Key word: Oat, PSB, Underutilized, *Trichoderma*

SIV/P-4

Value Addition of Some Endangered Edible Plants of Uttrakhand

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Agriculture/horticulture resource survey reveals that endangered edible plants available in Uttrakhand are nutritionally enriches with natural antioxidants and other nutraceutically important compounds. Traditionally the people from Uttrakhand utilize this crops/vegetation of their ambient environment in form of different products as food, fodder, fuel, medicine, fiber, timber etc. The members of some endangered and threatened taxa of edible plants belong to different families Mimosaceae, Averrhoaceae, Caesalpiniaceae, Euphorbiaceae, Bombacaeae, Ulmaceae, Ehretiaceae, Ehritiaceae, Moraceae, Tiliaceae etc. Among these useful species most of them are commercially exploited by local people and herbal based food manufacturers, presently many of such endangered species are in threat categories. There is a great potential for processing of endangered edible plants (comprises cereals, pulses, fruits, vegetables species, condiments etc.) available in Uttrakhand into various value added products. Hence, there is an urgent need for conservation and value addition of such species for sustainable development. The present study provides comprehensive information on the diversity, conservation status and utilization of some endangered edible plants available in Uttarakhand.

Key words: Edible, Endangered, Conservation, Herbal, Nutraceutical

SIV/P-5

Influence of Pulp and Paper Industry Wastewater on Soil Urease Activity

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Effluent from pulp and paper industries are highly toxic, this toxic nature is on account of the presence of several chemical compounds which are formed and released during various stages of papermaking. The biochemical and microbiological status of the soil has often been proposed as a sensitive indicator of soil ecological stress. Urease is an important enzyme responsible for nitrogen metabolism and particularly gained attention due to agricultural importance of urea as its substrate. Influence of pulp and paper industry wastewater on Urease activity of twelve soil samples from the area situated near by paper mill discharge at Saharanpur district were investigated. Soil samples were collected from 13 sites at a depth of 5-10 cm and the distance between the collecting sites was in the range of 50-100 m, including one reference site which was considerably far from the discharge and supposed to be uninfluenced with paper mill effluent contamination. Out of twelve samples, six samples were taken from agriculture land and rest from non-agricultural sites situated in vicinity to the paper mill discharge area. The average pH of soil samples collected from different sites varied from 5.8 to 7.6 whereas moisture content and soil organic carbon content ranged between 28.6-36.6% and 12.40-7.88% respectively. Considerable reduction in urease activity was observed both in the samples from agricultural site and non agricultural site near by paper mill drainage in comparison to the activity at reference site which was observed 7.70 mg NH_4^+-N $g^{-1}h^{-1}$. Urease activity in the samples from agricultural field and non-agricultural field was observed to be 54.41% to75.06% and 76.10% to 97.53% respectively lesser than the urease activity at the reference site. Heavy metal analysis was also performed to support the inference.

Key words: Soil enzyme, Urease, Pulp and paper industry, Effluent, Saharanpur, Toxicity

SIV/P-6

Occurrence of Seed Borne Diseases of *Cicer arietinum* (Chick pea) and Strategies to Control *Fusarium* Wilt by Bio Control Method

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Our balanced diet consists of two major components, cereals and pulses besides vegetable and

fruits. Seed health is being recognized as one of the important criteria in evaluating seed quality. According to current estimates, 10% of food grain is lost in storage due to microbial spoilage and insect attack. Storage fungi grow faster in 70-90% humidity. *Cicer arietinum* L. (Chickpea) commonly called as gram (Chana) is most commonly used as pulse in daily diet and important for making gram flour (besan). The reduction in yield and poor germination of gram seed may be due to presence of various fungal organisms and insect pests. After the harvest many fungal problems result into loss of about 20% of produce. This results in loss of viability, poor germination and production of toxins thus reducing the food value.

To find out the occurrence and solution of seed borne infection on gram an effort was made to analyse occurrence of fungal flora on gram (local variety) in control sets using three wet blotting papers, and with treatment of 1% NaOCl in PDA medium. The results showed occurrence of ten different fungi. Three species of *Aspergillus* were present. The paper deals with control of *Fusarium* sp. with *Trichoderma viride*a member belonging to Mitosporic fungi.

Key words: Seed mycoflora, Chickpea, *Fusarium*, Biocontrol

SIV/P-7

Effect of Systemic Fungicides on Okra (*Abelmoschus esculentous*) Plants

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The study was aimed to evaluate the inhibitory effect of systemic fungicides on growth and development of okra (*Abelmoschus esculentus*) cultivar "Niharika. A pot trial of okra plants was conducted for 28 days. Three widely used systemic fungicides i.e. Tricyclazole 75% WP, Carbendazim 50% WP and Sulphur 80% WP were used in the study in different concentration mixed in soil to appraise the inhibitory effect of fungicides on okra plants. Two different concentration of each of the three systemic fungicides and consortium of fungicides were applied as RD (Recommended dose) and double of the RD to study the morphological and growth attributes such as Germination Percent, Seedling vigour, Shoot length, Root length, No of leaves, No of roots and Fresh Weight at regular time interval of 7th, 14th and 28th days. Results indicated the suppression of plant growth due to the presence of fungicide in soil in all the doses. Abiotic stress due to the fungicides caused significant decrease in Germination Percent, Seedling vigour, Shoot length, Root length, No of leaves, No of roots and Fresh Weight in all treatments in comparison of control plants which showed luxuriant growth at the regular time interval in pots. Decrease in germination percent was recorded to be highest in treatments having Sulphur (33%) followed by consortium (28%) Carbendazim (16%) and Tricyclazole (11%). Percent decrease in seedling vigour was recorded to be highest in okra plants having Sulphur (53%) followed by consortium (44%) Carbendazim (28.6%) and Tricyclazole (23%). Percent decrease in fresh weight was recorded in all the treatments at regular time interval of 7th, 14th and 28th day. Suppression in plant length was recorded in all the treatments at regular time interval of 7th, 14th and 28th day however highest percent decrease was recorded in okra plants having Sulphur (54%), consortium (45%) and Carbendazim (35%) in comparison of Tricyclazole (24%) at both the doses. It is concluded that all the three fungicides produced inhibitory effect on plant growth and development but among them Sulphur 80% WP at both the doses produced the deleterious impact on growth and development of okra plants.

Key words: Systemic, Tricyclazole, Carbendazim, Sulphur, Seedling Vigour, Germination percent

SIV/P-8

Effect of Rice Based Cropping Systems on Soil Organic Carbon and its Fractions

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Soil organic carbon is the most important component of the soil and it is composed of different fractions with variable turnover rate. The labile fraction of soil organic matter is mainly composed of soil microbial biomass carbon, water soluble organic carbon and carbohydrate carbon. Since these labile fractions are very sensitive to changes in management of cropping systems they may serve as early indices of changes in soil organic matter. Humic substances, are the largest, most stable pool of organic carbon with a relatively slow turnover rate and serve as indicator

of organic matter accumulation in soil. The present work was designed to study the dynamics of soil organic carbon in terms of its different fractions in response to variation in rice based cropping systems in moist tropics. The cropping systems studied were rice fallow (RF), rice rice (RR), rice wheat (RW) and one undisturbed grassland (GL) situated at Agricultural Experimental Farm, Baruipur, University of Calcutta. Soil samples were collected five times during the annual cycle at various growth stages from 0-15 cm depth. Annual mean level of soil organic carbon and all its fractions viz. carbohydrate carbon, water soluble carbon and humus carbon were highest in grassland as compared to cultivated systems. Among the cropping systems, RW recorded the maximum levels for all the labile fractions while the humus fraction was highest in RR system. RF had the least value for both active and passive fractions of soil organic carbon. The ratio of active**:** passive fraction was highest in RW and lowest in rice fallow (RF). On this basis we may conclude that crop rotation of RW is a better management practice than intensive rice monocultures or rice fallow rotations for sustaining long term soil fertility in humid tropics.

Key words: Cropping systems, Organic carbon, Microbial biomass carbon, Labile fractions, Humus

SIV/P-9

Cultivation, Processing and Exploitation of Medicinal Plants in India-I

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India has a rich heritage of traditional system of medicines with its 20 agro climate zones, 45,000 plant species and 1500 medicinal plant. It is reported that above 1300 species are extremely used in different system of medicines. Most of the medicinal plants at present are collected from wild, As there is lack of effort on scientific farming, successful cultivation and commercialization needs people's participation and transparent financial backup by funding agencies and dynamic investors. It is reported that 80% of medicinal plant used by Pharmaceutical industries are collected from wild and about 70% of plant collection involves the use of bark, root, stems and in some cases the whole plant leading to destructive harvesting.Involvement of farmers in Cultivation, development of appropriate technologies that can be easily adopted by farmers, buy-back guarantee scheme to cultivators, research on development of high yielding varieties, efficient value added processing techniques are required to by promoted, Linkage between traditional medicinal system and people are to be strengthened, unethical trade and loss of intellectual properties are to be checked. Organic and certified production of medicinal plants can help in promoting social equity; adequate incentives for enhancing cultivation, value added processing and sustainable harvesting must be taken to capitalize on our rich heritage of traditional health care.

Key word: Medicinal plant, India

SIV/P-10

Seasonal Variation of Isoprene Emissions from Tropical Roadside Plant Species and Their Possible Role in Deteoriating Air Quality

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Volatile organic compounds (VOCs) are defined as any organic compound with high vapor pressures and also easily vaporized under normal conditions into the atmosphere. Many such compounds are released by plants which are normally untraceable for humans and are called as biogenic volatile organic compounds. Among all bVOCs isoprene is the most predominating one which may lead to implications on air quality such as production of tropospheric ozone (Gutherner et al., 2006) and aerosol production (Julia et al., 2011). In the present study, two widely adapted common Indian plant species viz. *Dalbergia sissoo* (Family: Fabaceae) and *Nerium oleander* (Family: Apocynaceae) were examined for normalized isoprene emission rate (NIER) using dynamic flow through bag enclosure technique. An attempt has also been made to evaluate suitability of these two selected plant species for city plantation programmes. *Dalbergia sp.* has got high isoprene emission (84.67 ± 3.87 µg/g/h) while *Nerium sp.* has minimum (0.001± 0.17 µg/g/h) during summer

season as compared to monsoon season (*Dalbergia* - 23.88 ± 0.23 µg/g/h; *Nerium* - 0.001± 0.11 µg/g/h). Thus, *Nerium oleander* falls under low isoprene emitting category while *Dalbergia sissoo,* under high isoprene emitting category. The plants having low emitting isoprene rate, it is more likely that non-functionalization of the this light-dependent Isoprene-synthase (IspS). IspS is responsible for inadequate generation of dimethylallyl diphosphate (DMADP) substrate causing mutations in the 2-*C*-methyl-D-erythritol 4-phosphate (MEP) pathway which generally interfere with metabolic processes and crucial for plant survival and emit less isoprene emission. Hence, *Nerium oleander* should be encouraged for further city plantation at roadsides and *Dalbergia sissoo* should be done on low scale so that the air will be clean and indirect production of other harmful pollutants (tropospheric ozone, aerosol production) will be minimized.

Key words: Isoprene, Indian plant species, Roadside, VOCs and air quality

SIV/P-11

Modern Pollen/Spore Rain Deposition Pattern in Lashoda Tal, Raebareli District, Uttar Pradesh

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The paper deals with the modern pollen rain/ vegetation relationship, based on the pollen analysis of ten surface samples gathered from Lashoda Tal, Raebareli District (U.P.). The pollen assemblages reveal the dominance of non-arboreals and relatively low frequencies of arboreals trees and shrubs). *Acacia* (av.6.35%) and *Madhuca indica* (av. 4%) are the major components among the tree taxa and they are steadily represented with av. 9.35% pollen, whereas rest of the trees viz., *Capparis*, *Holoptelea*, *Bauhinia*, *Ailanthus*, *Shorea robusta*, *Schleichera*, *Syzygium* and members of Meliaceae, occurring commonly in the region, are recorded meagerly. The under-representation of all theses taxa could be inferred to their low pollen production owing entomophilous mode of pollination. The selective preservation of their pollen in the surface sediments cannot be denied. In general, the tree taxa constitute av.17% fraction of the total pollen rain. The representation of grasses, sedges, Chenopodiaceae/ Amaranthaceae (Cheno/Am), Caryophyllaceae, Brassicaceae, Asteraceae, etc. in the pollen spectra substantiates their actual composition in the ground flora. The frequent encounter of Cerealia along with other culture pollen taxa viz., Cheno/Am, Brassicaceae, *Artemisia* and *Cannabis sativa* depicts the proximity of cultivated land and human habitation. In addition, a good number of fungal remains such as *Nigrospora*, *Tetraploa*, *Curvularia*, *Diplodia*, *Glomus*, *Alternaria*, etc. have been encountered frequently in the surface soils, indicating locally prevalence of damp condition with abundance of decaying organic matter.

The investigation has also provided database concerning the important pollen/spores in the local milieu, which get accumulated on the ground along with rains/dews after emission from the source plants. Their relative frequencies enables in determining the specific pollen/spores in the aerospora relevant to local allergic diseases.

Key words: Pollen analysis, Surface soils, Pollen/spore rain, Lashoda Tal, Uttar Pradesh

SIV/P-12

Ethnobotanical Notes on Some Wild Plants for Non-Medicinal Purpose by the Tribals and Rurals of Chitrakoot District, U.P.

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An ethnobotanical survey was carried out among the tribals and rurals of Chitrakoot district during different season of February 2013 to July 2014. The study mainly focused on the wild plants used by the tribals and rurals for various non-medicinal purposes (mat, net, broom, baskets and rope making, construction, dye and tannin, gum and resin, industrial purposes, hedge/fencing, religious, to ward off evil spirits, insect repellents etc.) through the consultation with the old and knowledgeable people. A total of 27 plant species belonging to 26 genera and 19 families were identified as economically important plants. With respect to the habit, 9 plants are herbs (1 plant is bamboo), 5 plants are shrubs and 13 are trees. Of these

are used for 4 plants are basketry, 3 brooms, 2 mats, 2 nets and 4 ropes, 6 plants as fencing, 3 plants for dying and tanning, 9 plant as religious, 4 plants for evil spirits, 2 as insect repellent, 2 fertilizer, 1 alcoholic drink, 3 toothbrush, 1 plates and bowls, 1 soil erosion, 4 plants household and building material and other miscellaneous uses of these plants are also recorded. Non-medicinal uses of plants with their Botanical name, local name of plant species, Family, part used and non-medicinal uses are described in detail. The investigation underlines the potential of ethnobotanical research and needs to document the traditional knowledge pertaining to the uses of plants for greater benefit of mankind.

Key words: Ethnobotany, Fencing, Religious, Evil spirits, Traditional Knowledge, Chitrakoot

SIV/P-13

Ethnomedicinal Plants used for Minor Accident of Burns by the Tribals of Banda District (U.P.), India

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Banda district is the smallest district of Uttar Pradesh which is surrounded by thick forestand repository economically as well as ethnomedicinally important for plants. This paper is based on an Ethnobotanicalsurvey conducted on the use of medicinal plants in the treatment of minor accident of burns (boils and blisters) by village dwellers, tribal people, village herbalists, herbal practitioners belonging to Banda district of Uttar Pradesh during different season of January 2013 to April 2014. For the purpose of this study, personal interviews with the help of a structured questionnaire were held to investigate the utility of various medicinal plants among these stakeholders. Through this study, a total of 15 plant species belonging to 12 families have been documented. Also, the medicinal plants used in the treatment of minor accident by tribal's have been listed with botanical name, family, local names, mode of preparation, part used and voucher number and collection date**,** As a whole, the study reveals that majority of the people of Banda district continue to depend on the medicinal plants at least for the treatment of primary healthcare. This data should be useful for pharmaceutical industries which can study the phytochemistry and prepare new medicines. It has been observed that rich information contents are lying with old generations must be recorded before it is last forever. By publishing their experience will not make only young generation to aware about their traditional knowledge related to use of plant parts, but also the people will have easy and cheap remedy to cure some minor accidents of burns.

Key words: Medicinal plant, Minor accidents, Traditional healers, Pharmaceutical industries, Phytochemistry, Burns

SIV/P-14

Economic Costs Due to Cement Air Pollution Linked Public Health Problem in Bihra Village, Near Jaypee Cement Plant, Rewa (M.P.)

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Cement industry is the one of the 17th most pollutant industries listed by central pollution control board. Cement industry is a continuous source of particulate matters (such as SPM and RSPM) and gases (such as SO_2 and NOx). Results determined the average concentrations of SPM and RSPM in the ambient air of study site have been observed above the standard value (200 µg/m3 for SPM and 100µg/m3 for RSPM for residential and rural uses), whereas the gaseous pollutants (such as SO2 and NOx) are well below the standard value (80µg/m3 for SO2 and NOx for residential and rural uses) during 2009-2010 prescribed by CPCB, New Delhi. Higher concentrations of pollutants during winter, moderate during summer and low during rainy seasons indicated seasonal fluctuations of pollutants under present study. These air pollutants have long been associated with prevalence of various diseases in human being due to cement air pollution. Results indicated higher incidence of respiratory disease followed by cardiovascular, gastrointestinal, others, skin, eye, ear and dental diseases. Whereas Others diseases is not correlated with air pollution linked problem. Questionnaire based survey was conducted to collect information on the economic losses on account of diseases caused due to air pollution by the cement

plants. This information included the losses of production due to possible in capacity to wages and medical treatment costs (medicine, transport, doctor fee, hospital admissions, bed charges, pathological test etc.). The maximum expenditure of villagers for health cost has been recorded as about wages (23,96,763 Rs.) followed by medicinal (15,55,947 Rs), Accidental (9,56,644 Rs), transport (3,92,886 Rs), doctor fee (1,05,261 Rs), bed (84,349 Rs) and other charges (36,888Rs). Finally concluded that SPM and RSPM is the prime accuse for deterioration of ambient air quality in the Bihra village.

Key words: Ambient air pollution, Human health, Economic Cost, Jaypee plant, Rewa, Madhya Pradesh

SIV/P-15

In vitro Antifungal Property of Extract of Lichen *Parmotrema nilgherrense* against Phytopathogenic Fungi

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Antifungal features of acetone, methanol and chloroform extracts of lichen *Parmotrema nilgherrense* were screened against five plant pathogenic fungi, viz., *Aspergillus niger, Aspergillus flavus, Fusarium oxysporum, Fusarium solani, Colletotrichum falcatum,* by the Kirby Bauer Disk-Diffusion assay. The Minimum Inhibitory Concentration (MIC) was performed by Broth Tube Dilution method. The obtained results indicated that all the three extracts manifested selective antifungal activity. The activity was more evident in relation to acetone extract followed by methanol extract. The least activity was evaluated for chloroform extract. The mean zones of inhibition for acetone ranged from 10.3±0.6 to 19.6±0.3 and for methanol the activity range occurred at 10.3±0.2 to 15.0±0.0. The highest MIC value was measured for *Aspergillus niger* and *Aspergillus flavus* whereas, lowest was shown by *Colletotrichum falcatum.* The study suggests that lichen shows potential broad spectrum antifungal activity against phytopathogenic fungi and may be effectively utilized as natural biocontrol agents.

Key words: Lichen, *Parmotrema nilghrr*iense, Antifungal activity, Kirby-bauer disk Diffusion assay, MIC

SIV/P-16

Potentially Toxic Elements and PAHs in Biomass Ashes Derived from Biomass Fired Power Plants

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Biomass energy production is steadily increasing worldwide specially in the industrialized countries. In developing countries like India it is expected to rise more as the non-renewable coal reserves would deplete sooner or later. But the residue obtained from the biomass fired power plants in the form of ash pose a serious problem in their disposal. The biomass ashes derived from five biomass power plants were analysedfor potentially toxic elements and polycyclic aromatic hydrocarbons. The fired biomass materials were mainly coconut, chicken, and wood waste. The elements present in significant amount are B (18.2 - 205 mg/kg), Cu (236 - 478 mg/kg), Cd (8.5 - 23.2 mg/kg), Ni (53 - 186 mg/kg), and Zn (9.89 - 400 mg/kg). The sequential extraction study showed that most of these elements are present in the non-available residual fractions. The total PAHs content was comparatively lower (0.2 - 12.3 mg/kg), except for two sample (193 - 2077 mg/kg). The ashes are significantly rich in plant nutrients (K, P, Ca, Mg, Zn, Cu, Mn, Fe, Ni) and can be used for soil amelioration, however, the PAH content in some of these ashes could be a bottle neck.

Key words: Biomass ash, Heavy metals, PAHs, Sequential extraction

SIV/P-17

Carbon - A Predominant Atom of Atmosphere and Viral Proteins Too

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The Japanese encephalitis (JE) is caused by an enveloped positive-sense single stranded RNA (~ 11

kb in length) virus, containing single open reading frame (ORF) encoding for a poly-protein. The poly protein is processed into three structural core protein (C), membrane protein (M) and envelope protein (E) and seven nonstructural (NS1, NS2B, NS2A, NS3, NS4B, NS4A, and NS5) proteins, flanked by 52 - and 32 -non-translated regions (NTRs). In the present study, virulent proteins of JE were analysed at atomic level. Though all the proteins in nature are made up of the same 20 amino acids, they only differ in their arrangements. We went a step down to analyze these proteins at atom level to find the significance of carbon in them. All the twenty amino acids are made up of basic five atoms namely carbon (C), nitrogen (N), hydrogen (H), oxygen (O), and sulphur (S). Amongst all these five atoms carbon is the main atom of atmosphere and also responsible for the hydrophobic property of proteins. Therefore, it is imperative to study the relevance of carbon in viral proteins too. The virulent proteins were retrieved and studied for the calculation of total carbon percentage in them. A dynamic programming algorithm was designed for the parsing and calculation of carbon atom in the protein sequences using perl programming. The percentage of carbon was further studied using Microsoft excel 2007. The results showed a great demarcation for the various proteins - the carbon range of poly protein being 31.26-31.36, envelop protein 29.12 - 35.34, E protein 31.20 - 32.19 and capsid protein 30.6 - 30.7. The results obtained clearly indicated that carbon could be used for proteins profiling in viruses, as it is not only the major atom of atmosphere, but nature has also made it the most essential atom of viral genomes.

Key words: Carbon, Hydrophobic, Japanese encephalitis, Protein

SIV/P-18

Insights into the Nature and Mechanism of Interference of Tropical Invasive Weed *Ageratum conyzoides*

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Ageratum conzyoides L. (family Asteraceae) is an invasive weed from tropical America that has now invaded in pastures, plantations, forests and arable land of Southeast Asia. It has formed huge monospecific strands in the infested areas and severely affected the natural communities. We planned a series of experiments to elucidate it nature and mechanism of its interference that helps in infestation in the alien environments. We observed that the weed releases certain metabolites into the rhizospheric region making it toxic for the growth of other plant species. These metabolites not only affected the growth of other species but significantly altered soil chemistry and affected availability of soil nutrients. The present paper discusses the role of secondary metabolites and root-mediated interactions of *A. conyzoides* in the alien environment and their role in heavy infestation in invaded areas.

Key words: Invasive weed, Allelopathy, Secondary metabolites, Root-mediated interaction

SIV/P-19

Emerging Agronomic Practices: Are they Really Sustainable?

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By the end of 20th century, global agriculture have faced the problem of nutrient deficiency, soil erosion, water scarcity, greenhouse gaseous emissions shielded by climate injustice. These natural repercussions in association with ever-increasing population especially in developing countries not only impacted on the economics of the state but also their social development. Various alternatives, commonly called sustainable agricultural practices, have been either emerged or modulated from previously established practices (called best management practices or BMPs) to cope up with such issues. Conservation agriculture, system of rice intensification (SRI), and soil amelioration of organics are a few well known agronomic promotion packages in tropical countries since two decades. They are claimed as resource conservation techniques (RCTs) having potential to meet the dietary requirement of present population. It has been observed that total exclusion of mineral fertilizers and pesticides is still doubtful due to partial dependency of emergent agronomic practices; however, there is a limited use. In addition, water

productivity and Carbon sequestration potential is increasing. However, critical analysis revealed that presence of labile organic matter addition through such practices might have accelerating effect over inherent organic matter loss *via* soil priming in long term. In addition, these practices are newer in most of the states, thus, labour cost in terms of skill development could hinder farmers to adopt them. Most importantly, the climatic variability in terms of drought, uneven rainfall and fluctuating diurnal temperature may hamper grain yield in particular area. Thus, in spite of blindly agreeing with the sustainability parameters of emergent agronomic practices, it is required to critically evaluate them on social, economic and environmental templates.Inclusion of climate models will further rectify farmers concern about yield penalty, if occurred unfortunately.

Key words: Agronomy, RCT, SRI, Carbon sequestration, Slimate model

SIV/P-20

Soil Test Based Nutrient Management in Turmeric (*Curcuma longa* L.) under Partial Shade Condition

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Sheesham (*Dalbergia sissoo* Roxb.), a tree species belongs to family Leguminaceae. This tree species cultivated under monoculture and agroforestry system in the Indogangetic plains of India. Turmeric (*Curcuma longa* L.) belongs to family Zingiberaceae. It is widely used as spices and natural coloring agents in food cosmetics and dye. Curcuminoids is its active constituents and have some medicinal properties. Nutrient management is one of the important practices for optimum yield and quality of selected plant, a field experiment was carried out under partial shade vs. non-shade conditions to optimize the yield and quality of turmeric at Banthra Research Station of CSIR-National Botanical Research Institute, Lucknow. The treatment combinations were T_1 - Control, T_2-100% NPK (125: 60: 90), T_3 - 100% NPK + $S_{30,}$ T_4 - 100% NPK + $Zn_{30,}$ T_5 - 100% NPK + S_{30} $Zn_{30,}$ T_6 - 100% NPK + S_{30} Zn_{30} + 20 t FYM, T_7 - 125% $T_{5,}$ T_8 - 150% T_5 with four replications in RBD design. Results indicated that all the parameters like plant height, number of leaves plant^{-1}, mother rhizomes, primary rhizomes and rhizome yield and essential oil content increased under partial shade condition in comparison to non-shade (open) condition. Under partial shade condition, maximum fresh rhizome yield was recorded (272 q ha^{-1}) with T_8 - 150% T_5 however it was at par (264 q ha^{-1}) in comparison to 125% T_5 (T_7). Maximum chlorophyll a (0.74 mg g^{-1}) and chlorophyll b (0.36 mg g^{-1}) was recorded in the treatment T_6 followed by T_7. However, maximum chlorophyll a and b and carotenoid were recorded in the order of middle leaves > new leaves> old leaves.

Key words: Nutrient, Turmeric, Essential oil

SIV/P-21

Pharmacolgical Importance of Fruit Juice and Waste of *Citrus maxima* (Burman) Merrill

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Citrus maxima (Burman) Merrill belongs to family Rutaceae and is commonly known as omelo or shaddock. The present study deals with the antioxidant and antimicrobial assay of juice, extracts of peel, and fibre with seed of the fruit. For non enzymatic assay *in vitro* antioxidant activity was determined by DPPH free radical scavenging activity (%) at concentrations (25-200µL). Highest activity at 200 µL for juice was found to be 97.12%, methanolic extract of peel and fibre was found to be 97.57 and 95.15 respectively while for aqueous extract for peel and fibre was found to be 88.95 and 89.49 respectively. Total antioxidant capacity (%) at 50µL of the reaction mixture was recorded as 98.80 for juice,78.98and 89.36 for methanolic extract of peel and fibre while10.37 and 1.94 for aqueous extract of peel and fibre respectively. The value for ascorbate oxidase (mM^{-1}cm^{-1}) was recorded as 0.0009, 0.0015, 0.00021, 0.0012 and 0.00086 for juice, methanolic fibre, methanolic peel, aqueous peel and aqueous fibre respectively at 0.01 (v/v). For catalase (mM^{-1}cm^{-1}) was recorded as 0.0006, 0.00025, 0.00071, 0.00078 and 0.00089 for juice, methanolic fibre, methanolic peel, aqueous peel and aqueous fibre respectively.

The antimicrobial extent the extracts were determined against *E. coli* by agar diffusion method. The MIC for streptomycin and tetracycline (1mg/mL) was recorded as 0.1µg/mL and 0.01µg/mL respectively. The zone for crude juice was found to be 0.050(v/v) followed by the both peel extracts as 0.075 (v/v) and was not recorded in fibre extract.

The study clearly points out that not only the juice but the part which is treated as waste can also contribute to the pharmacological field.

Key words: Antioxidant, Antimicrobial extent, Scavenging activity (%), MIC and agar diffusion

SIV/P-22

Green Infrastructure: Urban Trees and its Role in the City

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Urbanization is a global phenomenon. Rapid urbanization in India is bringing complex changes to ecology, economy and society. Cities are expanding with the sprawl of built-up area. Interspersed with this sprawl are the green spaces. Urban infrastructure includes contiguous vegetated areas such as parks or forest stands, and isolated trees growing along streets. This urban nature is vital for the human wellbeing and sustainable survival in the cities. Trees in urban system provide a variety of ecosystem services including biodiversity conservation, removal of atmospheric pollutants, oxygen generation, noise reduction, mitigation of urban heat island effect, microclimate regulation, stabilization of soil, groundwater recharge, prevention of soil erosion and carbon sequestration. In India, key players in greening urban areas are Government departments, educational institutions, municipal bodies, and local residents. The results of the efforts by forest department in Bhopal city are evident in the form of rich urban tree cover. Various parks and plantations comprising of evergreen trees species spread across the city contribute to an attractive green townscape. To make substantive progress towards urban sustainability, city managers and researchers need to know how the greening programs in urban areas have contributed to urban landscape in face of the rapid urban land cover and land use changes.

Key words: Urban trees, Green space, Parks, Plantations, Ecosystem services, Bhopal city

SIV/P-23

Efficacy of Repellency of Essential Oils of Selected Plants against *Anopheles gambiae*

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The essential oils extracted by steam distillation from aerial parts of *Ocimum gratissimum*, *Hyptis suaveolens* and *Vitex keniensis* growing in Western Kenya and selected electrophysiologically active blends of synthetic standards were bio-assayed for their repellency activity on the forearms of human volunteers against the female *Anopheles gambiae sensu stricto*. The oil of *Ocimum gratissimum* was the most repellent (RD_{50} = 2.77 × 10^{-5} mg cm^{-2}, 95% CI) and comparable to DEET (RD_{50} = 1.25×10^{-5} mg cm^{-2}, 95% CI) followed by *Vitex keniensis* (RD_{50} = 5.68 × 10^{-5} mg cm^{-2}, 95% CI) and *Hyptis suaveolens* (RD_{50} = 6.27× 10^{-5} mg cm^{-2}, 95% CI). The bioactive constituent of different oil was determined by GC-EAG and was confirmed by co-injection of crude oil with authentic standards. Partial synthetic blends of selected electrophysiologically active components of *O. gratissimum* and *V. keniensis* exhibited activities lower than their corresponding parent oils while partial synthetic blend of electrophysiologically active components of *H. suaveolens* exhibited activity higher than that of the parent oil. Subtractive bioassay was carried out to find out blend effects in the repellent action of the oils against the *Anopheles gambiae*. Absence of some constituents in the blends resulted in either an increase or a decrease in repellency action of resulting blends, while absence of some components had no effect in the repellency action of the resulting

blends. The significance of the results and their implication in the utilization of the plants will be highlighted.

Key words: *Anopheles gambiae*, Repellency, Subtractive bioassays, Essential oil, GC-EAG

SIV/P-24

Report on Municipal Solid Waste Management in Jamshedpur and their Effect on Plants

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Jamshedpur Utilities and Services Company is today India's only comprehensive urban infrastructure service provider. A Tata Enterprise, its services focus on the Tata Group Purpose "To improve the quality of life of the communities we serve". Its services include water, power, municipal solid waste management, roads and bridges, industrial, civil and structural construction. The Group purpose is reflected in JUSCO's Mission of providing "quality services for life". JUSCO works alongside civic bodies, large and small industries, urban local government bodies, communities and individuals to deliver value through sustainable solutions. The research primarily focuses on the innovative and customer friendly solutions to the segments of Municipal Solid Waste. The thorough study of the waste composition of Jamshedpur city was done and the innovative ideas have been captured in this literature through various interaction and field study regarding Organic and the Plastic fraction of the Municipal Solid Waste. In this research, the technical, economical, and environmental aspects of MSWM scenarios were investigated aiming to compare the scenarios and select the most appropriate one for implementation. Primarily focuses on the innovative and customer friendly solutions to the segments of Municipal Solid Waste. The thorough study of the waste composition of Jamshedpur city was done and the innovative ideas have been captured in this project through various interaction and field study regarding Organic and the Plastic fraction of the Municipal Solid Waste. Municipal solid waste is a valuable source of organic matter, nitrogen, phosphorus and other nutrients for plants.

Key words: MSWM, Compost, Plastic, Environment, Nitrogen

SIV/P-25

An Assessment of Herbicidal Potential of some Monoterpenes and their Formulations

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The indiscriminate use of synthetic chemicals to control weeds raises concerns related to their toxic effects on environment and human health. Their replacement with safer chemicals is, therefore, need of the hour. Several natural plant products offer an eco-friendly and safer source of natural herbicides. Among natural plant products, monoterpenes - one of the largest groups of plant based secondary metabolites, are known for their high biological activities. However, as regards their herbicidal properties, not much work has been done. In this direction, a study was conducted to assess the herbicidal potential of two widely occurring monoterpenes *viz*. limonene and -pinene against germination and growth of *Cassia occidentalis* L. (coffee weed) under laboratory conditions. Both monoterpenes at concentrations e" 2.5 mM inhibited the germination and early growth of test weed. -pinene was found to be more inhibitory than limonene. Further an attempt was made to improve the activity of these monoterpenes by forming their formulations with aqueous extract of leaf powder of *Chenopodium ambrosioides* and sodium caprylate, a non-ionic surfactant. The results indicated that herbicidal activity of these monoterpenes was improved by more than 50% compared to their activity alone. On the basis of the study it was concluded that monoterpenes alone or their formulations can serve as effective bioherbicides under sustainable weed management programmes.

Key words: Bioherbicides, Monoterpenes, Formulations, Limonene, -pinene

SIV/P-26

Ecological Assessment of some Underutilized Edible Plants around Chandigarh, India

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In order to feed the burgeoning population, new sources of food are being explored. Of these, one of the options is to utilize underutilized edible plants that may provide the nutrient rich food for the future. However, these plants lack potential market value owing to their less preference over the cultivated foods. Keeping in mind the likelihood of food crisis in future, these may serve as the best source of food. Many of these plants are fast becoming rare and endangered because of human negligence and lack of interest in them. Hardly any study is available on their ecological status and distribution. A survey based study was, therefore, conducted in the rural areas around Chandigarh during the years 2012-2013 to determine the ecological status of underutilized edible plants so as to prepare an inventory and restoring the biodiversity status and maintaining food security for future. The plants under the underutilized category were selected on the basis of their edible value either in form of fruits or leaves or buds and even flowers. The ecological status and distribution of these plants was studied as per the quadrat method and various parameters such as density, frequency, cover area and importance value index (IVI) were determined. During the field survey, 30 different plants belonging to 22 families were identified and documented. Most common species identified on the basis of survey were *Moringa oleifera*, *Zizyphus mauritiana*, *Carrisa carandas*, *Bauhinia variegata*, *Schleichera oleosa* and herbs like *Medicago sativa* or *Amarantus viridis* etc. Plants like *Cordia dichotoma*, *Annona squamosa* or *Bombax ceiba* have become very rare and hence need protection and human attention. During the deliberations of the conference, it is proposed to discuss the ecological status of generally ignored underutilized plants found around Chandigarh.

Key words: Underutilized edible plants, Ecological status, Inventory, Importance value index

SIV/P-27

Invasive Tree *Broussonetia papyrifera* Reduces the Growth and Establishment of *Bidens pilosa* though its Allelopathic Effect

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Invasive plant species often exhibit allelopathic properties as a part of their strategy to establish in the alien environment. By releasing allelochemicals, these plants eliminate the native species and thus succeed in occupying huge areas. *Broussonetia papyrifera*, an exotic tree in India that has established itself in the lower Shiwalik region of North-Western Himalayas especially in the state of Himachal Pradesh and Chandigarh. The tree has extensive root system through which it multiples vegetatively and spreads rapidly to the adjoining areas. The area under the trees supports sparse vegetation compared to an adjoining mixed forest composed of tree species like *Albizia lebbeck*, *Acacia catechu* or *Cassia fistula*. However, the mechanism for this sparse vegetation remains unknown. It was speculated that allelopathy - a type of negative ecological interaction, might have regulatory effect on the vegetation. In order to test this, a study was planned where the effect of leaf litter (which accumulates on the floor in large quantities) was studied on the germination and growth of *Bidens pilosa*, one of the common understorey plant of forests. In order to test that active chemicals released from the litter are responsible for the growth retardatory effect, activated charcoal (known to adsorb organic chemicals) was also added along with litter in the soil in a parallel set. The results indicated that growth of test species was significantly reduced in soil medium amended with leaf litter of *B. papyrifera* compared to control. However, there was lesser inhibitory effect when litter amended soils were incorporated with activated charcoal indicating the role of allelochemicals in growth inhibitory effect of leaf litter. The study concludes that allelopathy plays an important role in the invasiveness of the tree.

Key words: Allelopathy, Allelochemicals, Invasive and exotic tree, Leaf litter

SIV/P-28

Fluoride Content in Different Eatables and Water from Lucknow City

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Excessive intake of fluoride is responsible for the development of skeletal fluorosis, which causes

characteristic changes in teeth, bones and periarticular tissues. Fluorosis is thought to be endemic diseases and in endemic areas, a substantial proportion of the population may be affected, posing a severe health problem. Until now whole emphasis is given only to water and it was thought that main cause of fluorosis is excessive quantities of fluorine in drinking water. Although fluoride rich water is perceived as a major cause for fluorosis, in reality 50% of fluoride entered in the body through food. Hence hazard to human health is not fully recognized and is under reported in other than endemic areas where fluoride concentration in drinking water is within the permissible limit. Fluorosis may also persist in these areas but misinterpreted as arthritis and other lifestyle related diseases. Very little work has been reported on the concentration of fluoride in food items.

In the present study, fluoride content was estimated in the different eatables and water collected from Lucknow city. Although a nearby city of Lucknow, viz. Unnao is known as endemic area for fluorosis but Lucknow is not reported as endemic area. Water samples were collected from twenty different localities of Lucknow and it was found that almost all the studied samples had fluoride concentration within the acceptable limit and no substantial difference in fluoride concentration was found in all the samples except the samples from Bhola purva, Bakshi ka taalab area which has more than permissible limit i.e.1.2 ppm (BIS, 1983) of fluoride. In case of eatables, some of salty snacks which uses black salt in its preparation and some open tea samples had fluoride content beyond the permissible limit.

Key words: Fluoride, Eatables, Drinking water, Lucknow, Permissible limit

SIV/P-29

Some Medicinal Plants of Nine Wards of Purashava of Rajbari Sadar Upazila of Rajbari District, Bangladesh

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A survey of medicinal plants was completed in different localities of nine wards of purashava of Rajbari Sadar Upazila at Rajbari district in Bangladesh from 2013 to 2014. A total 105 medicinal plants under 59 families were documented during present investigation. These plants are used for people to treat about 71 diseases. Scientific names, local names, applied parts, names of control diseases are also mentioned.

Key words: Medicinal plants, Ayuravedic, Rajbari

SIV/P-30

Colony Growth Variability and Relative Virulence of *Pestalotiopsis* sp. Isolates Causing Leaf Spot Disease in Eucalyptus

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Eucalyptus is a diverse genus of flowering trees and shrubs in the Myrtaceae family cultivated widely in the tropical and temperate world, including the different continents. Eucalyptus one of the most significant genus which attracts environmentalists, horticulturists as well as global development researchers, because of its desirable traits such as fast growth, oil source and capacity to drain swamps and thus reducing the threat of mosquito born diseases. Eucalyptus provides raw material for different industries such as paper, plywood and pulp industries. Number of pathogenic fungal species has been reported to cause different diseases of Eucalyptus leading to productivity loss. *Pestalotiopsis* sp. is one of the common pathogen causing leaf spot disease in Eucalypts. The present investigation was conducted to screen cultural characteristics and relative virulence of nine isolates of pathogen collected by the Forest Pathology Division, Forest Research Institute, Dehradun from different sites of Uttarakhand and Uttar Pradesh. These isolates were grown on different culture media viz., Potato Dextrose Agar, Oatmeal Agar, Cooke's Rose Bengal Agar and King's Medium and their relative colony characteristics were compared. The relative virulence of isolates of *Pestalotiopsis* sp. was observed in potato dextrose broth at different incubation intervals. The Eulalyptus twigs were screened in the

filtrate of the liquid cultures of different isolates and the symptoms on leaves and twigs were recorded. The highly virulent isolates were recognized which can be useful in future studies while screening disease resistance in host germplasm.

Key words: Eucalyptus, *Pestalotiopsis* sp. PDA, OMA, KMBB, CRBB, Leaf spot disease

SIV/P-31

Hydrlogical Simulation on the Effects of Landuse Pattern Change on Stream Flow using Swat Model

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For the last 25 years, the increase in population growth has accelerated the Land use/Land cover (LULC) change globally. The hydrological cycle has been substantially influenced by LULC and human activity. So it is therefore important to investigate the impact of LULC on the hydrology particularly on River basin scale. The objective of this study is to analyze the long term variations of stream flow of Yennehole River basin located in Western Ghats region of Karnataka using a physically based, semi-distributed hydrological model Soil and Water Assessment Tool (SWAT). Land cover data for the post monsoon season in years of 1988, 2000 and 2013 were acquired from available Landsat Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM^+) and Operational Land Imager (OLI) respectively ware classified through the maximum likelihood digital image classification using the supervised classification approach. The results indicated that SWAT proved to be a powerful tool to simulate and analysis of impact of LULC change on surface hydrology in River basin scale. It is found that forest area, agriculture land and built-up area were highly dynamic than grassland and wasteland. In the catchment area, increased urbanized area and deforestation ware the strongest contributor to the increase of runoff at the sub-basin scale. It indicates that annual Yennehole River runoff decreases from past 25 years and simulated monthly pattern show that the largest decrease in the pre-monsoon month while largest increase in the post-monsoon month. It indicates less water possibly available for the region in future. It is need to manage water resources adaptability to address future water resources shortage.

Key words: LULC change, SWAT, Surface runoff, Yennehole River, Hydrological model

SIV/P-32

Edible Film from Food Waste: A Greener Approach towards Sustainability

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Global food production is going to rise by 60% by 2050 as per report of FAO but, in present scenario the way global food wastage is increasing; the food security is at stake with the environment. Hence, a proper design of the system is highly required which approaches towards sustainability via use of green technology. In the same time the growing concern for the environment with use of synthetic packaging material is also soaring. Therefore, by integrating sustainable films/coating preparation from food waste will be opening an unique opportunity to work on. Food wastes components are highly biocompatible which make them ideal materials for the development of edible film with biodegradable characteristics for applications in food and pharmaceutical industries. Even the physical properties, including mechanical strength and durability can be modified to act as smart barrier materials for oxygen or moisture migration. Based on green technology concept, proteinaceous food waste was chosen for the edible film preparation, while its characterization for packaging and coating were also performed.

Key words: Food security, Green Technology, Edible film, Biodegradation

SIV/P-33

Green Composites from Agro-Residues: A Review

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Green biocomposites are composite materials comprising one or more phase(s) derived from biological origin. Green Composites can be made using various kinds of cellulosic biofibers, such as; hemp fibers, jute, saccaharum fibers, pine needles, grewia optiva fibers, sisal fibers , eulaliopsis binata, flax fibers, coconut fibers, baggase fibers, rice husk, saw dust, wood flour, straw, Bamboo fibers, Oil palm frond fibers .The techniques used to manufacture biocomposites are based largely on existing techniques for processing plastics or composite materials. These include press molding, hand lay-up, filament winding, extrusion, injection moulding, compression moulding, resin transfer moulding and sheet moulding . The majority of current biocomposite materials based on thermoplastic polymers such as polypropylene and polyethylene are processed by compounding and extrusion. In the packaging industry, starch-based materials made of recycled fibers, are now slowly replacing the synthetic packing materials. The main problem associated with green polymer or green composite is to get required strength and specific properties associated with its synthetic counterparts. Green composite is having potential to capture nearly 25% market currently at least in the area of packaging and agricultural merchandise. In addition there could be a huge market for agricultural fibers used in building and automotive composites.

Key words: Biocomposite, Filament winding, Resin transfer moulding, Extrusion etc.

SIV/P-34

Arsenic Contamination in Ganga Plains, India: A Mini Review

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The occurrence of Arsenic, as a water quality issue in South Asia, became a matter of international concern, when widespread chronic arsenic poisoning cases became apparent in Bangladesh and later in West Bengal, India. Arsenic (As) pollution in groundwater in Ganga Plain of the Indian subcontinent has become a contentious issue. The major investigations into the causative factor of arsenic pollution and its immediate and long term remedy have become a prior research aptitude among researchers. Arsenic is one of the most toxic elements that is found on the earth and is positioned at 4th row and Vth column with atomic number 33 and group Va member of Mendeleev's periodic table. In nature arsenic appears in three allotropic forms: yellow, black and grey; the stable form is a silver-gray, brittle crystalline solid. The occurrence of arsenic in soil and minerals may be entered by sources like air, water and land through wind-blown dust and water run-off. In the present work, a mini review has been worked out to postulate the occurrences of As in the Ganga Plain. In India the initial report on As was first found in the year 1983 from 33 affected villages in four districts in West-Bengal, while the situation aggravated by 2008 with number of villages increasing up to 3417 in 111 blocks in nine districts. From 1999 to 2004 the arsenic groundwater contamination were also reported from various parts of India viz. Rajnandgaon district of Chattisgarh; Barisban and Semaria Ojhapatti, in Bhojpur, Bihar; Agra, Aligarh, Ballia, Balrampur, Gonda, Gorakhpur, Lakhimpur Kheri, Mathura and Moradabad districts in Uttar Pradesh; Sahibgunj district of Jharkhand state in the Ganga Plain. The As contamination level were raised above 10 µg/L to 50 µg/L in many parts. In the observed that most of the river channels from the Himalayan regions or foothills have significantly contributed to As contamination. Recently, it is found that Bahraich district of Uttar Pradesh is also records As in the groundwater. In the fertile Ganga Plains, it is believed that the arsenic is introduced into soil and groundwater during weathering of rocks and minerals followed by subsequent leaching and runoff. Along with this the anthropogenic sources are also one of the major resources for As contamination into soil and groundwater. From the discussions of various causative factors of As, it is found that the global factors controlling arsenic concentration and transport in groundwater, include: Red-ox potential (Eh), adsorption/ desorption, precipitation/dissolution, Arsenic speciation, pH, presence and concentration of competing ions, biological transformation, etc.

Key words: Arsenic, Ganga plain, Ground water

SIV/P-35

Study of Gender-Specific Semiochemicals of Five Ladybirds for their Commercial Utilization in Sustainable Agriculture

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Semiochemicals determine insect-life situations. They are thus potential agents for selective control for pest insects. Headspace solid-phase microextraction technique is employed for investigating the sex-specific volatile semiochemical profile of five ladybirds collected from Lucknow, India namely, *Coccinella septempunctata* (L.), *Coccinella transversalis* (Fabr.), *Menochilus sexmaculatus* (Fabr.), *Propylea dissecta* (Mulsant), and *Anegleis cardoni* (Weise) for the first time. Major compounds reported in *C. septempunctata, C. transversalis* and *A. cardoni* were reported to be methyl-branched saturated hydrocarbons, whereas in *M. sexmaculatus* and *P. dissecta* they are unsaturated hydrocarbons. Other than *A. cardoni*, both the sexes of the other four ladybirds had similar compounds at highest peak but with statistically significant differences. Among the studied ladybirds, *A. cardoni*, which is a beetle with a narrow niche, the major compound in both male and female was different. The difference in volatile hydrocarbon profile of the sexes of the five ladybirds indicates that gender-specific differences primarily exist due to quantitative differences in chemicals with only very few chemicals being unique to a gender. This variation in semiochemicals might have a role in behavioral or ecological aspects of the studied ladybirds. These gender-specific hydrocarbons may further be helpful in the sustainable agriculture practices where, organic agriculture in terms of biological control of pests and insects can be carried out.

Key words: Semiochemicals, Ladybirds, Solid-phase microextraction, Volatile hydrocarbons

SIV/P-36

Silicon Fertilization is an Effective Strategy to Improve Growth and Productivity of *Cicer arietinum* L. Genotypes under Salt Stress

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Soil salinity is widely recognised as a major threat to global food security. Exogenous silicon (Si) fertilization may reduce the toxic effects of salts and improve the adaptability of cropplants. Chickpea is one of the most salt sensitive legumes. Present study was aimed to evaluate the potential of Si on growth and productivity of *Cicer arietinum* L. genotypes (HC 3 and CSG 9505) grown under salt stress. Experiments consisted of a completely randomized block design with two factors - salinity (NaCl, 0-100 mM) and Si (K_2SiO_3, 2 mM and 4 Mm) with six replications each. Salinity negatively affected plant biomass and seed yield which could be correlated with increased sodium (Na^+) uptake. Biomass production was significantly better in +Si treated plants as compared to -Si salt treated plants. Si application offset the salt induced negative impacts by entrapping Na^+, restricting its uptake and lowering down Na^+ translocation ratio. Notably, the impact of Si was more clearly manifested in HC 3 than CSG 9505 in a concentration dependent manner. The study indicated the existence of Si-mediated inhibition mechanism of Na^+ in roots and its transport to above ground parts. It is suggested that Si nutrition is a vital approach to improve the agronomic yield of chickpea plants under salt regime.

Key words: Salinity, Silicon, *Cicer arietinum*, Sustainable agriculture, Productivity, Na translocation

SIV/P-37

Invasion of Weed Species in Water Reservoir of Sanjay Gandhi Thermal Power Station, Madhya Pradesh, India

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The Sanjay Gandhi Thermal Power Station (SGTPS) at Pali - Birsinghpur in Umaria district (M.

P.) is one of the four major thermal power stations in Madhya Pradesh. This thermal power plant is a coal based unit and established on the bank of Johila River. SGTPP receives water from the reservoir on the river Johila. The present study deals with ecological study of terrestrial and aquatic flora at Johila river up-stream, downstream of Johila reservoir as well as the canals used to supply the water to Sanjay Gandhi Thermal Power Plant. The study pertains to the impact of polluted water on flora of the site. The inventory of terrestrial floral species envisaged that 80 terrestrial plant species including 55-dicot plant and 25 monocot plant species were encountered at riverbanks of different study sites. Cyperaceae, Asteraceae and Poaceae family was the main dominating families in the area. Species richness was recorded to be maximum (64 species) at downstream site which shows the resistance towards pollution. In the upstream sites, 52 species were recorded. Some of the species recorded in the upstream sites was found to be absent at downstream sites i.e. *Anisomeles indica, Bothriospermum tenellum, Eragrostiella bifaria, Pulicaria wightiana Occimum tenuiflorum Solanum virginianum, Syzygium fruticosum, Verbascum chinense*. This change might be due to their non-resistance capacity to the changes occurring in water quality in the vicinity of reservoir in surrounding downstream. Amongst the aquatic macrophytes, 19 species of macrophytes recorded in different sites of river including 13 species in upstream site, 11 in reservoir site and 13 In downstream site with plant density ranging from 6.55/m2 to 38.89/m2. Mainly *Hydrilla verticillata, Chara vulgaris, Ceratophyllym demersum, Potamogeton crispus, Valisnaria natans, Butomus umbeltaus, Nitella hyaline, Najas Indica, Najas graminea, Najas minor, Utricularia stellaris, Utricularia flexuosa and Cyprus exaltatus*. The dominant species was *Ceratophyllum demersum followed by Hydrilla verticillata and Valisnaria natans were found*. Aquatic macrophytes are the large, predominantly angiospermic/algal plants and plays vital role in providing food for fish and other aquatic animals, provide shelter to algae and some animals along with cycling of nutrients in the given water bodies. On the other hand, most of the aquatic macrophytes may become problematic when grow profusely as weeds. In the study site, the major weed species *Typha latifolia and Ipomoea aquatica* were recorded in the return canal as well as near the reservoir. These weed species were found to be absent in the upstream and in the downstream. This might be due to effect of effluents discharge from thermal power plant. Moreover, some other plant species like *Aponogeton crispus, Potamogeton crispus, Aponogeton crispus, Valisnaria natans, Nymphoides indica, Polygonum barbatum etc* are predominantly overcoming in the reservoir site. Profuse growths of weeds become problematic for water management authority and discussed for their mitigation in this paper.

Key words: Weed species, Invasive species, Thermal Power plant, Aquatic flora

SIV/P-38

Agroforestry: An Approach towards Carbon Sequestration under Sodic Condition

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Approximately, 6.73 mha land in India is salt affected out of which 3.77 million hectare has been designated as sodic soil. Regions of arid and semi-arid climatic conditions are characterized with the presence of sodic soils in common, largely curbed to Indo-Gangetic plains of Punjab, Haryana and Uttar Pradesh in India. Sodic soils whether are of natural or anthropogenic nature have poor soil structure-chemical properties. It affects the plant growth directly through ion toxicity and nutrient deficiencies and indirectly through increased soil dispersion and decrease infiltration. These soils contain a very low level of soil organic carbon (SOC) content because of dispersed aggregates and SOC solubilisation. There is a clear link exists between the management practice and their potential in altering the carbon stock and fluxes in the soil, particularly in regards to land degradation and subsequent rehabilitation efforts. Various studies have been reported that establish the relation between vegetation and soil properties, land uses and climate. These studies revealed that

management practices play an important role in enhancing the level of SOC in soils. Rehabilitation of sodic soils through agroforestry systems is a highlighting approach these days to increase SOC accumulation, nutrient pool and soil fertility. Also, these systems help in sequestration of above and below ground carbon by reducing the mitigation of green house gases an addition to controlling the soil erosion and increasing the land efficiency. Under sodic conditions growing species like Prosopis, Casuarina, Tamarindus, Phyllanthus, Psidium, Carissa etc., can improve the soil pH and may support the degrading level of SOC by enhancing the availability of more stable pool of carbon and soil aggregates. An encouraging build up of various carbon fractions occurs under agroforestry systems due to long term addition of litter, rhizodeposition and minimum disturbances which sequentially facilitate the reclamation process of sodic soil.

Key words: Sodic soil, Soil structure, Agroforestry, Carbon sequestration

SIV/P-39

Antagonistic Activity of *Achromobacter xylosoxidans* K4. Isolated from Rhizospheric Soil of *Picrorhiza kurroa* Against Phytopathogens

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Extensive use of antifungal and antibacterial agents of chemical origin for the controlling of phytopathogen is the leading cause of evolution of resistance to these chemical pesticides. The possible way or alternate method to control the phytopathogens is through biological mean i.e. use of antagonistic biological organisms or by the use of biopesticides derived from plant sources. Such concerns are driving the researchers to search more environment friendly method to control plant disease that will contribute to the goal of sustainability in agriculture. In the present study soil samples collected from rhizosphere of medicinal plants growing at different places was investigated for its total bacterial and fungal load.. A bacterial strain of *Achromobacter xylosoxidans* was isolated from the collected soil samples, identified by 16 S RNA sequencing and correlated with Total Fungal Count. A significant variation in fungal load was observed in the presence and absence of *A. xylosoxidans*. The antifungal activity of *A. xylosoxidans* isolate was tested against fungal pathogens viz. *Aspergillus humicola. A. ochraceus, A. candidus, Rhizocotonia solani, Fusarium solani, Cladosporium cladosporoides, Alternaria alternata* to understand its antagonistic effect.

Key words: Antagonistic, Phytopathogen, Total fungal count

SIV/P-40

A Study of Wild Edible Plants Supplemental to Malnutrition among Tribals of Banda District (U.P.)

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A study of wild food plants of Banda district was carried out during the year 2013-2014. A total of 20 wild food plants belonging to 18 families were enumerated in the present communication. The report of ethnobotanical significance of these plants have also been described in this paper along with their botanical names, family, local names, and parts used for edible purpose.

A very little work has been done, or we can say that negligible work has been conducted in Banda dist. of Uttar Pradesh. There is a great need to explore such a vast valuable unexplored flora of Banda. These wild edible plants proves to be a supplement to malnutrition among the various tribals of Banda.

Key words: Wild edible plants, Malnutrition, Banda, Ethnobotanical, Tribals

SIV/P-41

Sustenance of Water by Water Footprint: Assessment of Rice Production

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Water scarcity has become a major environmental sustainability challenge throughout the tropical world.

Here we discuss concept of agricultural water footprint which reflects the quantification of water consumption in agriculture. Blue water footprint of agriculture (surface water bodies and groundwater) is significant as globally it account for 70-90% of the total water used for agriculture. In India, rice is a major water consuming staple crop as it occupies about 44 million ha land and consumes 70% of the blue water. With in India, the Indo-Gangatic Plains (IGP) is a major rice-growing region. IGP is expected to face irrigation water scarcity due to excessive exploitation of groundwater and due to climate change related rainfall pattern shift. Therefore, use of emerging agronomical practices for sustainable water management is urgently needed to narrow down the gap between demand and supply of water. For this, a priori water footprint assessment of recommended rice agronomy practices such as "System of Rice Intensification" (SRI) is required. Present work will discuss water footprint of different agronomic practices of rice. However, we understand that there is also a need for recommendation of site specific crop management for IGP.

Key words: Rice cultivation, Water footprint, Indo Gangetic Plains, Sustainable agriculture

SIV/P-42

AFPD: Anti Filarial Plant Database

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Lymphatic Filariasis a parasitic and infectious tropical disease, caused by thread-like parasitic nematode such as *Wuchereria bancrofti*, *Brugia malayi*, and *Brugia timori*. It is known as the second leading cause of long term and permanent disability. Filariasis is endemic in tropical regions of Asia, Africa, Central and South America with more than 120 million people infected and one billion people at risk for infection with little or no mortality rate. Basic symptom is clogged lymphatic ducts lead to severe swelling of limbs and genitalia, as well as damage to kidneys and the lymphatic system itself. In the later stages of infection, the disease is characterized by a disfiguring condition known as elephantiasis resulting in physical disability and severe social stigma and psychological distress. Despite the severity of filarial disease in physiological and psychological aspects and its barrier to progress in developing countries, research in this area is neglected and under-funded. Still there are no preventive measures. While only drug treatments such as Ivermectin, Albendazole, and Diethylcarbamazine are available this targets the immature stages but not the long-lived adult worms furthermore with high side effects. Hence there is a tremendous research scope in this area in relation with new aspects of drug designing. Herbs are staging a comeback and herbal renaissance is fashionable all over the globe. The herbal products today indicate safety in contrast to the synthetics that are stared as unsafe to human and environment. Although herbs had been priced for their medicinal, flavouring and aromatic qualities for centuries. Current effort of designing and development of this database reveals the role and significance of plants and their parts in different stages of filiariasis from prevention to cure. This portal is enriched with adequate current information about prognosis to available treatments of filiariasis including clinical trials on and where available. This database will be very much useful for scientists and researchers those who are dedicated to defeat this dreadful disorder as well as for academician and social workers those who want to seek information and to create awareness campaigns among people.

Key word: AFPD, *Wuchereria bancrofti*, Filariasis, Database, Herbal, Lymphatic, Elephantiasis

SIV/P-43

Studies on Floristic Composition with Special Reference to Invasive Alien Plant Species in Angul District of Odisha, India

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Angul is one of the centrally located districts in the Odisha state of India. Two rivers Mahanadi and Bramhani rush through the district making it fertile and suitable for variety of vegetation. This district is enriched with the resources like a number of coal mines which caters to the need of industrial requirement of alumina industries, thermal power projects, fertilizer

industries and heavy water plant. It is observed that heavy industrialization in this district made it one of the most polluted districts of India. An exhaustive floristic survey was carried out during 2013-2014 in this district to assess the diversity, nativity and use of invasive alien plant species (IAPS). The present floristic exploration revealed that a total of 136 species belonging to 101 genera under 41 different families were invasive alien plant species. Habit wise analysis indicated that the herbs were dominant with 117 species (8 6.02%) followed by shrubs (14), trees (02), climbers (03). Among the 41 families, Asteraceae was the dominant family with 25 (18.18%) species followed by Amaranthaceae (08), Euphorbiaceae (08), Caesalpiniaceae (07), Convolvulaceae (07), Fabaceae (06), Mimosaceae (05), Solanaceae (06), Poaceae (05), Asclepiadaceae (04), Cleomaceae (04), Tiliaceae (04), Cyperaceae (03), Lamiaceae (03) which comprised the most invasives, such as *Chromolena odorata*, *Alternanthera philoxeroides*, *Eichhornia crassipes*, *Lantana camara*, *Parthenium hysterophorus*, *Hyptis suaveolens* and others. The predominance of Asteraceae species in invasive categories exhibited its high impact on this region.

Nativity of the identified alien plant species was surveyed from the available literature which revealed that different native places of IAPS of Angul district are Tropical America (86), Tropical Africa (12), Tropical South America (10), Europe (4), Brazil(3), Tropical north America(3), West Indies (3), Mediterranean (3), Tropical Central South America(3), Tropical Central America (1), Tropical East Africa (1), Peru (1), Mascrene Island (1), Mexico (1), Temperate South America (1), Madagascar (1), West Asia (1), Afghanistan (1) and Tropical West Asia (1). Further information regarding uses of IAPS revealed that the plant species used as medicine (70), fuel (3), ornamental (6), rope making (2) and leafy vegetable (4).

Key words: Nativity, Invasive, Alien, Angul, Odisha

SIV/P-44

Analysis of Complex-Valued Recurrent Neural Networks with Time Delays

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To study more accurately the wide spread applications like signal processing pattern recognition and other engineering applications. We have presented a complex valued recurrent neural network given by a set of non -linear differential equations. The equation is shown to possess a unique equilibrium point beside having bounded solutions. Recently the research recurrent neural network has been shifted to complex-valued recurrent neural network.

Key words: Neural network, Mapping principle, Equilibrium point, Lyapunov function, Time delays

SIV/P-45

Eucalyptus Leaf Extract Mediated Green Synthesis of Iron Nanoparticles

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Plants possess a large array of phytochemicals called polyphenols, which are widely distributed in all the plant parts like as roots, stem, leaves and fruits. Polyphenols have natural antioxidant like properties due to which these can be used for the green synthesis of various types of nanoparticles. Eucalyptus contains high quantity of polyphenol in it's leaves that's why Eucalyptus leaves have enormous potential for the green synthesis of Zerovalent iron nanoparticles. Zerovalent iron nanoparticles have been synthesized by Eucalyptus leaf extract mediated reduction of Fe^{3+} to Fe^{0} during the time of drop wise mixing of ferric chloride solution with aqueous leaf extract. Zerovalent iron nanoparticles were found spherical, very fine < 100 nm in size and highly stabilized when characterized by SEM, TEM, FTIR, XRD and Zetasizer nano like instruments.

Key words: Iron nanoparticals, Zerovalent, Eucalyptus, Polyphenol

SIV/P-46

Anti-Sense RNA Therapy for Treatment of Ebola Hemorrhagic Fever (EHF)

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RNA viruses are a significant source of morbidity and mortality in humans all over the world every year. Additionally, these viruses may be the potentially utilized in the acts of bioterrorism poses a threat for worldwide security. The 2014 Ebola outbreak is one of the largest outbreaks in history. **Ebola** is the virus of the family *Filoviridae,* genus *Ebola virus*. Causing the disease Ebola Hemorrhagic Fever (EHF), a Viral Hemorrhagic Fever (VHF) with a high case death rate in humans and nonhuman primates and it represents a most important community health care for in equatorial Africa. The infection with Ebola leads to reflective immune inhibition and systemic inflammatory reaction causing harm of the vascular, coagulation and immune system, leading to multiorgan failure. Ebola is a filamentous, single-stranded RNA virus with a specific branched morphology, contains several viral proteins and glycoprotein embedded in the membrane. One of the surface protein is extensively glycosylated and this is believed to inhibit the generation of antibodies. The viral polymerase makes mRNA transcripts and starts replication of the virus then accumulation of viral proteins and (-) RNA followed by viral assembly and then budding through the membrane.

An antisense RNA mediated therapy could be developed to target the RNA genome of the virus. It utilizes single-stranded DNA or RNA oligonucleotides that inhibit protein production by mediating the catalytic degradation of target mRNA, or by binding to sites on mRNA necessary for translation. Double-stranded RNA oligonucleotides, called as short-interfering RNAs (siRNAs), also significantly mediate the catalytic degradation of complementary mRNAs. In this therapy, the possible complementary RNA products could be synthesized *invitro* and then using them for targeting the mRNA strands produced by the virus during its replication cycle in its host cell. Hence, destroying the infection of virus in the body. This reviews article is focusing current knowledge on therapeutic applications of antisense RNA and RNA interference for highly pathogenic RNA viral infections

Key words: *Filoviridae*, Ebola, Antibodies, Antisense RNA, Ebola Hemorrhagic Fever (EHF)

SIV/P-47

Assessing Tropospheric Ozone Effect in two Wheat Cultivars under Natural Field Conditions

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Tropospheric O_3 concentration is predicted to increase by 0.5-2% per year over the next century, mainly due to increases in precursor emissions from anthropogenic sources. Indo-Gangetic plains of Northern India have high level of ozone causing visible damage and significant yield reduction in crops. Ethylenediurea (EDU) has been used as ozone protectant under field conditions without appreciable effects of its own. Present study was conducted to assess visible injury, morphological and physiological and biochemical effects in two wheat cultivars (*Triticum aestivum* L) KUNDAN and PBW 343 treated with or without EDU. During study period, ambient O_3 concentration ranged between 38-78 ppb. EDU treated wheat plants showed less visible injury, significant increases in root and shoot length; significantly more biomass accumulation and increase in 1000 grain weight in comparison to non-EDU treated plants. EDU treated plants showed increased photosynthesis, low MDA content and higher antioxidant and enzyme activities. Of these two cultivars KUNDAN performed better in comparison to PBW 343 in all parameters. The present experiment indicated that prevailing ozone concentrations in and around Lucknow city are high enough to unfavourably affect various physiological and biochemical characteristics of two wheat cultivars leading to significant yield reductions. The study showed that of the two wheat varieties, KUNDAN is more susceptible to ambient ozone as compared to PBW 343.

Key words: Tropospheric ozone, Ethylenediurea (EDU), *Triticum aestivum*, Wheat, Cultivars

SIV/P-48

Ethnomedicina Plant used in Thetraditional Phytotherapy of Gastrointestinal Problem by Tribe of Senapati District, Manipur

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Senapati, the northernmost district of Manipur, is inhabited by a large number of tribals. A survey was carried out to study the ethnomedicinal plants used by tribes of Senapati district of Manipur. Through questionnaire, personal interviews and conversation, a total number of 20 plant species were used by the tribe to treat gastrointestinal problem. The plants are enumerated along with families, Manipuri name of the plants, parts used, and mode of application, established reports. The plant part used was constituted by roots, fruit, bark, flower, leaves and stem.

Key words: Ethno-medicine, Tribes, Gastrointestinal problem, Senapati district, Manipur

SIV/P-49

Impact of After-Ripening in Hot Pepper Seed Development During Post-Anthesis Physiological Maturity

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Seed development during its physiological maturity is critical for ensuring its quality. Though seed attain its highest quality at this stage but certain quality attributes attain the optimum level during after-ripening. Present study highlights the affect of after-ripening on seed quality in hot pepper. The seed harvested at peak physiological maturity behave differently under after-ripening period. The two year pooled data on shows seed harvested at 65 days after anthesis (DAA) with 2 days of after-ripening (DAR) and at 55 DAA with 5 DAR produce highest seed germination (87 and 90%), Speed of germination (12.4 and 12.8), Viability (87 and 85.5 %), usable transplants (83.5 and 88 %), seedling vigour index (1446 and 1556) and 1000 seed weight (7.2 and 6.6g).

Key words: Physiological maturity, After-ripening, Days after anthesis, Viability, Tetrazoloum test

SIV/P-50

Phytochemical Analysis and Antibacterial Potential of the Bark Extracts of *Adenanthera pavonina* L.

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Adenanthera pavonina L. (Fabaceae) commonly called as Red Sandal-wood is a deciduous tree and its bark is traditionally used for treatment of various disease conditions in gonorrhoea, haematuria, ulcers, etc. The objective of the present study was to investigate the hidden antibacterial potential of *Adenanthera pavonina* L. against some selected bacterial pathogenic strains. The research work was conducted in the Microbiology Research Laboratory of Post Graduate Department of Botany, Utkal University, Bhubaneswar, Odisha during November, 2012. Five bacterial strains i.e. *Escherichia coli* (MTCC-614), *Shigella flexneri* (MTCC 9543), *Staphylococcus aureus* (MTCC-1430), *Salmonella paratyphi* (MTCC-3220) and *Salmonella enterica typhi* (MTCC-733) were used in the study. The study revealed that methanolic extract of *A. pavonina* was most potent and it exhibited the highest zone of inhibition against *Shigella flexneri* at 6mg/ml which was quite comparable with reference antibiotic Ciprofloxacin (0.5 mg/ml). The n-hexane extract was moderately effective against all the test bacteria. Phytochemical analysis showed that the bark of the plant contained various constituents like flavonoid, tannin, alkaloid and triterpenoid. The presence of these phyto-constituents indicated that the bark extracts of *Adenanthera pavonina* might be a source for a new drug against some diseases like diarrhoea and dysentery and needs further investigation.

Key words: *Adenanthera pavonina*, Phytochemical analysis, Anti-bacterial activity, Ciprofloxacin

SIV/P-51

Study of Latest Traditional Medicinal Plants Having Antifertility Effects

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A large part of the current growth in the population is unplanned. According to a study half of all conceptions are unplanned and half of the resulting pregnancies are undesired. The reason behind these pregnancies is failure of contraception method. In poor nations, contraceptive use is further limited by restricted access to many available methods, both economically and culturally. Women have a wide range of contraceptive choices ranging from daily oral medications to intrauterine devices implanted every 5 years to sterilization. The two most common male contraceptive methods are vasectomy and condoms. The disadvantages of these methods are that vasectomy is not readily reversible and condoms have a high typical failure rate.

Even though, according to the studies it has been stated that various plants have capability to prevent the birth, still only few plants have so far been evaluated for antifertility potential.

In developing countries contraception is not used widely and limited to available methods due to the economic and cultural reasons. The improved availability and education regarding existing contraceptives and more contraceptive options is required. Studying the potency and toxicity of local plants for birth control in the folkloric medicine may generate greater confidence in and wider acceptance of herbal contraceptives. However, the search for an orally active, safe and effective plant preparation or its compound is yet to be needed for fertility regulation due to incomplete inhibition of fertility or side effects.

Key words: Contraceptives, Antifertility, Herbal, Economic

SIV/P-52

Environmental Effects on Physico-chemical Characteristics of Drinking Water at Banda (U.P.), India

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Assessment of Physico-chemical Parameters viz colour, odour, turbidity, PH, total alkalinity, total hardness, total dissolved solid, dissolved oxygen, Chloride, Residual free chlorine, Sulphate, Nitrate, Fluoride, Iron etc. of the drinking river water and tubewell water were determined in rainy season 2014. Samples were taken from eight points in the entire city. Water is the major part of the environment. Pollution of water bodies is one of the major concern to environmentalists. Water quality is an index of health and well being of the society. The various pollutants influence the water resources quantitatively and qualitatively. Besides, meteorological conditions viz photo period, atmospheric temperature, rainfall and relative humidity were also recorded monthly as they have direct impact on water bodies. Results reveal that drinking water was found turbid, Residual free chlorine was in excees further in distribution system due to leakages in pipe lines chloride was observed more. Obiously to some extent water was found unpotable.The river ken water (surface water) supply is qualitatively better than tubewells (ground water) supply. This indicates that ground water is affected by harmfull minerals in the ground strata. The values of parameters are compared with standard given by ISI/WHO.

Key words: ISI/WHO, Physico-chemical parameters, River and tubewell, Potability of water, Environment

SIV/P-53

Ecological-Integrity of Running Water for Human Welfare

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Municipal wastewater and urban storm water are potential pollution sources to downstream waterways and may seriously impact aquatic ecosystem health in rivers for mankind. Insufficient water flow/ water availability and continuous influx of untreated sewage in the urban river site carry enormous amount of pollutants, leading to profused growth of algal blooms. The algal community, macrophytes growth and extent with references to hydrological characteristic of the

running water were monitored during June 2013 to May, 2014 at river stream around Allahabad city. Quantitative and qualitative analysis of cyanotoxin (microcystin), nutrient/ nutrient transport, and their interaction with phytoplankton/ toxin producing algal species were also described. The amount of nutrient and water flow were dynamically influenced with time factor and water availability. The present study was performed to measure water quality variable, primary productivity, chl-a and biomass of phytoplankton/ toxin producing algal species. The maximum chl-a concentration, toxin producing algal species were found to be 515.00 and 615.00 in water sample of Ganga, while 551 mg/l and 641.22 mg/l in Yamuna water sample, respectively in the case of *Microcystis aeruginosa*. Ecological parameters to evaluate GPP, NPP and CR were found to be 397.00, 234.00 and 282.00 $mgCm^3/h$ in summer season in Yamuna river, respectively which is higher than Ganga river. A poor association existed between chl-a and GPP. Temporal variations (Photosynthetic rate) in A_{max} and P_{max} was also observed to evaluate the productivity of water stream. These running water ecological integrity are being incorporated into the urban critical deficits water supply/ treatment infrastructure in view of their religious importance and ecological sustainability to human welfare.

Key words: Algal blooms, Waste water, Cynotoxin, Nutrient

SIV/P-54

Engineering Resistance against Begomovirus Infection in Plants by Targeting Multiple Viral Genes

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Papaya leaf Curl Virus (PaLCuV), a bipartite (DNA-A and DNA-B) Begomovirus belonging to Geminivirus family is a potent inducer of a leaf curl symptom in papaya, a major cash crop of India. The intensity and severity of disease has caused large scale wipe out of Papaya cultivation in northern regions of India. The group of multifunctional viral protein encoding ORFs like AV1 (Coat protein), AV2 (suppresses RNA silencing), AC1 (replication associated), AC2 (transcriptional activator), AC3 (replication enhancer) and AC4 (repressor) constitute DNA-A of Begomoviruses. The other ORFs are present over DNA-B i.e. BC1 (movement protein) and BV1 (nuclear shuttle protein) responsible for a 'couple skating' type movement of viral DNA from one cell to another. In this study, we have tried to propose a RNA silencing approach against bipartite Begomoviruses based upon the principle of RNA silencing.

Various RNA silencing strategies have failed to be effective against bipartite Begomovirus owing to the presence of repressor viral genes and recombination events during viral replication in nucleus which help in retrieval of induced mutations in viral DNA in engineered plants. The repressors, suppressors and movement proteins (BC1 and BV1) are responsible for suppression of host RNAi machinery, development of disease symptoms and systemic transport of viral particles from one part of leaves to another by phloem mediated transport. We have successfully designed siRNAs against AC2, AC4 and AV2; but due to high variability in repressor ORF and its divergent molecular function across genera, it is difficult to engineer a repressor dependent broad host range of viral resistance in plants. Therefore, the strategy was designed to study the viral DNA-B ORFs of the bipartite Begomoviruses to investigate all leaf curl causing bipartite Begomoviruses to target the most conserved sequences for siRNA designing.

As we have designed siRNAs against BC1 and BV1 viral ORFs using bioinformatics tools for siRNA designing, we propose that incorporation of multiple siRNA in a single cassette or pyramiding multiple siRNA cassettes with AC4 and BC1/BV1 must be an essential part of any RNA silencing strategy against bipartite Begomovirus including PaLCuV.

Key words: PaLCuV, Begomovirus, Leaf curl, RNA silencing, siRNA, viral suppressors

SIV/P-55

Utilization of Urban Effluent for Crop Production, Quality and Economization of Fertilizer use

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In many countries around the world, water is becoming an increasingly scarce resource and it forced scientists to consider alternate sources of water which might be used economically and effectively. India is one of the most densely populated, developing and industrially fast growing country of the earth that not only facing the problem of water scarcity, but also the mismanagement of tremendous amount of wastewater (WW) produced every day. Whereas food sufficiency has also become challenge to feed the ever increasing population leading to excessive use of chemical fertilizers in agriculture that may causes serious health hazards. Therefore a study was conducted in the Aligarh city of India on chilli (*Capsicum annuum* L.) cv. Pusa Sadabahar to observe the suitability of WW (along with chemical fertilizers) for irrigation and how minimize the use of chemical fertilizers in agriculture by supplementing mineral nutrients through WW. The experiment was conducted to evaluate the effect of different concentrations of WW together with the basal application of four doses of phosphorus (P_0, P_{20}, P_{40} and P_{60} kg ha^{-1}) on growth, yield and quality of chilli cv. and results revealed that WW irrigation significantly increases the growth, photosynthesis, yield and quality of the crop. Lower dose of phosphorus fertilizer @ 20 kg ha^{-1} together with WW proved optimum and gave greater fresh and dry mass, leaf area, photosynthetic rate, chlorophyll content, fruit length, fruit number $plant^{-1}$ and fruit yield in comparison to control and even to higher phosphorus doses along with fresh water. All physicochemical characteristics of wastewater including some heavy metals were within the permissible limits set by Food and Agriculture Organization (FAO).

Key word: *Capsicum annuum*, Phosphorus, Wastewater, Yield, Quality

SIV/P-56

Strategies to Monitor the Pollution in Certain Areas of Vadodara City and Suggestions for Developing Green Belt

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Vadodara is cultural capital of Gujarat. It is famous for magnificent buildings like Nyaya mandir, Kala bhawan and Baroda Museum and Picture gallery. The museum has Greco Roman structural panels made in Indo Sarascenic style. Building of Laxmi Vilas Palace and Baroda college (144 feet high building) constructed in 1881 has second highest dome in Asia. This building was designed by architect Robert Chisholm. The city had a large number of gardens. Sayaji baug earlier called as Kamatti baug is a large garden in the heart of city.

A large number of trees can be seen in gardens and on both sides of roads. These trees help in reducing the temperature in hot summer and dust pollution throughout the year. Dust particles are major source of pollution in the city of country. The concentration of these particles may vary from season to season or areas where higher construction activities are taking place, vehicles playing on roads also secrete such suspended particles. An assessment of dust carrying capacity of certain road side plants in Vadodara was done. Leaves of Vad (*Ficus benghalensis*) and Mango (*Mangifera indica*) showed more accumulation of dust or SPM as compared to plants like Ashoka (*Polyalthia longifolia*) and Saptparni (*Alstonia scholaris*).The plants were able to accumulate 1.4 mg/cm^2 to 3.3 mg/cm^2 dust. Plants with higher chlorophyll and ascorbic acid contents are thought to have more pollution scavenging potential. A green belt plan for two important roads is suggested.

Key words: Plantation, Pollution, Eco-city, Vadodara, Busy roads, Raopura, Alkapuri, *Ficus benghalensis*

SIV/P-57

Microbial Composition of Water and their Impact on Human Health of Bharat Kund Pond of Faizabad District (U.P.), India

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The Bharatkund pond situated in south of Faizabad district of UP, has been described in the holy book Ramayan. Lord Bharat was related to Ayodhya, place which was the Capital of Awadh in Ancient time.In unpolluted water there are usually low organic nutrients. In such water autotrophic bacteria are common alongwith free living protozoans such as Euglena, Paramecium and various amoebae. Among the bacteria are sulphur bacteria, iron bacteria, free-

living spiral forms and some spore formers .In polluted water , there are large amount of organic matter from sewage, faeces and industrial Waste. The microbes present in such water are usually heterotrophic. Pathogenic organism enter the water through sewage contamination or discharge from animals or humans into reservoirs. The coliforms (*Escherichia coli*). *Streptecoccus faecalis* and C*lostridium perfringens* which are normal inhabitants of the large intestine of animal and humans enter the water Supply through faecal contamination.

Key words: Water bacteria, Sewage, Pathogen

SIV/P-58

Pollen Morphological Study of Selected Cotton Varieties (Malvaceae)

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The pollen morphology of eight selected cotton varieties viz., AKH-081, DHY-186 and PA-348, Ankur-216 and Kaveri-Kurnel, H-8, H-10 and LRA-5166 has been studied by Light and Scaning Electron Microscopy. All the selected varieties showed slight variation in terms of shape, size, aperture and exine ornamentation. Pollen grain in the all varieties of cotton are in the range of (P/E) 25.0 - 37.85 × 26.60 - 34.85µm. The shape of the pollen grains varies from sub oblate, oblate spheroidal to prolate spheroidal. Aperture pattern pantoporate, pores numerous. Exine 5-6µm thick, echinate, nexine as thick as sexine. SEM represents minor important features of pollen grains that were not found in LM observations and found to be vital instrument in studying pollen characters at high magnifying level.

Key words: Pollen Morphology, Cotton, LM, SEM

SIV/P-59

Contribution of PSB in Reducing the Requirement of P Fertilizer in Potato Production in Mid Hill of Himachal Pradesh

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Phosphorus is one of the key nutrients required for higher and sustained productivity of potato and its influence on tuber yield is very well established. The soils of North-Western Himalayas are acidic in nature and therefore, more P fixation take place due to presence of Al and Fe compounds which convert it into insoluble form. As a result most of the P applied is rendered in fixed form and unavailable for crop uptake. Thus, soils commonly have large reserves of 'fixed' P that could support long term crop requirements which could be mobilized through use of phosphate solubilizing bacteria (PSB) which converts insoluble forms of phosphorus to an accessible form and make the phosphorus available to plants from soil. Field experiments were conducted at Shimla **during 2008 - 2011 to investigate the role of phosphorus** solubiliz**ing bacteria on P economy in potato. T**he crop was grown during April following recommended package of practices**. The eight manurial treatments involving different levels of P through inorganic fertilizer *viz*., control, 25% P, 50% P, 75% P and 100% P with and without PSB inoculation were tried in** randomized block design with three replications. Application of 100 kg P_2O_5/ha (100% dose of recommended P) along with PSB inoculation gave highest tuber yield (216 q/ha) which was statistically at par with 100% P (206 q/ha). Application 100% P was statistically was at par with 75% P + PSB (203 q/ha). Higher mean of yield, phosphorus uptake, phosphorus use efficiency and apparent nutrient recovery were observed with seed inoculation with PSB as compare to without PSB. The results of this study indicated the beneficial effects of PSB inoculation on tuber yield and 11 to 18% of recommended dose of P can be saved with the seed inoculation by PSB.

Key words: Phosphobacteria, Phosphorus application, Potato, Tuber yield, Uptake

SIV/P-60

Antibiotic Resistance among Fecal Indicator Bacteria Isolated from River Yamuna, Delhi Stretch

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Antibiotic resistance is a global issue of concern. In present study, the Antibiotic resistance pattern of

fecal indicator bacteria isolated from Delhi stretch of River Yamuna from seven different sites has been determined. A total of 28 isolates were identified on the basis of morphological and biochemical characteristics. Antibiotic susceptibility of the isolates was tested by Kirby Bauer disc diffusion method. Antibiotic disc used were Amikacin (30mcg), Ampicillin (10mcg), Chloramphenicol (30mcg), Co-Trimoxazole (25mcg), Gentamicin (10mcg), Kanamycin (30mcg), Streptomycin (10mcg), Tetracyclin (30mcg). Percentage resistant and intermediate resistant to all evaluated antibiotics was shown as Amikacin (Resistant: 7.14%; Intermediate: 78.57%), Ampicillin (Resistant: 50%; Intermediate: 21.42%), Chloramphenicol (Resistant: 7.14%; Intermediate: 78.57%), Co-Trimoxazole (Resistant: 28.57%; Intermediate: 7.14%), Gentamicin (Resistant: 7.14%; Intermediate: 14.28%), Kanamycin (Resistant: 14.28%; Intermediate: 57.14%), Streptomycin (Resistant: 17.85%; Intermediate: 17.85%), Tetracyclin (Resistant: 35.71%; Intermediate: 14.28%). The study indicates a significant level of resistant and intermediate resistant bacteria in River Yamuna, Delhi and its imperative to determine the overall microbiological quality of river water.

Key words: Antibiotic resistance, Fecal indicator bacteria, Yamuna river, Microbial water quality

SIV/P-61

Biomedical Solid Waste Management in BRD Medical College Gorakhpur: A Case Study

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The objectives of this study were: (i) to assess the waste handling and treatment system of hospital bio-medical solid waste and its mandatory compliance with Regulatory Notifications for Bio-medical Waste (Management and Handling) Rules, 1998, under the Environment (Protection Act 1986), Ministry of Environment and Forestry, Govt. of India, at the chosen BRD Medical College Gorakhpur India and (ii) to quantitatively estimate the amount of non-infectious and infectious waste generated in different wards/ sections. During the study, it was observed that: (i) the personnel working under the occupier (who has control over the institution to take all steps to ensure biomedical waste is handled without any adverse effects to human health and the environment) were trained to take adequate precautionary measures in handling these bio-hazardous waste materials, (ii) the process of segregation, collection, transport, storage and final disposal of infectious waste was done in compliance with the Standard Procedures, (iii) the final disposal was by incineration in accordance to EPA Rules 1998, (iv) the non-infectious waste was collected separately in different containers and treated as general waste, and (v) on an average about 520 kg of non-infectious and 101 kg of infectious waste is generated per day (about 2.31 kg per day per bed, gross weight comprising both infectious and non-infectious waste). This hospital also extends its facility to the neighboring clinics and hospitals by treating their produced waste for incineration.

Key words: Bio-medical waste, Infectious waste, Human health, Hazardous waste

SIV/P-62

Correlation between the Sources of Carbohydrate Assimilation and Spoilage of Food Items by Pathogenic and Non Pathogenic Yeast

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Biologically active compounds are extra nutritional constituents that typically occur in small quantities in foods, vary widely in chemical structure and beneficially affect health and well being. Nutritional yeast is the powerhouse of nutrients and it's a great addition to healthy life style especially for the vegetarians. Nutritional yeast is deactivated yeast, often a strain of *Saccharomyces cerevisiae* , which is sold commercially as a food products. Some of the sub species of *Crytptococcus neoformans* are pathogenic for the human immune system. Yeasts for obtaining energy undergo assimilation reaction i.e break down of carbohydrate into its monomeric unit by various enzymatic activities produced by various yeasts. In the present study carbohydrate assimilation was studied by using different food products having pathogenic and non pathogenic yeasts. All the17

isolates of pathogenic yeast were used and two sub species of *S. cerevisiae* and *Rhodotorulla* which were isolated from yeast powder and curd respectively. It was seen by the use of spectrophotometer i.e. if the isolate has greater efficiency to assimilate food products then that food product having specific carbohydrate will be easily spoiled by the yeast. It was revealed by results that all the pathogenic yeast has high absorbance efficiency for fructose. It has been statistically proved't' calculated value (6.68) is greater than value of tabulated value (2.05) at 5% level of significant. The Rhodotourla obtained from curd sample, have high absorbance value (0.83) at is more favourable in food fermentation when food ingredients contains honey as energy. In milk proper absorbance value not obtained, indicating that Rhodotourla can be utilized in fermentation but not too much extent.

Key words: Yeast, Carbohydrates, Assimilation, Pathogenic, Non pathogenic

SIV/P-63

Isolation Identification and Characterization of Thermophilic Fermenting Yeast from Jaiselmer

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Due to a current challenge of increasing global temperature, thermo-ethanologenic yeasts receive considerably interest nowadays. In this study, 10 yeast isolates were checked for their thermophilic growth at temperature 400-450C four of them were selected for their fermentative capacity and ethanol tolerance at high temperatures. Only JCY2 was able to grow at 450C. Four isolates JCY2, JCY3, JBY1, SF112 performed significantly well (at the 95% confidence level) in fermentation at 430C. Of which JCY2was able to tolerate up to 20% v/v ethanol as compared to *S. cerevisiae*. Therefore only one isolate having high ethanol tolerance activity was selected indicating the further application feasibility of this yeast for ethanol production at high temperature was characterized.

Key word: Yeasts, Thermophilic, Ethanol

SIV/P-64

Different Strategies to Explore the Diversity of Soil Microbial Community

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Soil is a dynamic and complex system of microbial habitat. Traditional culturing methods cannot be fully describing the diversity of microbial world. To expand knowledge about soil microbial diversity several advanced techniques came in light from time to time with gaining advantages in exploring microbial diversity. These advanced techniques have been categorized under three different approaches - Genetic, Structural and Functional diversity. Under genetic approach Denaturant Gradient Gel Electrophoresis (DGGE), Terminal-Restriction Fragment Length Polymorphism (T-RFLP), Amplified Ribosomal DNA Restriction Analysis (ARDRA), Ribosomal Intergenic Spacer Analysis (RISA) is included. Fatty Acid Methyl Ester **(**FAME) and Phospholipid Fatty Acid Analysis (PLFA) are the methods to measure the structural diversity of soil profile. Enzymes activity Substrate Induced Respiration (SIR) Technique and Biolog assay to measure Carbon Source Utilization Pattern in soil are the functional approaches of diversity analysis. Apart from these techniques Soil Metagenomics is an approach with highly significant data in structural and functional diversity analysis of environmental samples. Thus all these strategies will open the door for climate change study with most reliable results of microbial contribution in nutrient dynamics and soil organic matter (SOM) pool.

Key words: Microbial diversity, DGGE, PLFA, Carbon source utilization pattern, Structural diversity, Functional diversity, Soil metagenomics

SIV/P-65

Basal Respiration, Soil Microbial Biomass and Enzymatic Activities of Natural Forest Types of North India

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A major portion of terrestrial ecosystem is covered by forest land in India. Different forest types have different dominant tree species differ in litter quality and root exudates, thereby exerting species-specific impact on soil properties and microbial activity. This study examined the influence of forest type on soil physio-chemical properties and its relationship with microbial characters among the selected forest types. The different forest sites selected for the study have been covered by dominant species, Sal *(Shorea robust)*, Pine *(Pinus roxburghii)* and Oak *(Quercus floribunda and Quercus leucotrichophora)*, respectively. The stands dominated by pine and oak are clustered together in the temperate region, while the sal dominated stands are dry deciduous in nature. The two region share different forest age and soil type and have variation in precipitation and temperature. We assessed soil physio-chemical properties among the selected forest sites that mainly include basal respiration, MBC(microbial biomass carbon), MBN(microbial biomass nitrogen), MBP(microbial biomass phosphorus) and enzyme activities. As a consequence of climate change and complexity in soil dynamics, the relationship between different soil characters and microbial activity cannot be measured accurately. The present study provides a base line conclusion about the influence of specific forest type on soil physio-chemical and biological condition.

Key words: Soil microbial biomass, Physio-chemical, MBC, MBN, MBP, Enzyme activity, Basal respiration

SIV/P-66

Need of Diversified Agriculture in Eastern UP for sustainable Development

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Agriculture play important role in our country development. Total aggregate of 13-14% in our GDP comes from agriculture. Today agriculture is not only a base of our country economy but also the mirror of our culture, civilization and lifestyle. Total 16% agriculture products contribute in our national exports and we are leading in milk, milk products, fruits, vegetable, tea, jute, mango, banana, sugar and coconut etc in the world scenario. But now-a-days the change in climate and environment our agriculture practices needs change fo sustainable development. Everything can wait but agriculture does not. According to a survey we needs 30 crore tonne food requirement till 2025. To fulfil this target 4% increase/year is necessary in our agriculture sector. This target can be achieved by adaptation of sustainable agriculture practices. The following recommendation must be followed for sustainable agriculture, e.g. crop diversification, conservation, fustigation, integrated water management, integrated nutrient and pest management, use of bio-fertilizer, bio-fuel, use of biotechnology in gene transfer for high yielding and disease free varieties, role of agro-forestry in agriculture, use of agriculture engineering in agronomical practices, nutritive fodder production, development of new varieties, priority on dry land agriculture, role of electronics media and computer in agriculture. All these recommendation not only increase in the production but also protect our environment for our coming generations.

Key words: Sustainable agriculture, IPN, IPM, Water conservation, Bio-fertilizers, Nutrient management, Environment conservation

SIV/P-67

Reviewing Impact of Petroleum Vapours and its Regulation

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Petroleum is one of the most precious non-renewable resource and should be conserve by all means. Reducing its evaporation loss at retail outlet across the country will not only eases economic burden but also advantageous in reducing air pollution. The objective of this paper is to put forward various regulations and practices which can be impose on oil marketing companies to reduce such emissions throughout its retail chain. Such emissions are not only carcinogenic but also have appalling safety and environmental concern. Stock Storage Tank Breathing phenomenon is discussed. Volumetric thermal expansion loss is approximated to infer cost saving

and calculate project implementation recovery.

Key words: Floating roof tank, Vapour recovery system, MDG, Stock loss

SIV/P-68

Study of Measures to Recycle Solid Waste

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There has been an exceptional growth in industrialization and urbanization in India over a last few years, leading to increase in generation of waste on a large scale. Due to decrease in the availability of land space in the country, landfilling these solid waste is not a sustainable solution. The urban population growth in India is predicted to grow at the rate of 30 percent by the end of 2015, which only magnifies the issue. Burning off the solid waste is not an ecological solution since it leads to air pollution which is equivalent to vehicular emissions. Municipal waste management has always been at the top of the agenda of various municipalities but have struggled to find a sustainable way to manage the waste.

Recycling or reusing of the solid waste might be an answer to a completely sustainable solution for solid waste management. A 3R (reduce, reuse and recycle) model should be incorporated in order to get viable solution and decrease the burden on the overflowing landfills. Reusing or recycling has not only answers to solid waste management but also has an impact over many ecological and social issues. With great improvement in the technology and infrastructure in recent years, sustainable solution of waste management by using 3R model is not unattainable.

This paper emphasizes on the current scenario of the measures been taken for reusing and recycling the solid waste and the study of feasibility of the 3R model for waste management in India.

Key words: India, Sustainable, Reuse, Recycle, 3R

SIV/P-69

Critical Analysis on the Impact of Pollution on Marine and Coastal Environment

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Due to advancement in recent technologies, pollution of water bodies near the coastal areas is a major concern to the society. Increasing population growth along the Urban and Coastal areas pose a great threat to the productivity of marine ecosystems. Pre-immersion, Immersion and post immersion of idols are also on a rising scale which poses a great threat to marine and aquatic life and hence there arises a need for Water Quality Assessment (WQA). The presence of plastic debris also affects the aesthetic and recreational value of marine life which causes a huge economic loss to bio-diversity. The recent pictures of tanker collision are vivid examples. Another main reason for concern about marine pollution is related to the direct effects of pollution on human health. Because many pollutants accumulate in marine organisms, humans are exposed to pollutants when they consume food from polluted areas. Most sources of marine pollution are land based, such as wind blown debris, industrial and domestic pollutants discharged and potential spill overs from freight/ bulk ocean carriers. In this study, we have tried to critically analyse the overall impact of natural and man-made activities which are the main cause of pollution affecting the marine and coastal life and in what way we can reduce the impact by following a balanced approach.

Key words: Pollution, Aquatic life, Marine pollution, Coastal life, Human health

SIV/P-70

Plant Gums-A Biomaterial for Substitutional Ingredient in Sanitary Products

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Recently, there is an urge and awareness towards sanitation and hygiene issues along with concerns towards environment polluting products that cause microbial contaminations leading to climate change. Poor sanitation, hygiene and related products in developing countries has been an insufficiently acknowledged problem which is currently made obvious. In India, there are some traditional old strategies which offers no protection, endangering

hygiene and reproductive health. In sanitary products, polyethylene, plasticizers, polyurethane, polyacrylates and recently starch, carboxymethylcellulose salts, cellulose, resins have been used in diapers and sanitary napkins and variety of products as absorbent materials for body fluids in the medical field, water sealing materials, freshness-retaining materials, moisture retaining in cosmetics, dehydrating agents and other industrial sectors. Some of the harmful chemicals have been found in sanitary napkins are: dioxin, rayon, pesticides, herbicides, artificial fragrances and deodorant which lead to toxic shock syndrome and sudden fall in blood pressure. Moreover, there is lack of development of scientific validated and standardized cost effective environment friendly biodegradable sanitary products for health and hygiene issues. Recent, trends is towards the use of plant based and natural products that demands the replacement of synthetic additives. Plant gums are important biomaterial/ agro- phytochemicals of high molecular weight polysaccharides which are GRAS (Generally Recognized as Safe). These not only provide improved hydro-gelling, water holding, moisture retaining, suspending, binding and encapsulating properties but also the medical health benefits including prevention and/or treatment of certain diseases. At present, there is little value addition .They possess unique functional properties and there exists lot of scope to enhance absorption properties to many folds through depolymerization, derivatization and transformation. There exists a specific chemistry and mechanism of action to behold water absorbency of the material. Hence to address the problems, studies have been proposed on some lesser exploited gum sources as *Cassia, Acacia, Tamarind, Sterculia*, and *Trigonella* using standard evaluation guidelines and pharmacopoeias. Researches are under scope for selection of abundant, available, eco-friendly plant gums with superior water absorbing capacity and explore them as potential biomaterial for substitutional ingredient in sanitary products to develop safe biodegradable products for self-sufficiency and economic growth.

Key words: Biomaterial, Derivatization, Gums, Sanitary products, Water absorption

SIV/P-71

Land Use Affects Fungicide Degradation and Microbial Resilience

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Agricultural reinforcement introduces many agrochemicals in fields that reduce the diversity of soil micro biota. The vicious use of fungicides for control of fungal pathogens has inflicted serious harm and problems to soil and human health. Carbendazim is a broad-spectrum systemic fungicide with protective and curative action and is used for the control of a wide range of fungal diseases such as molds, spot, mildew, scorch, rot and blight in a variety of crops. It has a long half-life of 3-12 months and does not get leached from soil, due to its strong adsorption to soil. Since carbendazim directly affect the microbial diversity and influence functions of the ecosystems its' potential degradation and harmful effect on soil microbial community was studied in two land use system. Leaving fallow soils has been reported to increase mineral nutrients in soil and increase yield, however toxicological effects of residual agrochemicals on microbial diversity under these conditions is not known. Thus the present study was aimed to assess the changes in extractability of Carbendazim and effect on microbial diversity from fallow soil and maize rhizosphere soil. Higher persistence of Carbendazim and its degradation products was observed in fallow soil than in rhizosphere soil. In the rhizosphere soil the HPLC peak heights of Carbendazim were found to have decreased by around 3 times as compared to initial and fallow soil. Principal component analysis (PCA) of the substrate utilization pattern separated the microbial communities into three groups; uncontaminated rhizosphere soil forming a first cluster, rhizosphere soil with 100 μg ml^{-1} carbendazim formed the second cluster and fallow soil with or without carbendazim formed the third cluster. The first two factors of the PCA scales separated at 57.69 and 18.74% respectively. It was inferred from the present study that leaving pesticide contaminated fields fallow may

prolong the presence of residual pesticides in soil and reduce soil microbial resilience and diversity.

Key words: Carbendazim, Fallow soil, PCA, Accumulation, Agrochemicals

SIV/P-72

Physiological Parameters for Evaluating Terminal Heat Stress Tolerance in Durum Wheat Varieties Grown in the Field Conditions

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A physiological approach can complement empirical breeding and can enhance the rate of yield improvement under late sown terminal heat stress conditions by identification important physiological traits associated with heat stress tolerance applicable on field. Durum wheat is an economically important crop contributes about 8% of the total world wheat production it is an important crop for the human diet (e.g., pasta, couscous, bread, etc.) good source of protein, total carotene (yellow pigment), vitamins and other minerals along with better adaptability to overcome the heat stress. This investigation was carried out under field conditions at IARI, Regional station Indore. Five heat stress tolerant and five heat stress susceptible cultivars of durum wheat which were selected base on the earlier performance of the yield. Canopy temperature, Chl Fluorescence and other yield contributing parameters were measured at vegetative, pre anthesis, post anthesis (grain filling stages) and after harvesting. Our findings showed that heat stress tolerant and susceptible cultivars shows significant difference in their physiological parameters. More reduction in all physiological characters was recorded in heat susceptible cultivars while exposed to heat stress and susceptible variety DBP 02-08, Malvi local and Sawer local, which showed also more reduction in yield and yield components. Heat stress tolerant HI 8691, MACS 3125 and HI 8627 were more stable and showed better adaptation and comparatively better physiological performance and higher yield under heat stress condition. This study emphasis on the importance of these traits particularly for breeder for improving heat stress tolerance durum wheat genotypes to compete with the changing scenario of the World climatic conditions.

Key words: Canopy temperature, Chl fluorescence, Grain yield, Terminal heat stress durum wheat

SIV/P-73

Indicative Value of Modern Non-Pollen Palynomorph Deposition in Paleoecological Reconstruction: A Case Study from the Darjeeling Foothill Region

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Use of the non-pollen palynomorphs (NPP) as a tool for palaeoecological indicators is growing rapidly due to their potential to complement palynological reconstructions of past environment. To understand the principal factors (whether anthropogenic or environmental) involved in sedimentation of these NPPs, a study using surface samples from different vegetation types as well as environmental condition is needed. Here we analyzed surface samples from two different forests (i.e. Sukna and Mahananda Wildlife Sanctuary) of the Darjeeling foothill region, eastern Himalayas to test the potential influence of sampling sites, vegetation types and anthropogenic influence on the sedimentation of NPPs to obtain a modern analogue model of NPPs. Surface samples from the above-mentioned forests yielded diverse NPPs including algal morphs (freshwater dinocysts like *Gymnodinium*, *Peridiniopsis* and other freshwater algal morphs i.e. *Peridinium*, *Cosmarium*, *Spirogyra* and *Zygnema* etc.), fungal spores (*Ascodesmis*, *Astraeus*, *Delitschia*, *Gelasinospora*, *Tilletia*, Gasteromycetes and Russulaceae etc.), pteridophytic spores (*Asplenium*, *Athyrium*, *Blechnum*, *Thelypteris*, *Pteris* and *Pteridium* etc.) and phytoliths (grass and non-grass types). It was observed that in addition to common depositional factors, water availability, openness of the landscape and anthropogenic activities influenced the NPP assemblage in the soil. The study may help to enrich the knowledge of the indicator value of NPP's and which further may aid palaecological studies from this part of the eastern Himalayas.

Key words: Non-pollen palynomorphs, Indicative value, Palaeoecology, Darjeeling foothill region

SIV/P-74

Modern Pollen-Vegetation Relationship in Tropical Deciduous Forest of Central Uttar Pradesh, India: A Reliable Measure for the Palaeoecological Studies

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The paucity of modern pollen-rain data from the Central part of Uttar Pradesh is a significant barrier to understanding the Late Quaternary vegetation history of this globally important, northern region of India. The relationships between current vegetation, the available environmental data and modern pollen are examined in Lucknow for both natural and human-induced vegetation types, as an aid for palaeoenvironmental reconstructions. A dataset of 25 surface pollen samples has been documented from the conserve forests of Kukrail, Lucknow (part of Central Ganga Plain). The palynodata reflects the mixed deciduous forest composing of *Butea*, *Salmalia*, *Acacia* and *Syzygium* under warm and humid climate in response to rainfall variations in the region. High monsoonal activity in and around the region is well identified due to presence of *Syzygium*-Moraceae-Euphorbiaceae assemblage in the sediments. Striking signal of winter dryness is well viewed in the palynoassemblage especially observed through Chenopodiaceae and *Artemisia*. The regular presence of pollen grains of conifer and other broad leaved taxa namely *Pinus*, *Quercus*, *Alnus* and *Betula* are suggestive of high wind activity from the higher altitude. Anthropogenic activity is in continuous pace and is reflected by the higher frequencies of Cereal pollen (15-25%) and Brassicaceae (2-5%). The contrasting frequencies of extant floral taxa recovered in form of pollen in varied surface samples are evidence of differential pollen production, dispersal and deposition. Therefore, for the very first time, attempt has been made to precisely observe the behavioural pattern of modern pollen deposition which could be helpful in assessing the expanse of pastoral practices, depth of deterioration of pristine forests as well as reconstruction of past climate and vegetation in Central Ganga Plain, India.

Key words: Central Ganga Plain, Climate, India, Kukrail, Lucknow, Palynodata, Surface samples, Vegetation

SIV/P-75

Comparative Analysis of Antioxidant Potential of Essential Oil and Water Extracts of *Hyptis auaveolens*

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Aromatic and medicinal plants have been the source of medicine to mankind since ages. These serve as the only source of medicine to the aboriginals and tribal people. Besides, being the source of medicine, these may also serve as the good source of antioxidants - the compounds that delay or inhibit the formation of free radicals. Owing to environmental pollution and life style changes, human are continuously being exposed to the toxic compounds resulting in excessive generation of free radicals in their body. The natural antioxidant mechanism is a part of all biological systems is not sufficient to combat them (free radicals). Hence, antioxidants are required from external sources either in the form of diet or medicine. A number of synthetic antioxidants used by the human beings to neutralize the free radical effect, have proven to be toxic and hence are not recommended. There is, thus, a great need to explore safer and non-toxic antioxidants and the plants especially the medicinal and aromatic plants serve as the best source. Plant based antioxidants are not only non-toxic but also biodegradable. A variety of aromatic and medicinal plants have been explored in the past and others are being investigated. In this context, a study was conducted on exploring the antioxidant and free radical scavenging potential of *Hyptis suaveolens*, an aromatic member of family Lamiaceae. The essential oil and water extracts prepared from the plant powder (PP) and residue powder (RP) were tested for various antioxidants properties determined through 2, 2-diphenyl-1-picrylhydrazyl (DPPH), hydroxyl radical ($^{\bullet}OH$) assay, hydrogen peroxide assay (H_2O_2), Iron (Fe^{2+}) chelating activity, total antioxidant activity (TAA) and ferric ion reducing power (FRAP) at different concentrations.

The antioxidant activity of both essential oil and water extracts (PP and RP) increased in a dose dependent manner. It was thus made evident that *H. suaveolens* possesses good antioxidant potential and could thus be exploited as a natural source of antioxidants.

Key words: Free radicals, Antioxidant potential, Essential oil, Water extracts

SIV/P-76

Development of an *In vitro* Strategy for Germplasm Preservation of *Glycyrrhiza glabra* L. An Important Medicinal Plant

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Glycyrrhiza glabra (Licorice) is an endangered medicinal plant and placed in red data book. Licorice root is a traditional medicine used in various diseases; roots contain the glycoside, glycyrrhizin which has a similar structure and activity as the adrenal steroids.

So there is an urgent need to conserve this plant. *G. glabra* is predominantly propagated through vegetative parts, mostly rhizomes, stolons or other cuttings but propagation methods are destructive and slow. For maintaining the germplasm, large number of subcultures was required and at each step risk of contamination was increased and this may lead to loss of genetic material. Therefore, for optimizing *in vitro* conservation protocol, the protocol should provide maximum survival rate of plants with minimum rate of recurrence of subcultures. In the present work, we have used slow-growth strategies for conservation of germplasm. Slow growth cultures were obtained by lowering incubation temperature and light intensity. Cultures were conserved for six month period with slow growth medium i.e. Modified MS with combination of 5.0 mg l^{-1} ancymidol, 0.1 mg l^{-1} abscissic acid and 1.0 mg l^{-1} polyethylene glycol under low light intensity (2.5 ìmol m^{-2} s^{-1} quantum flux density) and 10°C temperature. Among different combination of osmotic agents such as sucrose sorbitol and mannitol, 20 g l^{-1} of mannitol suited best for increasing the slow growth conservation period up to one year with only one subculture in a year. Shoots exhibited 100% survival and complete retrieval after conservation in a very low concentration of BA (0.1 mg l^{-1}) and IAA (0.05 mg l^{-1}).The successful plantlets were obtained in half strength medium with 0.25 mg l^{-1} BA, 1.0 mg l^{-1} IAA ,10 mg l^{-1} B-9 and 10 mg l^{-1} AdS. This research work provides a protocol for germplasm maintenance of this medicinally important and endangered plant.

Key words: Germplasm, Incubation temperature, Osmotic agents, Slow growth conservation, *Glycyrrhiza glabra*

SIV/P-77

Exposure Assessment of Mountain Peoples to Heavy Metals through Vegetables in Himachal Pradesh: A Case Study in Kullu Valley

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Consumption of vegetables contaminated with heavy metals is a major food chain route for human exposure. In the present study, the concentrations of Cu, Zn, Cd, Pb and Cr in most commonly consumed vegetables (tomato, cauliflower, radish and cabbage) by mountain people were quantified and their health risks were assessed by comparing the data with safe limits set by the Prevention of Food Adulteration Act (PFA), European Union (EU) and the Food and Agriculture Organization (FAO)/World Health Organization (WHO) and health risk index. Results showed that the concentrations of Cu, Zn, Cd, Pb and Cr ranged between 1.9 -56.9 mg/kg dw, 6 -87.7 mg/kg dw, 0.06 -5.7 mg/kg dw, 0.01 -7.6 mg/kg dw and 1.05 -8.9 mg/kg dw, respectively. Mean Cd concentrations in tomato and radish and Pb in radish were found to be above the safe limit set by the PFA. Mean Cd concentration in all the test vegetables had exceeded the safe limits set by EU and FAO/WHO. The results further showed that concentrations of Cu, Cd, Zn and Cr in test vegetables varied with seasons, but no consistent trends were observed. Consumption of test

vegetables contributes significant amounts of heavy metals to diets of both male and female. Health risk index values more than a unit indicate presence of health risks of contaminated vegetables. The study concludes that vegetables sold in mountain markets are contaminated with heavy metals, which further have potential for health risk of people.

Key words: Mountain markets, Heavy metal, Contamination, Vegetables, Health risks

SIV/P-78

Role of Soil Actinomycetes in Antimicrobial Activity against Multidrug Resistant Pathogens

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Soil is a diverse medium composed of many minerals and substrates essential for metabolic pathways of prokaryotic and eukaryotic inhabitants. The abiotic and biotic diversity present in this medium makes it complex for the isolation of all the microbial community present. Microorganisms like gram-positive, gram-negative bacteria and fungi have the ability of synthesizing antimicrobial agents. It was investigated that the top cultivable antimicrobial agent producers present in soil are the actinomycetes. The actinomycetes are a group of gram-positive bacteria that exhibit characteristics of both bacteria and fungi. Actinomycetes are also spore forming microorganisms, characteristic shared with fungi. Some of the characteristics that they share with bacteria are the formation and composition of the cell wall, the flagella and the ribosome. 10% - 33% of the total bacterial community present in soil is comprised of the genera *Streptomyces* and *Nocardia*, the most abundant actinomycetes found in soil. The genus *Streptomyces* is responsible of the synthesis of the majority of antimicrobial agents with clinical importance example:- Amphotericin, Erythromycin, Streptomycin, Tetracycline, and Rifamycin. Another group of gram-positive bacteria present in soil and responsible for the production of antimicrobial agents with clinical and agricultural importance is genus *Bacillus.*

Especially in hospitals, there are strains of *Staphylococcus* bacteria that are resistant to, not just one, but nearly all known antibiotics. Although most of the multiple-drug resistant *Staphylococcus* strains are only found in hospitals. The search for Novel antimicrobial agents with clinical importance is significant since many clinical pathogens such as *Mycobacterium tuberculosis*, *Streptococcus pneumoniae*, and *Staphylococcus aureus* are developing resistance to routine used antimicrobials. Therefore, in present research work attempts were made to isolate actinomycetes having antimicrobial activity against multidrug resistant pathogens causing various infections/diseases.

Key words: Actinomycetes, Amphotericin, Erythromycin, Streptomyces, Multidrug resistant pathogens

SIV/P-79

Antibacterial and Antioxidant Activity of *Sterculia foetida* L. Bark

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The aim of this study was to investigate the antibacterial and antioxidant activity of *Sterculia foetida* L. bark. Antibacterial and antioxidant efficacy of n-hexane and methanolic axtract of *S. foetida* was tested against *Shigella flexineri* (MTCC-9543), *Salmonella enterica ser typhi* (MTCC-733), *Bacillus subtilis* (MTCC-1305), *Streptococcus mitis* (MTCC-2897), *Klebsiella pneumoniae* (MTCC-109) and *Staphylococcus aureus* (MTCC-1144) using agar well diffusion method. The n-hexane extract of *S. foetida* showed high antibacterial potential (13 ± 0.24) against *Shigella flexineri* and its methanolic extract showed highest antibacterial activity (15.166 ± 0.20) against *Salmonella enterica ser typhi* with the concentration of 2 mg/ml. Tetracycline was used as srandard antibiotic drug. In this agar well diffusion method, the methanol extract of *S. foetida* was found to have a significant antibacterial efficiency than the n-hexane extract. These findings pinpoint the efficacy of these extracts to inhibit microbial growth. It may lead to the development of a new phytomedicine. Antioxidant potential of the extract was estimated on the basis of

the extracts scavenging activity and it was found that methanolic extract have more antioxidant value than n-hexane extract.

Key words: *Sterculia foetida,* Antibacterial, Antioxidant activity

SIV/P-80

Evaluation of Antioxidant and Antimicrobial Potential of *Leucas urticaefolia* (Lamiaceae)

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Leucas urticaefolia (Vahl) R.Br., commonly known as Goma or Guldora, is used for the treatment of diarrhoea, dysentery, uterine hemorrhages, dropsy, gravel, cystitis, calculus, bronchial catarrh, skin diseases, fever and mental disorder. The present study was designed to screen phytochemical constituents with antioxidant and antimicrobial activity of 50% EtOH extract of *L. urticaefolia*. Broad spectrum antimicrobial potential was exhibited in concentration dependent manner against *Staphylococcus epidermidis, Salmonella typhi* and *Candida krusei*. However, *Salmonella typhimurium* and *Aspergillus fumigatus* showed resistance at lowest concentrations but higher concentrations were effective in inhibiting both microorganisms. Total phenolic and flavonoid content were found to be 0.713% and 0.259% respectively. The different concentrations of extract showed dose dependent reducing power and free radical scavenging activity with IC_{50} 149.59 ìg/mL. HPLC analysis revealed the presence of important polyphenoles such as gallic acid, protocatechuic acid, chlorogenic acid, caffeic acid, rutin, ferulic acid and kaempferol, which may be attributed to antimicrobial and antioxidant activity of the extract. The observations provide sufficient evidences that *L. urticaefolia* might indeed be potential source of natural antioxidant and antimicrobial agents.

Key words: *Leucas urticaefolia,* Antioxidant, Antimicrobial agent

SIV/P-81

Allelopathic Effect of *Pluchea lanceolata* (DC.) C.B. Clarke an Invasive Plant on the Growth and Yield of Okra (*Abelmoschus esculentus* Linn.)

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New biochemicals, to which indigenous species are not adapted, are considered of great significance for success of invasive alien species in new host community (Novel Weapon Hypothesis). *Pluchea lanceolata*, an alien species is fast becoming an obnoxious weed in several areas of western Uttar Pradesh. A pot experiment was conducted to evaluate the impact of application of the aqueous extract of *P. lanceolata* (PLE) to okra. Stock PLE was prepared by soaking 100 gm shade dried leaves of *P. lanceolata* in 500 ml double distilled water for 48 hours. The stock PLE was diluted with double distilled water to prepare various dilutions of PLE 25%, 50%, 75% and 100%. Okra plants were raised in 10inch earthen pots filled with garden soil. There were three plants in each pot. The plants were sprayed with 10 ml PLE at 2 leaf stage, 15, 30 and 45 day stages. Growth and yield were evaluated in terms of root length, shoot length, root dry weight, shoot dry weight, leaf number plant^{-1}, number of fruits plant^{-1}, length of fruits, fruit dry weight, number of seeds fruits^{-1}, weight of seed fruit^{-1}, Chlorophyll 'a', Chlorophyll 'b' and total chlorophyll content. 25% PLE promotes all growth and yield parameters. Remaining three concentrations caused a decline in these parameters. The yield of okra, evaluated as fruit number plant^{-1} decrease by 18.51%, 40.74% and 57.4% in response to application of 50%, 75% and 100% PLE respectively.

Key words: Allelopathy, Alien, Extract, Invasive, Okra, *P. lanceolata*

SIV/P-82

Phenolic Composition of Seven Lichen Species and its Antioxidant Potential

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The phytochemical characterization and antioxidant potential of seven economically important lichen species were evaluated in three different solvent fractions. High performance liquid chromatography (HPLC) analysis of lichen species revealed the presence of phenolic compounds viz. Gallic acid, Protocatechuic acid, Chlorogenic acid, caffeic, Rutin, Ferulic acid, Quercetin and Kaempferol. The scavenging activities, 1,1-Diphenyl-2-picrylhydrazyl (DPPH) and 2,2'-azinobis-(3-ethyl benzothiazoline-6-sulfonic acid) diammonium salt (ABTS) exhibited high antioxidant action as compared to the studied metabolites. Amongst all the lichen species studied methanol fraction of *Flavoparmelia caperata* shows maximum ABTS and DPPH radical scavenging capacity as calculated by using ascorbic acid and quercetin as a control. The scavenging capacity of each lichen fractions (Acetone, Methanol and Hexane) were compared with individual scavenging capacity of the phenolic compounds. The significant correlation between antioxidant potential of lichen extract with individual phenolics shows the role of these compounds in conferring scavenging potential to the lichen species.

Key words: Lichens, DPPH, ABTS, HPLC, Scavenging potential

SIV/P-83

Variation in Soil Organic Matter Dynamics in Dry Tropics: Impact of Land use Change

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Land use change (LUC) has been considered to exert larger impact on soil organic matter (SOM) dynamics than projected climate change. Concerns have been raised for restoration of degraded ecosystems resulted from change in land use pattern of natural ecosystems. SOM, comprised of both the stable and the labile pools, plays a major role in C and nutrient cycling. Soil microbial biomass (SMB), represents the labile pool of SOM and has been considered as an important tool to predict changes in soil quality, whereas soil organic carbon (SOC), the stable pool, indicates the C storage status in soil. For designing long term restoration strategies, understanding of the impact of LUC on SOM dynamics through the soil profile is required especially in dry tropics. The broad objective of the present study was to evaluate the changes in SOM dynamics in terms of SMB and SOC dynamics in response to various land use patterns involving natural forest, degraded forest, agroecosystem and biofuel plantation in form of *Jatropha curcas* plantation in dry tropics. The experimental sites were situated at RGS Campus, Barakachha and forest of Marihan range, Mirzapur, India. Soil was sampled from three depths i.e. 0-10, 10-20 and 20-30 cm across all the land use patterns for analyzing SMB-C during rainy, winter and summer and SOC during summer only. Conversion of natural forest to agroecosystem resulted in highest loss of SOC, whereas it was lowest in biofuel plantation across the soil profile. SOC content was higher at upper layer and decreased with increasing soil depth across all the land use patterns. SMB levels were lowest during rainy season which increased through winter to the highest during summer across all the land use patterns. Levels of SMB were highest in natural forest through the annual cycle and across the soil profile, followed in decreasing order by biofuel plantation, degraded forest and lowest in agroecosystem. Since plantation of biofuel in degraded lands resulted in higher levels of SOC and SMB as compared to agroecosystem, it may be concluded that biofuel plantation in dry tropics holds promise in restoration of degraded lands.

Key words: Land use change, Soil organic matter, Soil microbial biomass, Soil organic C

SIV/P-84

Studies on Equilibrium, Kinetic, Thermodynamic Behaviors of Copper Metal Ions using *Dendrocalamus strictus* Charcoal Powder

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Copper, released into aquatic systems through natural and anthropogenic activities, upon entering the

living system can cause potential toxicity at higher concentrations while genotoxicity even at lower concentrations. Hence, there is need to explore the methods for removal of this metal or its ions from natural water bodies. The present study pertains to evaluate the adsorption behavior of copper using *Dendrocalamus strictus* charcoal powder following different conditions of pH, metal concentration, adsorbent dose, contact time and temperature. During adsorption studies, various isotherm models such as Langmuir, Freundlich and Tempkin were employed. Maximum adsorption of copper was observed to be 23.81 mg/g, at optimum condition pH (6-7), contact time (2 h), dose (0.2 g/100 ml) and temperature (25° C). Thermodynamic parameters, G^0, H^0 and S indicated adsorption of copper onto bamboo charcoal as feasible, spontaneous and exothermic in nature. Data analysis using pseudo-first and second order kinetic models revealed the pseudo-second order as the suitable model to describe adsorption. The study also included physical analysis of *Dendrocalamus strictus* charcoal powder using Scanning Electron Microscope (SEM) and Energy Dispersion Spectrometer (EDS) before and after the treatment. The results revealed that *Dendrocalamus strictus* charcoal could be used for the removal of copper ions from the water bodies.

Key words: Heavy metal, Isotherm, *Allium cepa,* Scanning electron microscope, adsorption

SIV/P-85

Plant-Based Squalene from Shed *Artocarpus* Leaves: An Environmental Credential for Safety, Supply and Cost

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Artocarpus lakoocha Roxb. is found to be a good plant source of squalene - an alternative to shark hunting. Squalene is found in small quantities in some vegetable oils, but its richest source is the shark liver oil yielding 99% of the product. From ecological perspectives the innovation of any commercially significant product from huge carpet of shed leaves of a tree could serve as a best 'green' alternate. The leaf extracts were fractionated following elutropic series and the purified compounds from hexane fraction of the shed *Artocarpus* leaves were subjected to mass spectra, infrared, and nuclear magnetic resonance (both ^{1}H and ^{13}C) for complete structural elucidation. Inhibition zone tests were used for microbial activity and the antioxidant activity was determined using the free radical, 2, 2-diphenyl-1-picrylhydrazyl. Spectral analysis revealed the shed leaves of *Artocarpus* as a considerable source of squalene (10-12% dry weight with 99.9% purity). This natural squalene exhibited potent anti-oxidative and anti-microbial activity. It inhibited the growth of *Sarcina lutea* and *Escherichia coli* and also retarded the growth of fungi causing aspergillosis. It showed significant antioxidant activity with IC50 value of 15.0 µg/ml, whereas tert-butyl-1-hydroxytoluene and ascorbic acid revealed 26.0 µg/ml and 5.0 µg/ml, respectively. It can therefore be concluded that recovery of squalene from a shed plant source could serve as an environmental credential for safety, supply and cost.

Key words: *Artocarpus lakoocha* Roxb., Squalene, Basking sharks, Antimicrobial, Antioxidant

SIV/P-86

Assessment of Grain Yield Components in Locally Adapted Rice Varieties

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Eighteen rice varieties were evaluated at research farm of Rajendra Agricultural University, Bihar, Pusa, India during wet season of 2011. The experiment was laid out in a randomized block design with three replications of 3m length. Row to row and plant to plant spacing were maintained at 20×15 cm. All the recommended agronomic practices were followed to raise a good crop. Observations were recorded for sixteen quantitative traits. Assessment about variance of eighteen locally adapted rice varieties indicated that all the varieties were significantly different with respect to all the sixteen quantitative characters which were studied. Biological yield plant^{-1}, grain yield plant^{-1}, number of effective tillers plant^{-1} and 100-grain weight had recorded high PCV, GCV, heritability and genetic advance as percent of mean. Grain yield plant^{-1} had a significant and positive association with

biological yield plant^{-1}, days to maturity, days to 50% flowering, leaf blade width, flag leaf width, number of effective tillers plant^{-1}, leaf blade length and panicle length both at phenotypic and genotypic level. The path analysis revealed that 100-grain weight, number of effective tillers plant^{-1}, leaf blade width, days to maturity, harvest index, days to 50% flowering, plant height and flag leaf length shows positive and direct effect on grain yield plant^{-1} at genetic level. Present study suggest that leaf blade width, number of effective tillers plant^{-1}, days to maturity and 100-grain weight should be given more emphasis during selection of parental lines for high yielding variety.

Key words: Rice, PCV, GCV, Correlation, Path analysis

SIV/P-87

Development of Protocol for Efficient Micropropagation of Rare and Important Medicinal Herbs of Muzaffarpur, Bihar: The Strategy of Conservation for Sustainable Future

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Plants are the lifeline for human beings as well as for any other animals on the earth. In spite of all they are being destructed by over exploitation for construction of roadways/ dams/ bridges, destruction of forests, global warming and climate change etc. and thus, they become rare, vulnerable, threatened, endangered and even extinct. Biodiversity hotspots around the globe are at risk and *in vitro* propagation methods have been used for rescuing and conserving endangered plants in many countries. Medicinal plants are also brutally exploited by laborers of Vaidya or by pharmaceutical industries. In the present work attempts have been made to develop an efficient micropropagation protocol for *Heliotropium indicum, Coleus sp, Centella asiatica* and *Bacopa monnerii* an important Ayurvedic medicinal herbs, using shoot apex and nodal explants.MS medium supplemented with 1.0 mg/l Benzyle Amino Purine (BAP) + 0.5 mg/l Kinetin + 0.2 mg/l Indole Acetic Acid (IAA) promoted the highest number of shoots from the nodal and shoot apex explants in comparison to other combinations in case of *Heliotropium indicum* after 30th day of culture .The multiple shoots elongated in the same medium on subculture.MS basal medium supplemented with 1.5 mg/l BAP +0.2 mg/l IAA was the most suitable medium among the all combinations in case of *Coleus sp*, as the highest number of axillary branches were obtained here. MS basal medium fortified with 2.5 mg/l BAP + 0.5 mg/l IAA induced highest multiple shoots in the nodal explants of *Centella asciatica*. MS basal medium supplemented with 0.3 mg/l BAP + 0.2 mg/l IAA was the most suitable combinations for the multiple shoot inductions on the nodal and shoot apex explants of *Bacopa monnerii*. In all the above experiments, it was observed that the nodal explants was more responsive in comparison to the shoot apex with respect to multiple shoot induction. These clusters of shoots were sub cultured for elongation and 40th day old plantlets were used for rooting in half strength MS medium supplemented with different concentrations and combinations of Auxins. Half MS medium supplemented with 0.2mg/l IBA was suitable for rooting in the plantlets of *Heliotropium indicum* while MS + 0.1 mg/l NAA or IAA induced maximum rooting in *Coleus* and half strength of MS +0.5 mg/l IBA induced maximum roots in both the plantlets of *Centella asciatica* and *Bacopa monnerii* respectively.

Key words: *Heliotropium indicum, Coleus forskoholii, Centella assiatica, Bacopa moneirii,* Nodal explants, Shoot apex, Micropropagation

SIV/P-88

Effect of Seasonal Environment on Microscopy and Chemical Constituents of *Tephrosia purpuria* (L.) Pers.

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Value addition of the medicinal plants is very much essential for commercial exploitation as well as the medicinal value of the raw drugs. The prevailing environmental factors during different seasons of the year could directly or indirectly affect the availability of some precursors that the plant needs for the biosynthesis of the active ingredients which are responsible for its biological activities but little is known about how such factors might inûuence a plant's

internal structure. Generally it is suggested that environment alone has diminutive effect on production of secondary metabolites. Seasonal variation in plant morphology and secondary metabolites has been a subject of considerable interest.

Tephrosia purpurea -'Sarapunkha' is used for the treatment of glandular swellings, splenic diseases, tumors, enlargement of liver and spleen, diabetes and skin diseases, since centuries. Recently, it has attracted the attention for its hepato-protective and stimulant activity. The present communication dealt with the environmental effect of season on microscopy and chemical constituents of *T. purpurea*. The plant material was collected in early summer, winter and rainy seasons. The microscopy showed variations in stomatal number and stomatal index which were more in early summer season as compare to winter and rainy seasons. The chemical markers identified through HPTLC were lupeol, rutin, rotenone and â-sitosterol. The quantity of these chemical markers varies from season to season. Rutin was maximum in early summer season i.e. 2076 µg/g and minimum in winter season i.e. 1169 µg/g while â-sitosterol was maximum in rainy season. However, lupeol and rotenone were found maximum in winter season i.e. 326 µg/g and 2482 µg/g respectively. From the ongoing studies it can be concluded that *T. purpurea* may be collected in winter season for hepatoprotective and anti-inflammatory activities while in early summer season for anticancer, anti-diabetic and antioxidant properties. Further, pharmacological investigations are required to validate these findings of 'Sarapunkha'.

Key words: *Tephrosia*, Seasonal environmental, Microscopy, HPTLC, Secondary metabolites

SIV/P-89

Natural Water Resources in Anthropecological Stress

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Man, the most destructive organism of the Earth has exploited the nature to such an extent that the natural resources have been forced to be in stress. All the natural resources are the precious gift of nature. This has been possible only because of appropriate distance between Earth and Sun and also due to its strong gravitational force, which keeps the atmospheric air, bound to it. Next to air, water is the most essential component of our ecosystem.Day by day all the natural water bodies are being ruined by anthropogenic pressure, either through encroachment or through industrial effluents. The situation has become so worse that more or less similar phenomenon is found to be operating all around.One of the examples which can be sited regarding encroachment is that seen in Ramgarh lake, a mighty lake in Gorakhpur. During 1916-17 the area of Ramgarh lake was 1980 acre, during 1971 it reduced to 1948 acre similarly by year 2002 its area reduced to 1800 acre and in the year 2007, the area has reduced to 1700 acre. Accelerated anthropogenic involvement has reduced the area of the lake to about 85% in the year 2007 as compared to its area in year 1916. Not only this government machinery it self is involved in this process, directly or indirectly. The solid waste of the city is dumped in to the lake, which promote the settlement of the slum-dwellers, initially; which is replaced by large and powerful builders in due course of time. For the study of water pollution river Ami, in Gorakhpur was selected, this is the river which passes through Maghar, the place where Kabeer took his last breath. The Physico-chemical properties of the water in river Ami were analysed fortnightly for a period of one year.The colour of river Ami at summer is dark yellow to blackish followed by winter season. During pre-monsoon period *i.e.* from the month of March to June the river water emits rotten sugar like smell. At the ends of rainy season odour of the water becomes fish like. The pH was recorded as high as 8.62, turbidity 16 mg/l,TS 2820 mg/l, TDS 2722 mg/l, Hardness 410 mg/l,maximum COD 370 mg/l and maximum BOD 190 mg/l. The study of change in water quality incurred in the river water after traveling through the distance of 21 km. from the last source of pollution reveals that 24.88% reduction in hardness, 4.59% reduction in TS and 34.36% reduction in the case of chloride occurred. At the same time variation in other parameters were discouraging as the pollution level of river was beyond the level of self-purification.

Key words: Anthropecoloy, Water, Ramgarh lake, Gorakhpur, River Aami

SIV/P-90

Improvement of Physical Environment of Sodic Soils through Adoption of Resource Conservation Approaches under Rice Wheat Cropping System

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Sodic soils are characterized with very poor physical structure and properties along with having high pH (>9.0) and very low percent of organic carbon content (<0.10%). Conventional practices of tillage and irrigation in rice wheat cropping system on these soils further deteriorates the soil structure. Rice cultivation done through wet cultivation which influences the soil water relation and affects water holding and transmission capacity of soil. On drying during wheat, these soils become compacted, hard and develop cracks of varying sizes. Tillage practices for wheat cultivation breaks the aggregates with high energy and exhaust the organic matter due to rapid oxidation. This also requires much time and labor input. These all activities led to soil degradation and deterioration of soil quality. Thus, there is a requirement to develop a sustainable cultivation system that is compatible with resources available and maintain the equilibrium with the present environment. In our experiment, use of 30% rice crop residue and zero tillage for wheat cultivation and dry ploughing, direct seeding of rice with/without *Sesbania* is found effective in improving the hydro-physical characteristics of sodic soils. Crop cover causes reduction in water loss. Minimum operational activities on soil reduced soil bulk density and penetration resistance. With the adoption of resource conservation techniques the hydraulic conductivity and infiltration rate increased about 6-7times over the control (conventional). The enhancement in organic carbon particularly in soil aggregates also increased in the plots where crop residue was applied with zero tillage practices. These practices however do not compromise with the rice wheat yield and gave at par results with conventional practice.

Key words: Rice-wheat, Crop residue, Zero tillage, Dry ploughing, Direct seeded rice

SIV/P-91

Varietal Evaluation of Gladiolus on Sodic Soil of Gangetic Plains of Uttar Pradesh

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In the modern era, floriculture is gaining much importance. The flowering industry has become a good source of income. Besides it also gives pleasure and happiness to human beings. A number of flowers are used for decorative purposes in homes. Gladiolus (*Gladiolus spp.*, family- Iridaceae) popularly known as the 'Sword Lily, is an ornamental plant having more aesthetic value, native to South Africa. It is grown in several parts of the world as a cut flower and a bedding plant. Most of the commercial cultivars of gladiolus are very attractive. Its elegant spike, richly varied in colour and along with it's vase life, are the reason for its ever increasing demand. Considering the potentiality of this floriculture crop which occupies the fifth place in the international floriculture trade, a field experiment was conducted during 2009-10 and 2010-11 on sodic soil at Banthra Research Station of National Botanical Research Institute, Lucknow, to study the comparative performance of nine varieties namely: Friendship, White prosperity, Red beauty, Picardy, Aldebran, Day dream, Green wood packer, White friendship and White goddess of gladiolus. During the investigation, results revealed that the pink colored friendship variety was found superior in respect of all growth parameters *viz*., plant height, leaf length and width, number of spike and it's length and diameter, number of florets followed by white colored white prosperity and red colored red beauty. Results revealed the suitability of these three varieties on sodic soil of Gangetic plain of Uttar Pradesh.

Key words: Gladiolus, Iridaceae, Floriculture, Sodic soil, Gangetic plain

SIV/P-92

Prospects of Mungbean (*Phaseolus radiatus*) for Intercropping with Spring Sugarcane to Assured Food Security

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Sugarcane an important agro-industrial crop plays a pivotal role in Indian economy since it provides raw-material to the second largest agro-based industry after cotton. Sugarcane has pronounced importance to provide sugar for more than half of the global population. World population is enhancing day by day and production land is in the worst situation. The cultivated land is diminishing rapidly due to urbanization, road construction and land deterioration. In India, intercropping of two or more crops is an old practice especially under normal and waterstress conditions. The system helps to improve utilization of natural resources, i.e. sunlight, land and water, and to combine cultural practices, often resulting increased productivity per unit area and time. With the limits on the availability of arable land and rapid increase in the population, intercropping needs to be adopted by farming systems for producing more food and other agricultural commodities from the same available area.Sugarcane is a long duration crop, planted in widely spaced (80-120 cm) furrows and usually irrigated with tubewell and/ or canal water. During spring season the initial growth of sugarcane is very slow and space between two furrows remains unutilized for nearly three months.Under such a scenario, if an intercrop like mungbean (*Phaseolusradiatus*) is taken during early growth period of sugarcane, it may give additional income to the farmers as well as protein rich diet alleviating protein malnutrition in rural masses. As mungbean is a pulse crop, therefore would also improve the soil fertility through nitrogen fixation. Thus by adopting intercropping of mungbean (*Phaseolusradiatus*) with spring sugarcane may provide an alternative way to food security as well as sugar security and also may uplift the socio-economic conditions of the farmers, contributing in the economic development of the state in future.

Key words: Sugarcane, Mungbean, Intercropping, Food Security, Future Prospect

SIV/P-93

Critical Assessment of Solar Power Based Electrolytic Defluoridation Plants in India

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Excessive intake of fluoride causes fluorosis, a disease affecting the multiple tissues, organs and systems in the body. Higher concentrations of fluoride in groundwater are a global problem, occurring in at least 25 countries across the globe and affecting millions of people. It is a threat to millions in the country as it ultimately leads to crippled and vegetative life. National Environmental Engineering research Institute (CSIR-NEERI), India has developed Electrolytic Defluoridation (EDF) technique for the treatment of excessive fluoride in water sources. The process is based on the principle of electrolysis by passing Direct Current (DC) obtained from solar photovoltaic cells through aluminium plate electrodes placed in fluoride containing water. During the process, aluminium plate connected to anode dissolves and form polyhydroxy aluminium species that remove fluoride in water by complex formation followed by adsorption and removal by settling. EDF technology provides a technically sound, cost-effective and reliable community drinking water Defluoridation system for supplying safe drinking water, which meets the guideline value (1 mg/L) of the World Health Organization (WHO) for fluoride. Solar power based electrolytic Defluoridation demonstration units were successfully installed at 4 places in India in the fluoride affected villages. Performance evaluation of these plants is being undertaken. It was found that EDF plants produce the treated water with fluoride less than 1 mg/L and 90 - 99% reduction in bacterial load from the raw water with the fluoride in the range 2 - 5 mg/

L and total coliform and fecal coliform counts in the range 120-630 CFU/100 ml and 70-100 CFU/100 ml respectively in raw water. Reduction in hardness and nitrate is also observed in treated water. The recurring cost for the treatment worked out for electrolytic Defluoridation demonstration plant is $ 0.4/m^3 of treated water which is much more less than the treatment cost by any other Defluoridation system available in the market. The capital cost of the plant is about $ 12000.

Key words: Electrolytic Defluoridation, Dongargaon and Usarvara villages, Fluoride in groundwater, Fluorosis, Solar energy

SV/KN-1

Deficiency and Toxicity of Micronutrients and Related Elements in Plants

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Many heavy metals are essential trace elements, but elevated concentrations are toxic. One central focus of our research is on the response of higher plants and algae to trace metals in terms of uptake, transport, sequestration, complexation, deficiency, toxicity and detoxification. These processes are decisive factors in plant nutrition because of vastly different (due to natural and anthropogenic influence) trace metal concentrations in various habitats, ranging from deficient to toxic levels.

In contrast to earlier studies in the field, we use conditions that allowed us to work also in the sub-nanomolar range and with a simulation of natural light- and temperature cycles. Thus, with the submerged water plant *Ceratophyllum demersum* as a model, we could show that heavy metal(loid) (As, Cd, Cr, Cu, Ni) concentrations that were previously considered as not having any effect actually have a strong impact on the plants, and with a different sequence of events than observed at very high concentrations. We used a combination of various biophysical and biochemical methods for measurements *in vivo* (e.g. photosynthesis biophysics, formation of reactive oxygen species, metal transport), *in situ* (e.g. quantitative (sub)cellular distribution and speciation of metals, mRNA levels) as well as on isolated proteins (for identification and characterisation of metalloproteins). For example, using metalloproteomics via native gels of protein extracts from plants that had been treated with heavy metals we are investigating the physiological and toxic binding of heavy metals to proteins. Analysis of pigments showed heavy metal-induced changes already at very low concentrations; this was reflected also by specific changes in biophysics of photosynthesis (e.g. spectral changes in non-photochemical quenching). As a result of the changes already mentioned, starch metabolism as well as production of reactive oxygen species were influenced by such sublethal concentrations of heavy metals and the metalloid arsenic in *C. demersum*. Our work in the sub-nanomolar range further showed that *C. demersum* stopped growth unless Cr(III) as Cr^{3+} or Cr(VI) as CrO_4^{2-} became available, as extrapolated from the growth decrease towards the lowest achievable Cr (0.17 nM). This was a surprise because Cr is not regarded as an essential nutrient for plants. Chromium deficiency was furthermore found, although not at severe likely due to lower demands comparable to the lowest achievable Cr concentration, in the crop plants *Glycine soja* (soybean) and *Triticum aestivum* (wheat). We isolated several proteins that bind Cr with high affinity, and are currently characterizing them.

Key words: Heavy metals, *Ceratophyllum demersum*

SV/O-1

A Responses of *Allium cepa* L. Root Meristematic Cells to the Arsenic (III) Contaminated Groundwater in Eastern Parts of Burdwan District, W.B., India: A Molecular Cytogenetic Approach

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Both Geogenic and anthropogenic activities have resulted in arsenic pollution of groundwater especially in the Eastern region of Burdwan district in West Bengal. Response of *Allium cepa* L. genetic material to the presence of potential cytotoxic and genotoxic substances in aquatic environment was used to evaluate the arsenic contaminated groundwater-induced genotoxicity and hormesis. Depending on the arsenic content, water samples collected from blocks Kalna I and II, Katwa I and II, and Purbasthali I and II were grouped into four sets viz. d"50µg/L, d"100µg/L, d"500µg/L and d"1000µg/L. For in situ monitoring of the cytotoxicity level, the inhibition of mitosis in root meristematic cells was assayed. To study genotoxicity, micronucleus assay and DNA purity assay (by $A_{260/280}$ ratio) were used. Treatment for 4 days of newly developed roots of *Allium cepa* L. with water samples with arsenic content d"50µg/L exhibited

stimulation in mitotic activity whereas samples with arsenic d"1000µg/L showed inhibition of mitotic activity apparently indicating hormesis. Inhibition of mitosis was compared with the concentration dependent increase in generation of reactive oxygen species (ROS), cell death, decrease in activity of antioxidative enzymes (catalase, superoxide dismutase), the absorbance ratio ($A_{260/280}$) of DNA, or micronuclei in root cells. These findings indicated that contaminated groundwater depending on the magnitude of the arsenic concentration, might either be mitogenic or mitostatic/toxic, which in turn has obvious implications in agriculture and human health.

Key words: Micronucleus, DNA purity assay, Hormesis, Genotoxicity

SV/O-2

Response of Duckweed to Lead Bioaccumulation and Potential Use as Bioindicator

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The fact that heavy metals content in water plants is mostly higher than in the waste water has led to use of hydrophytes as phytoremediators. Lead (Pb) is among the most notorious heavy metals as an environmental contaminant. Duckweed (*Lemna gibba* L.) is a small-sized fresh or wastewater floating macrophyte which inhabits stagnant to gently floating surface waters. The species showed the potential as heavy metals absorbent. This study aims at testing the response of duckweed to Pb pollution as bioaccumulator and bioindicator. Populations of duckweed were raised in growth medium under gradient of Pb concentrations ranging from 10 to 100 mg/L. Bioaccumulation, removal efficiency, pigment content, degreening and recovery of duckweed were monitored at intervals. The bioaccumulation of Pb in plant tissues increased from initial concentration 0.11 to 4.8 mg/g dry weight after 12 days, while values decreased with the increased concentration in the growth medium. The removal efficiency exceeded 90% at low Pb concentrations in the growth medium and was less than 30% at concentrations higher than 20% mg/L. Similar trend was observed for degreening of pigments which attained up to 94% during the first days and decreased with time and increased Pb concentration in the growth medium. Chlorophyll *a* content was higher than chlorophyll *b* and carotenoids at lower Pb concentrations and during the first growth days. The percentage recovery of stressed plants from excessive Pb bioaccumulation ranged from 40-58% and recovery from degreening ranged from 5-80% depending on the type of pigment. Due to the high removal efficiency of Pb, and the ability to recover from degreening and release of the excessive amounts from the plant tissues, duckweed is recommended as candidate for phytoremediation of polluted waters and use as biomentor or biosensor of heavy metal levels in waste and fresh waters.

Key words: *Lemna gibba*, Bioaccumulation, Removal efficiency, Pigments, Degreening, Phytoremediation

SV/O-3

Suitability of Treated Brewery Effluent as Liquid Fertilizer for Growth and Yield Improvement in Two Genotypes of Soybean (*Glycine max* L. Miller)

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Pot experiments were carried out to investigate growth, yield and seed nutritional composition of TGX 1987 10F (G1) and TGX 1987 62F (G2) genotypes of *Glycine max*, irrigated with water containing different concentrations of treated brewery effluent. Treated effluent collected from Nigerian brewery in Lagos State, was used to irrigate plants at 0% (control), 20%, 40%, 60%, 80% and 100% (v/v) in greenhouse studies. Number of leaves was significantly higher in both genotypes at all concentrations of effluent than in control. Growth parameters including leaf area, plant height, stem girth, root length, biomass and relative growth rate improved at 20-40% and 20-60% effluent in G1 and G2 respectively, but decreased at higher concentrations, compared to the control. Similar trend was also obtained in yield parameters: number of pods and seeds per plant, pod mass, seed mass and 100-seed mass. Comparatively, yield improvement was

better in G2 than G1, relative to their respective control treatment. Effluent led to an increase in leaf total chlorophyll of both genotypes up to 60% effluent, but decreased at higher concentrations. Percentage protein and lipid in the seeds of effluent-treated plants increased over that of the control, while percentage fibre was unaffected. Effluent increased the concentrations of heavy metals: Zn, Pb and Cu in the seeds, but not at a toxic level. N and P concentrations increased under all effluent treatments, while Ca and Mg only increased up to 60% effluent but decreased at higher concentrations. Na and K were not affected except for a slight decrease recorded at 80-100% and 100% in G1 and G2, respectively. Treated brewery effluent can serve as an alternative liquid fertilizer in improving productivity and seed quality of TGX 1987 10F and TGX 1987 62F genotypes of *Glycine max*.

Key words: Soybean, Effluent, Brewery, Fertilizer, Yield improvement

SV/O-4

Interaction of UV-B (285-325nm) Radiation and Phytohormones on Vegetative Growth, Photosynthetic Activities in a Few Crop Plants

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Due to anthropogenic release of chlorofluorocarbons, the stratospheric ozone gets depleted during the past few decades. The depletion of stratospheric ozone has led to enhanced amount of UV-B rays in the solar radiation impinging on the earth's surface. Enhanced UV-B radiation has been shown to be detrimental to both plant and animal systems. With regard to higher plants, the most vulnerable target sites of UV-B are the shoot apex, lamina and the PSII in chloroplasts leading to depression in overall growth and photosynthetic activity. Phytohormones play a vital role on the regulation of growth and development of plants. In the present study, an attempt has been made to understand the impact of phytohormones *viz.* salicylate and brassinosteroids on the alleviation of UV-B induced effects in a few crop plants like *Vigna mungo, V. unguiculata, V. radiata, Amaranthus* and *Mentha*.

Key words: Brassinosteroids, Chlorofluorocarbons, PSII, Photosynthesis, Phytohormones, Salicylate

SV/O-5

Residue, Dissipation and Safety Evaluation of Thiamethoxam and Lambda-Cyhalothrin in Tea

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Tea is one of the most popular consumed aromatic non-alcoholic beverages throughout the world. To ensure high-quality and quantity of tea production, tea plantation has mostly depended on the use of conventional broad-spectrum, synthetic pesticides, synthetic pyrethroids and a number of new chemical classes, such as neonicotinoids. Thiamethoxam [(*EZ*)-3-(2-chloro-1,3- thiazol-5-ylmethyl)-5-methyl-1,3,5-oxa-diazinan-4-ylidene(nitro)-amine] is the first commercial neonicotinoid insecticide which acts by binding to nicotinic acetylcholine receptors. Lambdacyhalothrin [(RS)-alpha-cyano-3-phenoxybenzyl-3-(2-chloro-3,3,3-trifluoropropenyl)-2,2,-dimethylcyclopropanecarboxylate] is a synthetic pyrethroid insecticide and acaricide used to control a wide range of insects and mites. An effective analytical method was developed for the determination and quantification of thiamethoxam and lambda-cyhalothrin present in mixed formulation Alika 247 ZC in green tea leaves, made tea, tea infusion using LC-MS/MS and GCMS/ MS in MRM mode respectively. The method includes extraction with acetonitrile for thiamethoxam and ethyl acetate: cyclohexane (9:1) for lambda-cyhalothrin separately followed by cleanup using dispersive solid phase extraction with PSA ,C18, GCB (excluding tea infusion) and activated MgSO4. The recovery percentage ranged between 85-110% for all matrices and correlation coefficient (R2) of matrix matched calibration curves were e"0.998. The method was also sensitive enough to set LOQ at 20 ng/g on green tea, made tea and at 10 ng/g for tea infusion for both test compounds. To evaluate its safety use, a multilocation

field dissipation study in tea was conducted at four locations (viz. UPASI-TRF, Vandiperiyar; UPASI-TRF, Valparai; Kamalpur Tea Estate, Darjeeling and Hantapara Tea Estate, Jalpaiguri) by following the above established method. The mixed formulation o f Alika 247 ZC in tea bushes was applied @ 33g and 66g a.i./ha. In case of thiamethoxam, the half life could not be evaluated as there was no residue after 1st day of application. In case of lambda-cyhalothrin half-life value was determined in the range of 1.97-2.85 days on made tea irrespective of any doses and locations. According to the EU, MRL of lambda-cyhalothrin was fixed as 1.0 mg/kg in tea, the preharvest interval was calculated in the range of 1.61-4.13 days for the present study. This experiment clearly revealed that this mixed formulation will not create any residual toxicity problem in tea plantation.

Key words: Tea, Thiamethoxam, Lambda-cyhalothrin, Residue, Half-life, Pre-harvest interval

SV/O-6

Toxicity of Pesticide Industry Effluent on Plant Growth and Metabolism of Mung (*Vigna radiata* L.) Plants and its Phytoremediation

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Chemical pesticides in excess amounts are highly detrimental for the environment, plant and human beings. Sometimes even low concentrations, pesticides proved to be quite toxic and even produce carcinogenic effects.

This aspect in view, an investigation was carried out to study the effect of pesticide industry effluent on growth and metabolic parameters in Mung plants. These plants when supplied with excess pesticide industry effluents, caused reduction in plant growth and the contents of chlorophyll, carotenoids, total sugars and protein concentrations. However, activities of two antioxidant enzymes, i.e. CAT and POD along with lipid peroxidation found to be enhanced.

Remediation of otherwise toxic effluent was observed when effluent were supplemented with a biopesticide i.e. neem (*Azadirachta indica* A.Juss). Almost all the studied growth and metabolic parameters such as photosynthetic pigments, protein and sugar contents were found to be enhanced with the supplementation of biological pesticide viz. neem. However, addition of neem was resulted into reversing the positive effects in the activities of two antioxidant enzymes viz. catalase and peroxidase and lipid peroxidation.

Thus it can be inferred that ill effects of chemical pesticide effluents can very well be negated or rectified by the introduction of a biopesticide (neem) in suitable amounts.

Key words: Biopesticide, Phytoremediation, *Vigna radiate*, Catalase, Peroxidase, Neem

SV/O-7

Effect of Lead, Cadmium and Thallium on Growth, Biochemical Parameters and Uptake in *Lemna minor*

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The toxicity and accumulation of lead, cadmium and thallium in the aquatic plant *Lemna minor* were investigated, using a modification of the Organisation for Economic Co-operation and Development (OECD) standard growth inhibition test. Plants were cultured in a modified Swedish Institute Standard (SIS) at pH 6.5 under 85 µmol m^{-2} S^{-1} at 25°C and exposed to a wide range of metals concentrations from environmentally realistic to very high concentrations (0.1, 1, 10, 100, 1000 and 10 000 µmol L^{-1}) for seven days. Various physico-biochemical endpoints were measured after seven days of exposure. The concentrations of dissolved lead, cadmium and thallium remaining in the residual solutions, and accumulation of lead, cadmium and thallium in fronds and roots were assessed using inductively couple plasma - Mass Spectroscopy (ICP-MS). Over the first four days of exposure, lead, cadmium and thallium concentrations in solution decreased rapidly and chlorosis was observed in fronds exposed to the three highest lead, cadmium and thallium concentrations. After seven days of exposure, there were significant

decreases in the relative growth rate (RGR), relative frond area (RFA), pigment content (chlorophyll a, b and total carotenoid) and activity of photosystem II (Fv/Fm) at concentrations of 100, 1000 and 10 000 µmol/L. Cellular concentrations of lead, cadmium and thallium were higher in roots than fronds, whereas more lead, cadmium and thallium were adsorbed to the extracellular matrix of fronds than roots. The bio - concentration factor (BCF; i.e. lead concentration in plant tissue at day seven relative to residual lead concentration in the growth medium at day seven) indicates that *L.minor* is a good accumulator of lead, cadmium and thallium but the physiological data shows that it is toxic at concentrations that can be encountered in wastewater treatment facilities. Therefore additional studies are required to evaluate the potential of *L.minor* for phytoremediation of wastewater contaminated by lead, cadmium and thallium, and of other metals.

Key words: *Lemna minor*, Heavy metals, Toxicity, Phytoremediation

SV/O-8

Impact of Vehicular Emission Particulate on Plants

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The plants are living bodies**.** Like human beings the plants are adversely affected by air pollution. The industrialization has become a major threat to the crop production. The plants respond abnormally in a behavior which is elusive and measurable. The damage to plants by air pollution is caused due to impediment in photosynthesis and respiration. Consequently, the resultant impact manifests in the form of chlorosis and necrosis of the plants.

The present study was conducted in the environment of Gaborone which is the capital city of Botswana. Botswana is a landlocked country in the Southern African region. Gaborone is a fast growing city mainly in the area of industry, mining and building construction. The number of vehicles has increased to over 300,000, Consequently the main source of pollution is due to vehicular emission.

The number concentration of airborne particulate with their sizes over a size range from 0.1 ìm to 5ìm and hence their size distribution, using automatic particle counters, have been continuously monitored over a period of about ten years. Simultaneously, using gas analysers, measurement of the gases like CO_2, CO, SO_2, NO_x and HC have been conducted.The increase in vehicular population has resulted in the number concentration of aerosols. It was also established that, Using ESEM (Environmental Scanning Electron Microscope), the chemical composition analysis showed that in the environment of Gaborone, Ni, Cr, Pb, Zn toxin particles are present. The mass loading of plant leaves result in a thin moist layer of such particles. In plant leaves, the stomata of size 10ìm-20ìm are present which open in the sunlight but close in the night. These particles ,whether dissolved state or undissolved state in the moisture, sweeps into the plant leaves. It was also reported that Pb and Zn concentration and accumulation, in particular, in the plants along highways have been high.

Key words: Atmospheric particles, Air pollution, Vehicular population, Plants

SV/O-9

Salicylic Acid Altered Photosynthetic and Antioxidants Traits under Different Levels of Chromium (VI) in *Brassica juncea*

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Salicylic acid has been known to modulate antioxidant system for improving the efficiency of plants, grown under various metal stresses. The seeds of *Brassica juncea* were sown in cups, and at 10 d stage, seedlings were exposed to Cr (0, 50, 150 or 300 µM) through sand and allowed to grow till 20 d stage of growth under natural conditions. At 21 d stage, plants were sprayed with DDW (control) or 10^{-5} M of salicylic acid (SA). At 30 d stage of growth, plants were harvested to assess the various growth as well as selected biochemical characteristics. The chromium stress significantly reduced plant growth and gas-exchange parameters, and increased proline content and electrolyte leakage in the leaves. Toxic effects induced by lower level of Cr (50 µM) were completely

overcome by follow-up treatment of SA. Applications of SA up-regulated the activities of the antioxidant enzymes, such as catalase, peroxidase, and superoxide dismutase under Cr stress. The up-regulation of antioxidant enzymes as well as proline (osmolyte) triggered by salicylic acid could have conferred tolerance to the Cr stressed plants.

Key words: Antioxidant system, Chromium, Photosynthesis, Proline, Salicylic acid

SV/O-10

Application of Soil Amendments for Reducing Cd Uptake in *Amaranthus caudatus* and its Consequent Effect on Yield and Oxidative Biomarker Responses

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Present study includes assessment of yield, cellular cadmium (Cd) accumulation and oxidative biomarker responses in leafy vegetable *Amaranthus caudatus* under soil amendments. The test plant was grown in Cd contaminated soil (6 µg Cd g^{-1} soil) amended with rice husk (RH), saw dust (SD), farmyard manure (FYM), farmyard in combination with nitrogen, phosphorus and potassium (FYM+NPK) with different doses: 0.5, 2, 5 and 10 %. Result showed that in edible part (shoot) of *A. caudatus*, the cellular Cd accumulation declined maximally at 5 % dose of each amendment. The Cd content in tissues was decreased under amended soil and it was maximum (45%) in FYM+NPK amendments over the value recorded in plants grown under non amended soil. Yield of plant was also higher under amended soil. This increment was maximum under 5 % dose of each amendment. The decrease in cellular Cd concentration following amendment the level of oxidative biomarkers (superoxide radical: $O_2^{\cdot-}$, hydrogen peroxide: H_2O_2 and malondialdehyde content: MDA) were also decreased as a result of significant increase in the activity of enzymatic antioxidants (peroxidise; POD, ascorbate peroxidise; APX, superoxide dismutase; SOD and catalase; CAT). Among all amendments, the combination of farmyard with nitrogen, phosphorus and potassium (FYM+NPK) fertiliser was found to be best for reducing metal contamination and increasing plant quality. Therefore, this kind of sustainable technique can be easily applied at metal contaminated agricultural fields for reducing metal load in food chain and for the improvement of food quality.

Key words: Heavy metal**,** Amendment, Oxidative biomarker, Antioxidant, Yield

SV/O-11

The Thiol-Metalloid Relations in Arsenic Exposed Rice Seedlings

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Phytochelatins (PC) chelate metals and thiol metabolism is the primary detoxification strategy to tolerate metal stress in plants. In light of this, it is very important to understand the the importance of harmonised thiol metabolism with metal accumulation and tolerance. In the present study, As(V) and As(III) seemed to have modulated the whole pathway of thiolic metabolism in both lines evaluated in terms of various metabolites and important enzymes of the pathway. The sensitive cultivar had a higher upregulation of thiol metabolsim given the sensitization due to higher As influx (13 times higher in roots than the tolerant one at 25 µM As III exposure in hydroponics). Though, the PC accumulation was also found higher in the sensitive cultivar, it was not adequate enough to detoxify the high As burden and therefore lead to sensitivity in the plant. This was further validated by the lower As accumulation in the contrastingly tolerant cultivar, where the thiol metabolism did not show much up-regulation but the PC accumulation was enough to detoxify the accumulated low levels of As and therefore, the tolerance in the genotype. It is concluded that tolerant genotype synthesizes adequate thiols to detoxify metalloid load while sensitive variety synthesizes higher but inadequate levels of thiols to tolerate exceedingly higher load of metalloids as evident by thiol : metalloid molar ratios and shows phytotoxicity response. It may be suggested that plants stimulate both the synthesis and consumption pathways of thiols to combat metalloid toxicity to maintain equilibrium

of the various processes and to maintain proper redox state of the cells.

Key words: Arsenic, Detoxification, Phytochelatin, Thiol, Tolerance

SV/O-12

Exogenous Glutathione Protects Wheat Seedlings from Lead-Induced Oxidative Damages by Upregulating Antioxidant Defense and Glyoxalase Systems

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The effect of exogenous glutathione (GSH) on antioxidant defense and glyoxalase systems under lead (Pb)-induced oxidative stress was investigated in leaves of wheat (Triticum aestivum L. cv. Pradip) seedlings. Six-day-old seedlings were supplemented with GSH (1.0 mM) and Pb [1 and 2.0 mM $Pb(NO_3)_2$] separately and in combination, and further grown for 48 h. Lead stress at any levels significantly decreased the ascorbate (AsA) content of the seedlings. The amount of reduced glutathione (GSH) and glutathione disulfide (GSSG) increased with an increase in the level of Pb, while the GSH/GSSG ratio remained unchanged. The ascorbate peroxidase (APX) and glutathione *S*-transferase (GST); glutathione peroxidase (GPX) and glutathione reductase (GR) activities increased significantly with increased As concentration, while monodehydroascorbate reductase (MDHAR), dehydroascorbate reductase (DHAR), catalase (CAT), glyoxalase I (Gly I), and glyoxalase II (Gly II) activities decreased upon the imposition of Pb stress. Sharp increase in hydrogen peroxide (H_2O_2) and malandialdehyde (MDA) content was resulted in Pb stressed seedlings. On the other hand, GSH-supplemented seedlings, when exposed to Pb, resulted in an increase in AsA and GSH content and high GSH/GSSG ratio aas well asd increased the activities of APX, DHAR, MDHAR, GR, GST, GPX, CAT, Gly I, and Gly II compared to the Pb-stressed plants without GSH. Consequently, reduction in the levels of H_2O_2 and MDA was observed in those GSH-supplemented seedlings as compared to Pb stress alone. These results suggested that the exogenous GSH provides an enhanced tolerance to Pb-induced oxidative damage by enhancing their antioxidant defense and glyoxalase systems.

Key words: Glutathione (GSH), Lead (Pb)-induced, Oxidative stress, malandialdehyde (MDA)

SV/O-13

Arsenic Tolerance in Rice (*Oryza sativa* L.) Involves Coordinated Role of Thiol Metabolism and Antioxidative Defense System

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Arsenic (As) contamination of paddy rice in south and south-east Asia has raised much concern as rice is the subsidence diet for millions. The mechanism of arsenic (As) tolerance was investigated on contrasting rice (*Oryza sativa* L.) genotypes (Triguna and IET-4786), selected for As tolerance and accumulation. Arsenic induced oxidative stress was more pronounced in IET-4786 than Triguna especially in terms of reactive oxygen species, lipid peroxidation, EC and pro-oxidant enzymes (NADPH oxidase and ascorbate oxidase) during AsIII stress. Similarly, most of antioxidants such as superoxide dismutase (SOD), ascorbate peroxidase (APX), guaiacol peroxidase (GPX), catalase (CAT), monodehydroascorbate reductase (MDHAR) and dehydroascorbate reductase (DHAR) increased significantly in Triguna and decreased in IET-4786. Phytochelatin synthase, GST and ã-ECS gene showed high expression pattern in Triguna and coincided with their specific activity, however in IET-4786 they were generally down-regulated at higher AsIII exposure. Besides maintaining the ratio of redox couples GSH/GSSG and ASC/DHA, the level of phytochelatins (PCs) and phytochelatin synthase (PCS) activities were more pronounced in Triguna, in contrast to IET-4786. The effect of silicon (Si) supplementation on As accumulation, growth, oxidative stress and antioxidative defence system was also investigated during As(III) stress. 1 mM Si addition, significantly ameliorated As induced oxidative stress in Triguna

cultivar by lowering the As accumulation and improving antioxidant enzymes and their isozymes compared to IET-4786. The study suggests that IET-4786 appears sensitive to As due to reduction of both antioxidative defense system and thiol metabolic pathway. However, a coordinated response of thiol ligands and stress responsive As was seem to play role for As tolerance in Triguna to achieve the effective complexation of As.

Key words: Arsenic, Oxidative stress, Antioxidant, Thiol metabolism, Rice, Silicic acid

SV/O-14

Comparative Proteomics of Roots and Leaves of Two Cotton Species Undergoing Drought Stress and Recovery at Different Growth Stages

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Differential proteome analyses of two cotton species, *Gosspium hirsutum* and *G. herbaceum*, undergoing drought stress and recovery, were carried out in roots and leaves at vegetative and flowering phase. In roots, proteins related to stress response and defense, amino acid metabolism, carbohydrate and energy metabolism were up-regulated in *G. hirsutum* while almost all the proteins belonging to these categories were down-regulated in *G. herbaceum* roots. Reduced expression of carbohydrate and energy metabolism related proteins in *G. herbaceum* roots would have resulted in reduced carbon flow to roots and less energy availability for proper functioning of roots. In addition, root morphology related protein, tubulin which imparts mechanical strength to cells, was also down-regulated in *G. herbaceum*. In leaves, 12 out of 13 identified up-regulated proteins in *G. hirsutum* were related to defence, osmotic adjustment and photosynthesis. This indicated that *G. hirsutum* was able to maintain photosynthesis and active antioxidant defence mechanisms to overcome drought stress.

Drought at flowering phase produced different results. Comparative proteomics revealed that more than 90% of the up-regulated proteins in *G. hirsutum* and *G. herbaceum* roots were related to signalling, protein and energy metabolism. However, the proteins of root morphogenesis, e.g. tubulin, actin, were highly up-regulated in response to drought in *G. herbaceum* while they were down-regulated in *G. hirsutum* roots. In leaves more than 60% of identified proteins were up-regulated in *G. herbaceum* in response to drought. While in *G. hirsutum* more than 65% proteins were down regulated during stress. In *G. herbaceum*, photosynthesis, defence and N metabolism related proteins were highly up-regulated during drought stress. While in *G. hirsutum*, many proteins related to phososynthesis, protein folding and energy metabolism were down-regulated. The enhanced drought tolerance of *G. herbaceum* at flowering phase appears to be governed by a more efficient removal of toxic by-products, maintenance of photosynthesis and ultimately a better potential for growth recovery on rehydration. The comprehensive proteomic study revealed that the effect of drought stress on different physiological processes is complex and interconnected. The study highlights the importance of studying response of drought at different developmental stages.

Key words: Drought, Cotton, Leaf-root proteomics, MALDI/TOF-TOF, 2D PAGE

SV/O-15

Residual Fate and Persistance Behaviour of Mixed Formulation Emamectin Benzoate 1.5% and Fipronil 3.5% EC in Chili

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Chili (*Capsicum annum* L), an important universal spice as well as vegetable crop, occupyies a large portion of food habit in Indian people. It has medicinal properties due to presence of capsicine, enriched with vitamins (especially Vit-A and Vit-C) and antioxidants. This commercial vegetable crop is infested with a number of insect pests (viz. mites, thrips etc) causing considerable yield loss. The mixed formulation of Emamectin Benzoate 1.5% and Fipronil 3.5% EC, is a mixture of Emamectin benzoate, a novel semi-synthetic epimethyl amino derivative of the

natural product of Abamectin consisting of 16 membered macrocyclic lactone, effective against Lepidopteron class of insect and Fipronil, a phenyl pyrazole, broad-spectrum insecticide, effective against thrips, mites and fruit borer etc. To find out the persistence behaviour, a multilocational supervised field experiment at four different locations (viz., IGKV, Raipur, B.C.K.V., Mohanpur, Nadia, TNAU, Coimbatore and Dhakrani, Dehradun) in India were conducted during the season 2011-2013. The formulation was applied at field recommended dose of 750 mL/ha (T1) and double the recommended dose 1500 mL/ha (T2). Extraction of chilli fruit involves acetonitrile: water (9:1) for Emamectin Benzoate and ethyl acetate for Fipronil as solvent and subsequently the extracts were cleaned up by using Florisil and GCB. The final quantification of emamectin benzoate and fipronil was done using LC-MS/MS and GC-ECD. The recovery percentage was ranged between 86-110% for chilli matrices and correlation coefficient (R2) of matrix matched calibration curves were e"0.99. The experimental LOQ was set at 20ng/g and 50ng/g for chilli fruit sample for Emamectin Benzoate and Fipronil respectively. The half life of Fipronil was found between 0.74-0.98 days and it follows 1st order kinetics. In case of Emamectin Benzoate, the half life could not be determined as there was no Emamectin Benzoate residue after 1st day of application. Pre harvest Interval (PHI) was determined in respect of Fipronil in the range of 6.9-8.9 days considering the EU MRL value 0.005 mg/kg for chilli fruit sample. From this study it was proved beyond doubt that this mixed formulation may not create any residual toxicity problem.

Key words: Chili, Emamectin benzoate, Fipronil, Lc-Ms/Ms, Gc-Ecd, Half-life

SV/O-16

Urban Aerosols and their Impact on the Biochemical Constituents of Medicinal Plants in Delhi Region

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Various anthropogenic sources emit significant amount of particulates and gaseous pollutants, which are finally deposited onto various surfaces such as vegetation and water bodies etc. Plant exposure to particulate matter affects the morphology and biochemistry of the plant further influencing photosynthesis, flowering, yield and reactive oxygen species scavenging properties. This study reports impacts of air pollutants on the biochemical and morphological characteristics of five medicinal plants viz. Arjuna (*Terminalia arjuna*), Morus (*Morus alba*), Ashok (*Polyalthia longifolia*), Sheesham (*Dalbergia sisso*) and Oleander (*Thevetia peruviana*) at a residential site (Jawaharlal Nehru University, JNU) and an industrial site (Sahibabad, SB) in Delhi region. Results showed that the industrial site had 2-4 times higher fluxes of dustfall on the foliar surfaces. Deposition fluxes of dust were recorded as 281 and 113 mg/m^2/d on Arjuna leaves at industrial and residential sites, respectively. Similarly, dustfall deposition fluxes on Morus, Ashok, Sheesham and Oleander leaves were recorded as 344, 142, 275 and 272 mg/m^2/d at industrial sites and 130, 142, 110 and 100 mg/m^2/d at residential sites, respectively. Fluxes of total SO_4^{--}+NO_3^- were noticed 4-8 times higher at the industrial site than that of residential site. It was observed that the higher value of fluxes of dust SO_4^{--} +NO_3^- had a significant impact on the biochemical constituents of the plant. Concentrations of chlorophyll and carotenoids were noticed decreasing due to increasing total fluxes of dust SO_4^{--}+NO_3^- whereas proline and ascorbic acid were found to be increasing with the increase in total fluxes of dust SO_4^{--}+NO_3^- indicating significant pollution stress. Dustfall fluxes were recorded higher at the industrial site as compared to the residential site due to the greater influence of industrial activities. The study showed that the deposition of dustfall was responsible for greater damage to stomata and leaf surfaces.

Key words: Dustfall, Dry deposition, Biochemical constituents, Foliar morphology, Stomata, Biomonitoring

SV/O-17

TiO_2 Nanoparticles Induced Metabolic Adoptions in *Triticum aestivum* L.

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Plants, an important biotic component of terrestrial and aquatic ecosystems, are exposed to nanoparticle containing wastes released into the environment. It has been observed that chromium oxide nanoparticles reduced seed germination and seedling growth in *T. aestivum*. Titanium oxide (TiO_2) NPs have a range of applications from cosmetics to electronics. In this study, it was observed that TiO_2 nanoparticles are internalized and translocated to leaves in *T. aestivum*. Further, a concentration dependent increase in ROS, MDA content and leakage of the solutes was observed in leaves. The loss in photosynthetic pigments, reduced photosynthesis and stomatal conductance was observed in TiO_2 nanoparticle exposed seedlings of *T. aestivum.* TiO_2 NPs induced ultra-structural and metabolic alterations were also observed in the leaves of *T. aestivum*. The observations made in this study indicate the need for phytotoxicity assessment of various commercially used NPs to formulate strategies for both prevention of trophic transfer of NPs and 'safe by design' nanomaterials to protect human and environmental health.

Key words: TiO_2 nanoparticles, *Triticum aestivum*, Phytotoxicity, Metabolic changes

SV/O-18

Physiological Responses of Cauliflower to Interaction of Salinity and Cadmium

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In order to investigate the interaction of salinity and cadmium on changes in *Cauliflower* protein pattern, an experiment in a randomized complete block design with 3 replications in the agricultural research greenhouse in the Islamic Azad University in 2014 was conducted. The examined factors were included: The first factor of cadmium at levels [zero (control), 50, 100 and 200 ppm], the salinity was the second factor at three levels [zero (control), 50 and 100 ppm]. The studied characters in this research was included the catalase and peroxidase activities, the changes amounts in protein content, Malondialdehyde (MDA) content and in the amount of proline. According to the cadmium variance analysis results on the one percent probable ($p>0.01$) on the proline, protein content changes and Malondialdehyde (MDA) and peroxidase enzyme activity and on the five percent probable ($p>0.05$) on catalase enzyme activity have meaningful effect and also cadmium on the one percent probable ($p>0.01$) on the Malondialdehyde (MDA) content changes and peroxidase enzyme activity has a significant effect but on the catalase enzyme activity, the amount of proline and protein content changes has not meaningful effect. It was showed that the interaction effect of cadmium with salinity on the amount of proline and protein content changes and peroxidase enzyme activity on the one percent probable ($p>0.01$) was significant, but on the catalase enzyme activity and Malondialdehyde (MDA) content changes was not significant. Based on the obtained results by increasing the protein content, protein content changes and by increasing the catalase and peroxidase enzyme activities, proline and Malondialdehyde (MDA) content were decreased, It should be noted that the between levels 50, 100 and 200 ppm of cadmium in catalase enzyme activity and MDA content between control and 50 ppm cadmium as well as 100 and 200 ppm of cadmium significant difference in protein content and peroxidase enzyme activity no statistically significant difference was observed, also showed that 200 ppm of cadmium had the most effect. Also by increasing the salinity, Malondialdehyde (MDA) content and peroxidase enzyme activity was increased, so that the most change in the salinity of 100 ppm was obtained.

Key words: *Cauliflower,* Salinity, Cadmium, Proline, Antioxidative compound

SV/O-19

Physiological and Biochemical Responses of Cadmium Toxicity in Green Gram (*Vigna radiata*)

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Green gram (*Vigna radiata* L.) plants exposed to excess cadmium produced visual symptoms of toxicity which were observed intensified with increasing level and duration of metal supply. At 10 days after cadmium exposure at 0.5mM, symptoms of leaf interveinal chlorosis, aggravated later as necrosis. Plant growth

was stunted. Plants treated with cadmium supply had lower pod yield and biomass, reduced concentrations of chlorophylls (a and b) and Hill reaction activity. The catalase activity and protein content were also found to be reduced over the control which suggest strong induction of oxidative stress due to excess cadmium. There was concomitant increased activity of peroxidase, ribonuclease and acid phosphatase with increase in cadmium supply. The cadmium concentration in tissues was increased as levels of cadmium were increased from 0.05 to 0.5 mM. The appearance of metal specific toxicity is likely due to damage predominantly due to enhanced generation of reactive oxygen species (ROS) at higher (0.5 mM) cadmium supply. The accumulation of cadmium in plants may cause several biochemical, physiological and structural changes.

Key words: Green gram, Cadmium, Acid phosphates, Necrosis, Toxicity

SV/O-20

Effect of Reducing Fertilizer Application and Aquatic Plants on Nitrogen and Phosphorus Loss in Agricultural Runoff

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Nitrogen and phosphorus loss is an important factor of surface water eutrophication. Study on effect of reducing fertilizer application and aquatic plants on loss of nitrogen, phosphorus in farmland runoff is important to reduce surface water eutrophication risk.

We carried out field test in the typical agricultural catchment of outskirts of Guangzhou city. The effects of conventional fertilization, reducing fertilizer application 1 (20% less than the conventional fertilization) and reducing fertilizer application 2 (30% less than the conventional fertilization) on N, P loss in agricultural runoff was studied by the method of field plot experiment.The field grass ecological ditches are constructed with several Species of aquatic plants, such as *Pontederia cordata, Acorus calamus,* and *Hydrocotyle verticillata*, and the effects of their reducing nitrogen and phosphorus loss in farmland drainage system was studied.

The results showed that: (1) concentrations of nitrogen and phosphorus loss in ditch runoff were high with different fertilization levels, the average loss of TN0NH_4^+-$N_0NO_3^-$N in farmland runoff were 20.5 mg/L ~ 34mg/L, 2.2mg/L ~ 2.4mg/L, and 6.3mg/L ~ 9.5mg/L, respectively, while the average loss of TP, DP were 7.7mg /L ~ 11.1mg/L and 2.1mg/L ~ 2.4mg/L, respectively. (2) The concentrations of TN and NO_3^-N loss can be significantly reduced by reducing fertilizer application, Compared with the conventional fertilization, the concentrations of TN loss were reduced 40%, 32%, respectively, and NO_3^-N loss were reduced 23%, 35%, respectively, with reducing fertilizer application 20% and 30%, respectively.(3) Compared with the conventional fertilization, the loads of TN loss were reduced 24%019%, respectively, and NO_3^-N loss were reduced11%029%, respectively, with reducing fertilizer application 20% and 30%, respectively.(4) Effect of the field grass ecological ditches to reducing N and P loss is obviously. The reducing rates of 3 species of aquatic plants to TN were 78.5%, 88.5% and 86.8%, to NO_3^-N were 88.1%, 89.6% and 87.5%, and to TP were 37%, 40.5% and 36.5%, respectively.

The research results can provide scientific basis for the management of fertilization, field drainage and contaminants reduction.

Key words: Reducing fertilizer application, Agricultural runoff, Nitrogen and phosphorus loss, Aquatic plants, Field grass ecological ditches

SV/O-21

Investigation Fluctuating Asymmetry and Elements Analysis in Several Plants' Leaves Developing in Various Degree in Condition of Pollution

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The purpose of the conducted research is to analyze changes in phenotypic expression of accidental symmetry in the leaves of plants planted in soils ecologically contaminated and devoloping in various degrees, and analysis the properties to accumulate the metallic elements in the leaves. For this, an attempt was made to analyze indicators of fluctuating asymmetry in the leaves of dicotyledonous

herbaceous cultural plants *Vicia faba* L. and *Cicer arientum* L.and accumulated elements in their leaves by SEM . The results of the conducted research showed that apart from being a more active phytoindicator compared to *Cicer arientum , Vicia faba* is capable of uptaking more harmful chemical elements from soil. This allows using Vicia faba L. both as a phyto-indicator and phytoremediator in environmental monitoring.

The reasearch analyzes the leaves of economically and decoratively important *Olea europea* L. plants of about the same age planted in varied ecologically contaminated areas. The *Olea europea* plant is an active phytoindicator in environmental assessment and a phytoremediator in environmental management. Environmental prognostics based on sustainable development dynamics of plant populations can be quite important for the protection of plant diversity in environmental monitoring

Key words: Environmental monitoring, Fluctuating asimmetry (FA), Elements analysis

SV/O-22

Combined Use of EDTA and Oxalic acid promotes Chromium Uptake, Translocation and Ameliorates Toxicity by Glutathione, Phytochelatins and Adjustments of Gas Exchange Attributes in Indian Mustard (*Brassica juncea* L.)

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Present experiment is focused on to examine the Cr accumulation by Indian mustard (*Brassica juncea* L.) in presence of chelating agents: EDTA and Oxalic acid. The plants were monitored for oxidative stress by measuring MDA contents and tolerance strategy by enzymatic (superoxide dismutase, catalase, ascorbate peroxidase, guaiacol peroxidase, glutathione reductase) and non-enzymatic antioxidants (cysteine, non-protein thiols, glutathione) along with phytochelatins. The treatments of Cr (VI) and chelating agents were applied in four sets: Cr (VI) alone, Cr (VI) with EDTA 1:1, Cr (VI) with oxalic acid 1:1, and Cr (VI) with EDTA and OA 1:1:1, in varying concentrations of 0, 6.25, 12.5 and 25.0 mg/250 gm of soil, respectively for 42 days of exposure. The results revealed the highest amount of Cr accumulation in roots (8.16, 15.64, 12.38 and 18.22 mg kg^{-1} DW) and shoots (1.84, 5.04, 8.36 and 8.69 mg kg^{-1} DW) for exposure of Cr (VI) alone, Cr(VI)+EDTA, Cr (VI)+OA and Cr (VI)+EDTA+OA, respectively. These findings are suggesting that combined application of EDTA and oxalic acid promotes chromium uptake and translocation which is a prime requirement for success of phytoremediation. Combined application of EDTA and oxalic acidalso ameliorates Cr toxicity confirmed by biochemical parameters such as MDA content, chlorophyll contents, fresh biomass, dry biomass and gas exchange attributes (A-7.56 ìmol m^{-2} sec^{-1}, E- 5.74 mmol m^{-2} sec^{-1}, G_{H2O}- 346.40 mmol m^{-2} sec^{-1}, WUE-1.32, TR- 0.76 recorded against 25.0 mg of Cr (VI)+EDTA+OA exposure). The plants had achieved a good level of tolerance against Cr (VI) as evident by significant ($p<0.05$) synthesis of many antioxidants, primarily glutathione (2.099 ìmol g^{-1} FW) and phytochelatins (0.625 ìmol g^{-1} FW) @ 25 mg of Cr exposure. Present findings suggested that Indian mustard could be used as a potential remediator of Cr under combined application of EDTA and oxalic acid.

Keywords: *Brassica juncea* L., Chromium, EDTA, Oxalic acid, Antioxidants, Phytochelatins, Gas exchange

SV/O-23

Effect of Zno and Cuo-Nanoparticles Versus Zn and Cu-Salt: Analysis of Stress Responses in *Lolium perenne*

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Heavy metals are added to soils and water through large diverse anthropogenic activities. Their non-biodegradability results in prolonged persistence in the environment, and their impact enhanced via bio-enrichment in the food chains. Similarly the manufacture and use of nanomaterials such as metal oxide nanoparticles has led to their presence in the environment. Despite an abundance of literature on metal uptake by plants and the use of several amendments to enhance it, a relative lack of understanding on the behaviour of various forms of copper and zinc still remains a less explored field of

study. Our study investigated the combined effects of ethylene diamine dissuccinic acid (EDDS) and a phytohormone gibberellic acid (GA) on free and nanoform of copper and zinc by *Lolium perenne* (ryegrass). In this investigation commercially available plant growth regulator gibberellic acid (GA) and a biodegradable chelating agent ethylene diamine-disuccinic acid (EDDS) were used to enhance the phytoextraction of free ions $Cu^{2+,}$ Zn^{2+},and ZnO , CuO nanoparticles in a hydroponic solution. While individual applications of Gibberellic Acid (100 µM) and EDDS (500 µM) served as an effective treatment for zinc and copper uptake in shoots of ryegrass plants with a translocation factor of 9.88 and 1.88 respectively , combined applications moderately enhanced shoot tissue concentrations. A relatively higher toxicity was associated with copper ions when compared to their corresponding CuO nanoparticles exhibiting lipid peroxidation levels of 6.72 and 4.19 nmol/g FW, a similar behaviour was observed with Zn^{2+} ions. While gibberellic acid effectively enhanced free ion concentrations of zinc, a higher translocation of copper and zinc was observed in their nanoforms under individual EDDS treatments (3.91, 10.47) over a 21 day exposure duration. Results indicated damage to *Lolium perenne*, by both free- and nano-sized zinc and copper, as observed by lipid peroxidation levels, and these effects could be discriminated between the different zinc and copper forms.

Key words: EDDS, Free ions, Lipid Peroxidation, Nanoparticles, Plant growth regulator

SV/O-24

Insight into the Kinetics and Cellular Processes Caused by Short Term Nickel Exposure in *Elodea canadensis* Leaves

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Species of *Elodea* have been frequently used for biomonitoring heavy metal pollution, and water quality. This is accomplished by investigating the physiological responses caused in the monitor organism. Prediction of heavy metal stress as a function of specific cellular responses through various biomarkers is an invaluable for biomonitoring. Short term (0-24 h) nickel exposed (sublethal nickel concentration of 50 ìM, as nickel sulphate) leaves of *Elodea canadensis* have been investigated for net photosynthesis, pigment concentration, lipid peroxidation, activity of antioxidant enzymes (SOD, CAT, GR) and accumulation of thiol-containing compounds. Nickel was accumulated as soluble (60% of the total bound Ni) and polymeric (20%) non-protein fractions. Nickel significantly stimulated net photosynthesis during 1-12h exposure and also increased chlorophylls and carotenoids level in *Elodea* leaves. However, after 24 h the photosynthetic activity decreased below the control level. The sequential appearance of protective responses has been revealed in *Elodea* leaves: the fast, short-term exposure (1-4h) induced an increase of non-protein thiol concentration, the activation of antioxidant enzymes (SOD, CAT, GR) was observed after 4-8h and the longer exposure resulted in accumulation of SH-containing compounds. We conclude, that nickel (50 ìM) induces a sublethal oxidative stress in leaves. Exposure time is crucial for the activation of specific mechanisms of Ni detoxification and stress protection. In this lecture a) bioaccumulation of nickel in in short term Ni exposure. b) ecophysiological responses focussing photosynthetic pigments, photosynthesis and respiration c) induced antioxidative enzymes and d) thiols and metal complexes shall be discussed.

Key words: Catalase, Glutathione reductase, Membrane bound protein fraction, Non-protein polymeric fraction, Non-protein soluble fraction, Non-protein thiols, Soluble protein fraction, Superoxide dismutase, Thiobarbituric acid-reactive substances

SV/O-25

Searching for Common Responsive Parameters for Ozone Tolerance in Rice: Results from Ethylenediurea Studies

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Tropospheric ozone is one of the most important air pollutants causing significant yield losses in crops worldwide. The ozone tolerance of species and cultivars varies and there would be a great economic benefit in the selection of tolerant cultivars. In the present study, 18 locally important rice (*Oryza sativa*) cultivars in Indo-Gangetic plains of India were screened throughout the growing season to evaluate ozone impacts on different rice cultivars. The aims were to find the variation in the ozone tolerance of these cultivars and to find parameters that could be used in screening rice cultivars for ozone tolerance.

Plants were treated with EDU ([N-(2-2-oxo-1-imidazolidinyl) ethyl]-N'-phenyl urea) to ameliorate the phytotoxic impact of ozone. EDU is suggested to prevent the harmful effects of ozone by up-regulating antioxidant defense. The experiment was conducted at two separate fields 25 km apart, in urban and semi-urban areas at ambient ozone concentrations. EDU was applied as foliar spray at 300 ppm concentration at 15 days interval. Antioxidative activity, malondialdehyde content (MDA), chlorophyll content, gas exchange and biomass were studied at vegetative and flowering phases, and biomass and yield parameters at harvest phase to return a dataset of 24 parameters. Responses of cultivars were assessed with multivariate analyses in order to characterize the key factors defining the differences between the EDU-treated and non-EDU treated rice cultivars.

Responses to EDU treatment in terms of growth, biochemical and yield parameters varied among cultivars and developmental phases, and between the experimental sites. The most responsive parameters to EDU treatment included superoxide dismutase (SOD) and catalase (CAT) activities, contents of oxidized (GSSG) and reduced (GSH) glutathione at flowering phase and MDA content at vegetative phase. The most promising parameters as candidates for screening ozone tolerance could be CAT activity and GSH content at the flowering phase, since these parameters had a positive correlation with the yield in the tested cultivars.

Key words: Ozone, Rice, Cultivars, India, EDU (ethylenediurea)

SV/O-26

Responses in Two Cultivars of Mustard (*Brassica rapa* syn. *B. campestris*) to Tropospheric Ozone

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Tropospheric ozone is a phytotoxin that causes oxidative stress in plants. In India, concentrations of tropospheric ozone are regularly high due to high ozone precursor emission and high light conditions. These high ozone levels cause growth reductions, foliar injury and crop losses. In this study, we grew two cultivars of mustard (*Brassica rapa* syn. *B. campestris)* originated from India in control and ozone treatments. In ozone chambers, ozone concentration was increased gradually in the morning with a maximum of 120 ppb for five hours daily and decreased in the afternoon, roughly simulating ozone conditions in India. Our aim was to monitor changes in metabolites induced by chronic tropospheric ozone exposure. Thus, leaf samples were taken before the start of the ozone fumigation and after 1.5, 7.5 and 20.5 days of ozone fumigation. We also monitored volatile organic compounds (VOCs) emitted by the plants. Primary metabolites and VOCs were analyzed by GC-MS. We wanted to find out, (1) which compounds increase or decrease in quantity in response to ozone, (2) whether the changes induced by ozone are similar in the two cultivars, and (3) whether the changes induced by ozone are transient or persist for long periods of time. Ozone treatment decreased the number of viable leaves and biomass in both cultivars. Old leaves of ozone treated plants senesced and fell off. The new leaves that emerged during the experiment had higher chlorophyll content

in ozone treated plants as compared to controls. Changes in primary metabolites reflected the time series and the ozone treatment. Particularly concentrations of sugars were affected by ozone. Ozone-treatment affected also emissions of VOCs: Emissions of monoterpenes (-pinene and 3-carene) increased in response to ozone in both cultivars.

Key words: Tropospheric ozone, Metabolomics, *Brassica*, Mustard

SV/O-27

Effect of Different Down Stream Processing Techniques on Lipid Extracted Microalgal Metabolites

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Due to the high cost of upstream and downstream processing, such as culturing, harvesting, lipid extraction and trans-esterification, microalgal biofuels are neither economically feasible nor environmentally sustainable. The biorefinery concept has attracted much attention to exploit other aspects of microalgal biomass in order to improve the feasibility of biodiesel production. Lipid extracted algae (LEA) is the residual biomass, obtained after lipid extraction from microalgae. LEA contain significant amounts of metabolites such as carbohydrates, proteins and lipids that can be used as source of energy in the form of feed for aquaculture, poultry, livestock as well as energy production such as bio-methane and biohydrogen generation etc. The use of different drying and cell disruption methods have been examined widely for lipid production, however the literature on the effect of different downstream processing on LEA (lipid extracted algae) metabolites is scanty. This study evaluated the effect of different downstream process on LEA metabolite of *Scenedesmus* spp. grown on BG11 medium in the raceway pond (300000L). The biomass was harvested on late log phase and the effectiveness of different lipid extraction processes on LEA qualities was observed. The result revealed that the microwave assisted cell disruption of microalgae shows highest lipid production followed by sonication, autoclave and osmotic shock (10% NaCl), which was 19%, 18%, 10% and 6.8 % (% DW), respectively. Freeze dried biomass yielded highest lipid, whereas there was no significant difference in lipid yield in sun dried and oven dried biomass. The carbohydrates in sun dried, oven dried and freeze dried whole cell microalgal biomass was 14.6 %, 14 % and 12.84 %, respectively. The results revealed 0.18-5.6 % increase in carbohydrates; in sun dried, microwave assisted LEA and oven dried, autoclaved LEA, respectively. Interestingly, we observed that the percentage of total carbohydrates (as reducing sugar) increased in LEA. This may be due to repeated cell disruptions, causing the microalgal cell to become fragile and thus better percentage of carbohydrates were achieved in LEA in comparison of whole cell algae.

Key words: Microalgae, Lipid extracted algae, Metabolities, Carbohydrates

SV/P-1

Effect of Soil Condition on Oil Content, Chemical Composition and Carbon Isotope Ratio of Lemon Grass Grown on Sodic and Non Sodic Soil

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Lemon grass has been used in medicine in India for more than 2000 years. However its use for distillation is about 100 years old and the first distillation in India was started in about 1890 from wild grass in Kerala. Lemon grass is indigenous to Malabar coast of India and at present cultivated in various parts of the country. Lemon grass oil serves as a good source of citral (nerol + geranial) used in perfumery and preparation of ionones and vitamin A. Lemongrass is widely adapted to a wide range of soils and performs well on sandy to clay loam soils. Lemon grass grows well in soils, with a pH value ranging from 4.3 to 8.4. Under this study the experiments have been carried out on lemon grass growing in sodic (pH 8.9) and non sodic soil. The essential oil content, chemical composition and carbon isotope ratio of lemon grass were studied in different soil conditions as sodic and non sodic soils. The oil content obtained in non sodic soil was 0.56% whereas it was 0.68% in sodic soil. The chemical composition analysis enabled

the identification of total 43 constituents in lemon grass oil sample, constituting 96.21 to 97.48% of the total oil content. The major constituents were citral, myrcin, limonene, beta citronellol and geraniol acetate. Citral (65 to 71%) and limonene (0.79 to 3.37%) were significantly higher in lemon grass grown in sodic soil, whereas myrcin (0.09 to 7.64%) and beta citronellol (0.42 to 2.54%) contents were higher in plants gown on non sodic soil. Carbon isotope composition of lemon grass decreases significantly (from - 15.28 to - 13.77 per mil) when grown on sodic soil.

Key words: Oil content, Carbon isotope, Lemon grass

SV/P-2

Effect of Lead Stress on Morphology of *Leucaena glauca*

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This work consist effect of lead on the morphology of plant *Leucaena glauca* in the context of its possible harm due to the heavy metal. This plant was planted for 105 days to observe the results. The study aims evaluating morphological parameters of the plant species. To analyze morphological changes, various doses of lead had treated to the plant. The doses were 0.2, 0.4, 0.6, 0.8 and 1.0 mg/kg of lead nitrate with the pot experiment in laboratory. The morphological changes occurred in the plant species during the experiment. The results concluded that few changes occurred in the morphology of the plant species. The study may be significant in phytoremediation.

Key words: Heavy metal, Pollution, Tolerance, Phytoremediation, Plant

SV/P-3

Impact of ZnO Nanoparticle on Water Stress and its Recovery in *Oryza sativa* L.

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Zinc oxide (ZnO) nanoparticle (NP) is being widely used in various research. Plant system being extremely critical requires the fundamental understanding on the influence of ZnO NP on its cellular growth and functions. Our study evaluates the effect of ZnO NP on growth and physiological changes of *Oryza sativa* L and also try to ameliorate PEG induced water stress and its recovery in rice. Water stress induced growth reduction in rice seedlings, but the effect of ZnO NP, which may be involved in alleviating the adverse effect of water stress on rice seedlings by stimulation of growth parameters and the increase in photosynthetic pigments. It can also be suggested the water stress recovery may be counteracted by ZnO NP at lower concentration. Further, detail study on the ZnO NP effect on physiological events during water stress and physiochemical and antioxidative responses of growing seedlings of rice (*Oryza sativa L*) can reveal the exact mechanism underlying the amelioration of water stress and its recovery in rice. The present study gives an insight on the possible role of zinc transporter protein and their interaction with ZnO NP during water stress acclimatization and stress recovery process in rice which in turn will open new ideas on biointerface on protein-nanoparticles interaction in future. Detailed understanding of the regulation of zinc transporter in response to Zn nanoparticles is required to dissect the physiological mechanism regulated by ZnO NP during water stress and its recovery in rice.

Key words: *Oryza sativa*, Water stress, Recovery, ZnO nanoparticle, Physiological responses

SV/P-4

Germination of Seeds in Soil Samples of Heavy Traffic Zones of Hyderabad Andhra Pradesh, India

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Plant toxicity bioassays through fast germinating agricultural crops can indicate the phytoremediation potential, effects on growth and survival and also assess the extent of pollution. In the present study, the phytotoxic effect of heavy traffic/ petrol driven vehicle

contaminated soil was studied on two agricultural crops, namely Indian mustard (*Brassica juncea*) and Ragi/ finger millet (*Eleusine coracana*)in four different heavy traffic zone contamination. All the test plant species tolerated against contamination at 20-80% levels and the total percent seed germination were found between 3 to 70 %. The change in physicochemical charecterstics of soil samples before and after seed germination suggesting cultivation of these crops in polluted areas helps in controlling of soil pollution.

Key words: Heavy traffic zone soil samples, Phytoremediation, *Brassica juncea, Eleusine coracana*, % germination, Tolerance indices and % inhibition

SV/P-5

Effect of Automobile Exhaust on the Micro-Morphological and Physiological Parameters of *Bougainvillea spectabilis* Willd

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Air pollution has long being known to have an adverse effect on plants. The main sources of air pollution are the industries, traffic as well as energy generation. An automobile contributes significantly to air pollution in urban areas. To study foliar surface configuration and biochemical changes in plant species *Bougainvillea spectabilis* willd. grown at polluted site, (charbagh, loco area) and garden of University campus in Lucknow city which has been taken as reference site were investigated. It was observed that air pollution caused by auto exhaust showed marked alteration in photosynthetic pigments (chlorophyll , carotenoid and phaeophytin) and relative water content were reduced while antioxidative enzymes like catalase and peroxidase were found to be enhanced. The changes in the foliar configuration included marked alteration in epidermal traits, with increased number of stomata, stomatal index and epidermal cells per unit area while length and breadth of stomata and epidermal cells was found to be decreased in leaves samples can be used as biomarkers of auto pollution.

Key words: Stomata, Biomarker, Antioxidative enzymes, Photosynthetic, Bougainvillea

SV/P-6

Influence of Pollution and Climate Change on Floral Nectar Features: Threat to Plant-Pollinator Interphase

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Since Early Cretaceous era, insects have been the prime vectors for pollination in flowering plants. Pollen- and nectar-rewards play a fundamental role in attracting pollinators for gaining benefits from their services. It is well-accepted that in angiosperms nectaries became dominant as a result of multiple, independent origin and evolution in different groups. These secrete nectar, the central energy reservoir that has been exhaustively linked with pollinator-guilds and performance. Plasticity of nectar quantity and chemical composition regulates pollinator identity/diversity. The nectar traits together influence the quality and effectiveness of the entire pollination mechanism. Optimal nectar secretion rate and composition in each plant species have been evolutionarily and metabolically stabilized in relation to key pollinators. Any deflection arising due to erratic changes in abiotic or biotic factors might result in reduced plant and pollinator fitness/vigour and eventually de-coupling of interactions. Several studies have emerged lately indicating the presence of pollutants in nectar and the derived commercial honey products. A major threat throughout the world is of radioactive pollution, whose common source lies in the building materials such as cement, granite, clay, marble and phosphate. Pollutants, including toxic chemicals, radionuclides and cations that get deposited in the atmosphere or are present naturally in the plant substratum as trace elements tend to be uptaken by the plants. Therefore, nectar composition and pollinators, especially bees have been routinely exploited as bioindicators of radioactive pollution. Furthermore, gradual ozone layer depletion is manifested as continuous increment in the incoming UV-radiations in the atmosphere. Levels of CO_2 and other greenhouse gases are also increasing, largely due to human-induced factors. These alterations affect the plants at various levels.

Such environmental changes hinder pollinator services by influencing the olfactory and visual perceptions of visitors and can have significant ecological and evolutionary implications for plant reproduction. In the long run, the selection pressures posed by environmental changes would have an impact on gene pools of plants as well as associated pollinators, thereby affecting their genetic diversity and physiological vigour. Comprehensive understanding of underlying issues will help in identifying the vulnerable species and mitigating the possible damage.

Key words: Pollution, Climate change, Nectar traits, Pollinator decline, Pollinator foraging behaviour, Plant reproductive success

SV/P-7

Evaluation of Physico-Chemical Characteristics and Heavy Metal Contents of Agricultural Soil and Crops Cultivated Around Rivers of Punjab, India

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Punjab is the land of rivers and historically, the centre of civilization due to the availability of fertile soil composed of alluvium deposited on banks of the rivers for thousand years. However, due to rising tide of industrialization, urbanization, extensive use of chemical fertilizers, thoughtless disposal of untreated industrial and urban wastes in natural systems in recent years, soil pollution is increasing at an alarming rate. Considering this, a study was conducted to determine the physico-chemical properties and heavy metals contents in soil of agricultural fields from different villages (6) of Punjab under the different types of cultivations *viz.*, sugarcane (1), barseem (4) and mustard (1) around the rivers Sutlej and Beas in Punjab, India. The soil samples were found to be alkaline in nature with sandy texture and contained very low soil organic matter (SOM) as well as soil nutrients such as nitrogen, phosphorous, potassium, sodium, calcium, magnesium and carbonates. Five heavy metals Cr, Cu, Co, Cd and Pb were analyzed in soil and crop samples. Heavy metal contents in soil were found to be within national and international permissible limits for soil and were ranging as Cr (BDL - 75.70 mg/kg), Cu (BDL - 19.98 mg/kg), Co (0.13 - 3.83 mg/kg), Pb (2.83 - 9.17 mg/kg) and Cd (BDL - 0.08 mg/kg). Heavy metal contents in crop samples ranged as Cr (24.25 - 73.70 mg/kg), Cu (12.28 - 22.28 mg/kg), Cd (0.27 - 0.70 mg/kg), Co (BDL - 1.38), Pb (1.67 - 4.33 mg/kg). Cr content in all the barseem samples was found to be above Chinese Hygienical Standards for animal feed (GB 13078-2001). Cr, Cu, Cd and Pb contents in sugarcane and mustard plants samples also exceeded the Chinese maximum levels of contaminants in foods (GB 2762-2005). Higher levels of heavy metal contents in crops can be attributed to leaching of heavy metals from upper soil layers to lower layers, high metal uptake by plants, aerial deposition in plants and period of sampling. It can be concluded that the crops in the studied area were observed to be contaminated with heavy metals that can pose severe health risks to the residing population and livestock.

Key words: Crops, Heavy metals

SV/P-8

Role of Phosphorus in Mitigating the Chromium Toxicity in *Raphanus sativus* L., as Assessed by Physiological and Antioxidant Enzymes Parameters

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Impacts of pollution due to heavy metal are widespread. Not only has it affected the soil biota, but also plants and animals, by entering into the food chain, leading to biomagnification. However, there are certain inorganic ions (like inorganic phosphate) in soil which affect the uptake of some heavy metals by plants. The present study reports that the amendment in phosphorus supplies in the growth medium suppress the physiological and oxidative toxicities, caused by chromium in *R. sativus* L. The hydroponic-experimental procedure included a complete randomized factorial design in 5X5 fashion, where five increasing concentrations of Cr were treated with *R.*

sativus, and each chromium supply was amended with five increasing concentrations of P supplies for 28 days. The harvested plants (only root parts) were measured for the physiological parameters like total Cr, P and N accumulations, along with, total chlorophyll and biomass estimations. For measuring the level of oxidative toxicity, concentrations of antioxidant enzymes, like superoxide dismutase (SOD), catalase (CAT) and peroxidase (POD), along with the levels of malondialdehyde (for measuring lipid peroxidation) were measured in root tissues. Cr and N accumulation were almost doubled at the highest concentration of Cr supply, without any P amendment, whereas at the highest P concentration, the accumulation was reduced to almost half. A significant reduction in toxic effects of Cr was determined as there was three-fold increase in total chlorophyll and biomass at the highest P amendment. Antioxidant enzymes like SOD, CAT, POD and LP were analyzed at various levels of Cr each amended with five levels of P. It was observed that at highest level of P amendment, the reduction percentage in toxicity was 33, 44, 39 and 44, respectively. Concluding the findings, the P amendments resulted in the marked reduction in the toxicity caused by the supplied Cr in *R. sativus* under the hydroponic conditions. Hence, we suggest that this finding can be applied in the chromium stressed crop-lands, in which, increasing the P content of fertilizer will competitively prevent the entry of Cr in plants, and thus the food chain.

Key words: Antioxidant enzymes, Biomass, Chlorophyll, Chromium toxicity, Phosphorus, *Raphanus sativus* L.

SV/P-9

Effects of Lead and its Phytoremediation Potential in *Eichhornia crassipes* (C. Mart.) Solms

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Around the world, there is an increasing trend in areas of land, surface waters and groundwater affected by contamination from industrial, military and agricultural activities due to either ignorance, lack of vision, or carelessness. Ecosystem contamination from cadmium, copper, and lead pollution may damage aquatic organisms at the cellular level and possibly affect the ecological balance. Growth changes are often the first and most obvious reactions of plants under heavy metal stress .The effects of increasing concentrations of lead nitrate on growth characteristics of *E. crassipes* including root length, leaf area and biomass production was studied. The present investigation also reveals that *Eichhornia crassipes* can be effectively used to cleanup aquatic ecosystems. *Eichhornia crassipes* have great potential to accumulate heavy metals and can be effectively used in phytoremediation. In this study increasing concentration of lead showed higher accumulation capacities and may be better treatment option for lead by means of phytoremediation. Bioconcentration factor showed a clear conclusion and supportive proof about the species as a tool for phytoremediation of lead. The change in BCF of *E. crassipes* was studied to know capacity of *E. crassipes* to concentrate lead from varied concentrations. Lead concentration showed a significant negative correlation between root length, leaf area, fresh weight and dry weight.

Key words: Plant growth assessment, Lead accumulation, *Eichhornia crassipes* Phytoremediation, Biomass production

SV/P-10

Utilization of Industrial Wastes for Cultivation of East Indian Lemongrass in Sodic Soil

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Sustainable utilization of industrial wastes and rehabilitation degraded waste lands is the demand of time to mitigate global warming and for sustainable development of these natural resources. East Indian lemongrass [*Cymbopogon flexuosus* (Nees ex Steud.) Wats] is a perennial, industrial cash crop which can be cultivated as optional crop on lands which do not support production of food crops due to their hardy nature. The leaf oil of lemongrass is used in perfumery, cosmetics, and pharmaceutical industries. The essential oil has insect repellent and anti-cancerous properties. Citral, an important constituent of lemongrass oil is used as starting material for the preparation of á -ionone (used as a flavor, cosmetics and perfumes) and â-ionone (used for synthesis of vitamin A). A field experiment is being conducted at Distant Research Centre, CSIR-National Botanical Research Institute, Lucknow (80^0 45^l- 53^l E 26^0 40^0 -

45[l] N), Uttar Pradesh. Randomized block design with four replications and seven treatments i.e. T1-Control, T2- Press mud @ 20t/ha, T3- Fly ash @ 20t/ha, T4- Fly ash @ 2.5t/ha + Press mud @ 20t/ha, T5- Fly ash @ 5t/ha + Press mud @ 15t/ha, T6- Fly ash @ 7.5t/ha + Press mud @ 10t/ha, T7- Fly ash @ 10t/ha + Press mud @ 5t/ha in 2 X 2 m size plots were used during present study on degraded sodic land having 9.5 pH. Growth responses, biochemical changes, and productivity were evaluated under different treatments to identify appropriate dosages of ameliorants for cultivation of East Indian lemongrass in sodic soil. Maximum survival percentage was recorded in T2- Press mud @ 20t/ha. Maximum plant height was recorded in T5- Fly ash @ 5t/ha + Press mud @ 15t/ha, whereas maximum number of tillers/plant and no of spike/plant were recorded in T4- Fly ash @ 2.5t/ha + Press mud @ 20t/ha.

Key words: Industrial waste, Sodic soil, Lemongrass, Fly ash, Press mud, Essential oil

SV/P-11

Effect of Balrampur Chini Mill Effluent on Seed Germination and Seedling Growth in Tomato (*Lycopersicon esculentum* Mill.) of Different Varieties

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Sugar industry is one of the most important agro-basic industry, ranking second amongst major agro-based industry in India. Although, sugar industry is seasonal in nature and operates only for about 120-200 days in a year, significantly largest volume of water is generated during the manufacture of sugar and contain a high amount of pollution load particularly in the form of suspended solids, organic matter, air and water pollutants. Balrampur Chini Mill(B.C.M.) is a very popular sugar industry in Uttar Pradesh, India. In this paper effect of different concentrations viz.25%, 50%, 75% and 100% of effluent discharged from Balrampur Chini Mill on the seed germination and seedling development in four varieties of tomato is assessed. The effluent had beneficial effect on the percentage of the seed germination and seedling development at lower (25%) concentration. Increase in effluent concentration showed decrease in seed germination and vigour index. The treated effluent can be used as a liquid fertilizer after dilution to a suitable concentration.

Key words: Tomato, Seed germination, Seedling growth, Sugar industry

SV/P-12

Accumulation of Arsenic in Locally Grown Crops and Vegetables of Sahibganj, Jharkhand: A Threat to Food Security

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Arsenic contamination in groundwater of South East Asia is a much talked about issue. The calamity due to arsenic contamination in the Bengal Delta Plain (BDP) has been an alarming one. Several studies have indicated that West Bengal, Uttar Pradesh, Manipur, Assam, Bihar and Jharkhand to be affected with arsenic in its groundwater. In Jharkhand, three blocks of Sahibganj have been reported in previous studies to contain arsenic in its groundwater. The present study was undertaken to investigate the concentration of arsenic in groundwater utilized for irrigation, surface soil and uptake and translocation in edible crops and vegetables locally grown in three blocks of Sahibganj district, namely Sahibganj, Rajmahal and Udhawa. Groundwater, surface soil and plant samples were collected from the three blocks. Plants samples were collected from the agricultural fields in their harvesting period. Soil samples were collected from the same sampling point from where the plant sample was taken. Onsite measurements and laboratory analysis was done for hydrochemical parameters to understand the nature of the groundwater favouring arsenic enrichment. Arsenic and other metal estimations were done in ICP-OES in all the samples to find the degree of contamination. Arsenic concentration ranged between 1 and 133µg/L in groundwater with Badi Kodarjanna village of Sahibganj block showing the maximum value. Fe and Mn were found between 0.05 - 0.20 mg/L and 0.10 - 0.84 mg/L respectively. Among ions nitrate varies from 0.8 - 2.6 mg/L and ammonium varies from 0.2 - 5.26 mg/L. High negative values of

ORP indicate the extreme reducing condition in groundwater.

Key words: Arsenic, Bioavailability, Crops, Uptake, Health impacts

SV/P-13

Effect of intermittent exposure of SO_2 on the root-knot disease and plant growth of bottle guard and cucumber

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An investigation was carried out to examine the individual and interactive effects of intermittent exposures of SO_2 on the morphological and physiological parameters of plants and on the root-knot disease development on bottle gourd and cucumber. Seedlings of the two cucurbits (four week old) were transplanted in the earthen pots filled with the autoclaved soil (soil and compost 3:1 ratio) and were inoculated with the root-knot nematode, *Meloidogyne incognita* (2000 juveniles/kg soil). Two days after inoculation the plants were exposed to 25, 50 and 75 ppb SO_2 for 5 hrs on alternate day for 60 days. The plants exposed to 75 ppb SO_2 showed characteristic interveinal leaf chlorosis and exhibited relatively lower photosynthetic rate, lower stomatal conductance, higher transpiration and longer trichomes. The growth, biomass production and yield were significantly suppressed in plants exposed to 75 ppb SO_2 over control. Both the cucurbits were found susceptible to the root-knot nematode and developed characteristic oval, large and fleshy galls on the roots. The nematode disease became severe on the plants exposed to 75 ppb SO_2. The gas exposure significantly enhanced the fecundity and egg mass production of *M. incognita*. The soil population of root-knot nematode was also higher in the root zone of plants exposed to 75 ppb SO_2. Synergistic interaction was recorded between the nematode and 75 ppb SO_2. However, an effect of 25 or 50 ppb was not observed on the plant growth or root-knot development.

Key words: SO_2, Cucurbits, Chlorosis, Root-knot nematode, Reproduction, Plant physiology

SV/P-14

The Effects of Salinity Pretreatment of *Glomus fasciculatum* on Induction of Sality Tolerance in Barley Plants

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In the environmental stress, salinity stress is a serious problem that has affected about two million square kilometers of using lands in agriculture and therefore a major limiting factor in crop production around the world is considered. Furthermore, the studies have shown that the efficiency of microorganisms that are resistant to the salinity stress can be effective in revitalize and production of resistant materials. In order to investigate the effect of salinity on the *Glomus fasciculatum* fungus in the induction of resistance to salinity stress *Barley* plant, a research as a factorial randomized complete block design in the agricultural research greenhouse of *Saveh Islamic Azad University* in 2014 was conducted. The examined Factors included: The first factor was the *mycorrhiza* pretreatment at 0, 25, 50 and 100 mM salt the second factor by applying the salinity on plants at 0, 25, 50, 100 and 200 mM salt. According to the variance analysis results *mycorrhiza* pretreatment with salt and salinity treatment in plant on the one percent probable ($p>0.01$) on the fresh and dry weights of aerial organism and bush and root, *LA*, *RGR*, *RLAGR*, *ULR*, *peroxidase* activity, *catalase* activity, *polyphenol oxidase* activity, *malondialdehyde* and *proline* has affected. Also its interaction effect has meaningful effect on root dry weight, *LA*, *RGR*, *peroxidase* activity, *catalase* activity, *polyphenol oxidase* activity and *proline* on the one percent probable ($p>0.01$) and on the *RLAGR* and *malondialdehyde* on the five percent probable ($p>0.05$) was significant. The mean comparison results showed that *mycorrhiza* pretreatment with salt and salinity stress in plant was decreased plant growth parameters and was increased the activity of the biochemical characteristics in the *Barley* plant; it was also found that *Barley* plant in the

of 25 mM treatment is resistant to salinity stress, but by increasing salt amount, plant is damaged. 25 mM salinity treatments in the plant in the absence of *mycorrhiza* pretreatment by salt have the best effect on it.

Key words: Salinity stress, Proline, Barley, Antioxidants, Mycorrhiza

SV/P-15

Interactive Effect of Agricultural Utilization of Sewage Sludge and Fly Ash on Physiological and Yield Response of *Raphanus sativus*

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Unprecedented population growth, industrialization and urbanization have aggravated the issue of proper management and safe disposal of solid wastes like Sewage sludge and Fly ash in most of the developing countries as they lack proper solid waste management practices, resulting in environmental degradation. Using Sewage sludge (SS) and Fly ash (FA) in agriculture might be a sustainable approach for managing such wastes. However, these wastes may contain toxic substances like heavy metals, that may cause detrimental effects on the biota, water and soil, and consequently on humans. The aim of the present study was to assess the physiological and yield response of *Raphanus sativus*, a commonly consumed vegetable in Indian households, at different SS and FA ratios as well as mixtures. Four amendment ratios of fly ash (FA) - sewage sludge (SS) mixture, viz. 4 (SS):1 (FA), 4:2, 4:3, and 4:4 denoted as A, B, C and D, respectively, mixed with the soil at different ratios were taken to assess their effect on the physiological response of *Raphanus sativus* for this study.

Results showed that total chlorophyll contents increased significantly in all the amendments with maximum increase in C40 amendment (116.4%), followed by B40 (103.2%) as compared to the control plants. Similarly carotenoids content increased significantly in all the amendment ratios as compared to control plants. However, maximum increase in carotenoid content was reported in C40 (97.3%) followed by D40 (81.6%) and A20 (76.3%) as compared to control plants.

Significant increase of 45.4% has been reported in yield of D20 with respect to the control plants. Total biomass of *Raphanus sativus* increased significantly at all amendments ratios, except A40 and C20. Maximum increase in total biomass was observed in D20 followed by C40 as compared to control. Overall experimental results showed that mixture B, C and D were found to be suitable in terms of better yield and positive physiological response.

Key words: Sewage sludge, Fly ash, *Raphanus sativus*, Chlorophyll, Yield, Biomass

SV/P-16

Complimentary Application of Advanced Analytical and Imaging Techniques: A Tool to Investigate Arsenic Metabolism in Plants

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Arsenic (As) is a ubiquitous element that is nonessential for plants and toxic to all forms of life. The continuous loading of As in arable land by means of contaminated irrigation water is of serious concern not only as a route for dietary human As exposure through plants but also due to As toxicity and yield losses. In the view of diversity of chemical forms of As existing in the environment and their variable toxicity to living systems, investigation of arsenic species and its localization in plants is of paramount significance. The recent advancements in analytical and imaging techniques have greatly enriched our knowledge about arsenic metabolism in plants. However, in the view of sensitivity and selectivity limitations of each technique, their complementary application is required to obtain more complete information about As (or other element) metabolism and toxicity.

The speciation and distribution of As in leaves of the aquatic plant *Ceratophyllum demersum* L. was investigated under environmentally relevant conditions through chromatographic and synchrotron based techniques in a complementary way. While

chromatography is more sensitive to identify different variants of thiol bound As, it requires extraction of plant thus loosing spatial information. In this respect, synchrotron based techniques have been proven to be unique for in situ investigation of elements and their chemical forms. Speciation through HPLC parallel coupled to inductively coupled plasma-mass spectrometry and electrospray ionization-mass spectrometry [HPLC-(ICP-MS)-(ESI-MS)] revealed up to 20 As-containing species binding up to 60% of accumulated As. Of these several thiol-bound (phytochelatins [PCs], glutathione, and cysteine) species were identified, including many novel As complexes. The tissue resolution speciation in intact frozen hydrated leaves, performed through confocal X-ray absorption near-edge spectroscopy (μXANES), showed that the epidermis of mature leaves contained the highest proportion of thiol (mostly PC)-bound As, while in younger leaves, a lower proportion of As was thiol bound. At lethal As concentrations, the percentage of unbound arsenite (AsIII) increased in the vein and mesophyll of young mature leaves. At the same time, cellular element distribution through X-ray fluorescence (μXRF), in the same tissue, showed an increase of total As in the vein and mesophyll. Taken together, at lethal concentration level of As in the form of AsIII increased in vein and also spread in the mesophylls. Arsenic also disturbed the distribution pattern of micronutrients in leaves, as observed by the Zn distribution μXRF map.

The cellular distribution and speciation of As could be correlated with onset and progression of toxicity observed at biochemical and biophysical level. The biochemical and biophysical investigation showed that photosynthetic pigments were inhibited first, started at much lower As concentrations (0.5μM), however, the core photosynthesis (e^- transport and PSIIRC) was not affected up to sub-lethal As concentration (up tp 2μM). At lethal As concentration (5μM), the photosynthesis was completely inhibited resulting in enhanced generation of superoxide and eventually the appearance of severe toxic symptoms.

Thus, As toxicity was correlated with a change in As distribution pattern and As species i.e. increase of arsenite in mesophylls, the photosynthetically active tissue, rather than a general increase in many tissues.

Key words: Arsenic, *Ceratophyllum demersum*, X-ray absorption near-edge spectroscopy, X-ray fluorescence spectroscopy

SV/P-17

Induced Herbicides Genotoxicity in the Root Meristems of *Fagopyrum esculentum* Moench (Buckwheat)

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The present study summarizes information that herbicides show detrimental effect in the environment above optimum level. The root tips were treated with 0.25%, 0.5%, 0.75% and 1.0% concentrations of both herbicides at room temperature for 3 hrs. In the present investigation a comparative cytological study was conducted to study the effects induced by Glyphosate and Atrazine on root meristematic cells of *Fagopyrum esculentum* Moench. The result revealed that both the herbicides had depressive effects on the mitotic index as compared to their respective controls. The percentage reduction in the Active Mitotic Index (AMI) value was higher in case of Glyphosate treatment as compared to Atrazine. It was evaluated that both herbicides induced different types of abnormalities comprising scattering, precocious movement; stickiness, bridges, laggard etc. which were frequent along with the increasing doses of treatment. It is almost clear that Glyphosate is more mitodepressive and chromotoxic as compared to Atrazine as it registered the highest level of chromosomal damaging. Scattering and stickiness are the common abnormalities prevalent among them.

Key words: *Fagopyrum esculentum*, Herbicides, Chromosomal anomalies, Mito-depressive, Mitotic Index

SV/P-18

Effect of Heavy Metals Cadmium, Copper, Zinc and Mercury on Two Commercial Varieties of Mustard (*Brassica juncea*)

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Environmental Pollution due to heavy metals (HM) is a global issue. Both terrestrial and aquatic

ecosystems are severely affected with HM due to various anthropogenic activities such as mining, improper waste disposal practices, extensive use of potentially hazardous agrochemicals. These HM persist indefinitely in the soil thereby posing an ever increasing threat to the whole ecosystem. HM such as Cadmium (Cd), Copper (Cu), Zinc (Zn), Mercury(Hg) etc. are established environmental pollutants that cause toxic effects to wide variety of plants, thereby reducing the yield and productivity. Plant responses to HM stress have been studied extensively. Mustard is considered as one of the most important oil yielding crop of North India and it is mainly used as edible oil. The present study demonstrates the effect of different HM i.e. Cd, Cu, Zn and Hg on two commercial varieties of Mustard (*Brassica juncea*) i.e. RH-30 and Laxmi. The toxic effects on seed germination, plant length, plant growth, seedling vigor of mustard (*Brassica juncea*) were studied in i*n-vitro* conditions using different concentrations (10, 25, 50, 100 and 200 *mg/L)* of all the HM along with the control. Results indicate that HM adversely affect the normal growth of plants by reducing seed germination, plant length and seedling vigour in comparison of control. Hg resulted as the most toxic metal followed by Cu and Cd. Hg completely inhibited seed germination and seeding growth in both the varieties at all the concentration. However, variety specific differences were observed in all the studied parameters in case of other studied HM. It was observed that in Cu and Cd treated plants of both the varieties decrease in growth parameters were there with the increase in HM concentration. Whereas Zn resulted in higher seed germination, plant length and seedling vigour in both varieties as compared with other tested HM. Out of two varieties, RH-30 was more tolerant then Laxmi to HM stress.

Key words: Agrochemicals, Cadmium, Copper, Zinc, Mercury, Heavy metal, *Brassica juncea*

SV/P-19

Improvement in Growth and Biochemical Responses of Wheat with Integrated FYM and Inorganic Fertilizers Use in Halomorphic Soil

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A composite soil sample was collected from the Jankipuram area in Lucknow district (Semi- arid region), this native soil was evaluated a halomorphic soil (pH, 8.4; E.C., 3.8 mS/cm, $CaCO_3$, 0.8%, exchangeable sodium, 12.5%). Soil amended with various doses of NPK fertilizers viz., control**;** 120:60:60; 240:120:120; 360:240:240 respectively and FYM (Farm yard manure) compost @ 10 t ha^{-1} in combination with NPK (360:240:240) fertilizers. Wheat growth (shoot length and dry matter yield) and biochemical constituents increased with increase in doses of NPK fertilizers in soil; whereas application of FYM in soil along with NPK (360:240:240) increased shoot length by 255%, dry weight production by 159% and total chlorophyll content by 82.5% and protein content by 181.22% over NPK fertilizers(used singly in the native soil). Use of FYM in combination with NPK fertilizers also increased nutrients (N,P,K,Zn and Cu) status of the soil.

Therefore study concluded that, the native soil with adverse conditions of their physic-chemical properties, used first time for agricultural practices, needs a high dose of NPK fertilizers (360:240:240) for optimum growth yield of wheat. The NPK fertilizers in combination with FYM compost was enhanced crop production and nutrients condition in soil, more effectively.

Key words: Halomorphic soil, NPK fertilizers, Wheat, Biochemical responses, FYM, nutrients

SV/P-20

Bioavailable Fraction of Soil Arsenic and Related Threat to Plants

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Arsenic is a toxic metalloid contaminating soil and water, naturally and through various anthropogenic activities. Arsenic contamination is posing risk to millions of population worldwide. It has been found at various places that arsenic in soil system is above its threshold limit of 20 mg kg^{-1} given by European Union for agricultural soils. Due to its high concentration in soil, it is being absorbed by all the plants, but it is more concentrated in leafy vegetables and paddy crops. The toxicity of arsenic is largely dependent on its bioavailable fraction content in the

soil. The total arsenic content in soil is not a real estimate of its toxicity to plants. The assessment of bioavailable soil arsenic fraction may reflect actual arsenic toxicity at particular site. This may help in formulating effective arsenic bioremediation programmes.

Key words: Arsenic, Soil, Bioavailable fraction, Plants

SV/P-21

The Inhibitory Effects of Heavy Metal Stress on Growth of *Vigna radiata* L. Alleviates via Nitric Oxide

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Environment pollution due to toxic heavy metal is mostly due to anthropogenic activites and there are many reports that the agricultural field adjoining to industrial areas contain to varying load of heavy metals. In the present study sodium nitroprussides (SNP) mitigates the effects of heavy metal stress on mung bean. The stimulatory effects of SNP on growth persisted even in the presence of lead (Pb). Mung bean seedlings were grown in soil supplemented with graded concentrations of lead with and without SNP. Mung bean seedlings growth decreased in the supplemented at higher concentration of Pb i.e. 2g/kg soil as compared to control plants. Pre-treatment of mung bean seedlings for 3h with 1mM SNP resulted in significant reduction of detrimental effect of heavy metal stress on growth and morphology. Photosynthetic pigment, total soluble sugar, nitrate reductase activity and protein concentration decreased with increased concentration of heavy metals. Gradual increase in lipid peroxidation was observed in response to Pb. The inhibitory effects of heavy metal on growth were accompanied by increased activities of antioxidant enzyme viz. superoxide dismutase, catalase and adiate on. The purpose of the study is to help understand how SNP mediates the biological process in mung bean under heavy metal stress.

Key words: Antioxidants enzymes, Heavy metal stress, Lead (Pb), Lipid peroxidation, *Vigna adiate*

SV/P-22

Genotoxic and Mito-Inimical Impact of Heavy Metals in Root Meristems of Coriander (*Coriandrum sativum* L.)

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Globally, the environment is facing the threat of toxic effects of heavy metals. It is undisputed that various groups of heavy metals are adversely affecting the genomic constitution of various floras through bioaccumulation. Basically, some metals are essential for proper growth and development of plants, at an appropriate concentration. However above optimum level heavy metals induce several stressful genotoxic responses and distort the synchronisation of cell division. Chromosomal plant assessment is an important array for estimation of mito-depressive behaviour of heavy metals at an elevated level. The present study aims to observe the possible genome damaging impact of heavy metals viz. $Pb(NO_3)_2$ and $CdCl_2$ in the root meristems of *Coriandrum sativum* L. in relation to mitosis. For this purpose four variable concentrations of $Pb(NO_3)_2$ and $CdCl_2$ viz., 50ppm,100ppm, 150ppm, and 200ppm were taken and a control set was maintained separately. The phenomenon of cyto-chromotoxicity was exaggerated as concentration level increases which was recorded in form of reduced active mitotic indices and enhanced chromosomal anomalies such as stickiness, c-mitosis, unorientation, precocious, bridges, laggards, *etc*. Conclusively, both the heavy metals impart genotoxic responses but $Pb(NO_3)_2$ shows greater extent of chromotoxic behaviour in compared to $CdCl_2$.

Key words: Genotoxic, Mito-inimical, Chromotoxicity, $Pb(NO_3)_2$, $CdCl_2$, Exaggerated, Anomalies, *Coriandrum sativum* L.

SV/P-23

Antioxidative Response of Tomato (*Lycopersicon esculentum* Mill.) to Copper Stress

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Thirty days old seedlings of tomato (*Lycopersicon esculentum* Mill.) treated for four days by addition of different concentration i.e. 0.0, 0.5, 1.0, 1.5, 2.0 and 2.5 mg Cu kg^{-1} soil. 0.5, 1.0 and 1.5 mg Cu kg^{-1} soil gave an stimulating effect on growth being maximum at 1.5 mg Cu kg^{-1} soil, however a decrease in growth, more pronounced in roots than in leaves and in stems were observed at 2.0 and 2.5 mg Cu, as compared to control. 2.0 and 2.5 mg Cu induced an increase in the rate of lipid peroxidation. An enhancement in the activity of catalase, adiateon and superoxide dismutase of leaves were observed upto the concentration of 1.5 mg Cu. These results together indicate that a toxic concentration of copper (2.0 and 2.5 mg Cu kg^{-1} soil) induces oxidative stress and differential responses of antioxidant enzymes in plant.

Key words: Catalase, Copper, *Lycopersicon esculentum*, adiate on, Superoxide dismutase

SV/P-24

Assessment of Growth and Yield of Tuberose Cultivated under Different Sodicity Levels

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A field experiment was conducted to screen the sodicity tolerance of tuberose during 2011-2012 at Gehru Research Centre of CSIR-National Botanical Research Institute, Lucknow, (India). The beds were prepared in the field having natural sodic heterogeneity with different sodicity levels from control pH 8.1-8.5 to 10.50 with the rounded difference of pH 0.50. The 25 ton ha^{-1} FYM was mixed properly in each bed of the experiment. In the month of February 2011 uniform size sprouted tuberose bulbs were transplanted at 40 x 25 cm, row to row and plant to plant distance in the beds of 4 x 3 meter length and width size following the Randomized Block Design. The irrigations, hoeing and weeding operations were conducted uniformly for each experimental bed. The plant growth and yield observations on plants survived per bed, number of sprouts per plant clump, plant height, number of leaves per plant, length and width of leaves were recorded at monthly intervals after two months of transplantation of sprouted bulbs. The number of spikes per plant clump, length of spike, number and length of florets, number of bulb lets per plant clump and fresh and dry weights of plant clumps were also recorded accordingly. After two years of study it was observed that except the parameter width of leaves, all the growth and yield attributes of tuberose plants decreased though at all sodicity levels but drastically at higher sodicity levels than that of control pH level 8.1-8.5. While plant height, length of leaves, spikes and number of florets and fresh weight of plant clump parameters were reduced to increasing sodicity levels with significant difference to each other level of sodicity. No significant reduction was noticed for plant height and number of leaves from pH level 8.51-9.0 to 9.1-9.5. Tuberose being bulbous crop, its above ground plant growth totally depends on nutrient availability from its bulb which develops underground. Tuberose bulbs properly develop in loose and fertile soils, while sodic soils with high exchangeable sodium percentage (ESP) and bulk density, low impermeability and reduced primary and micronutrients availability do not provide the favourable conditions for proper development of tuberose bulbs. Considering the unfavourable sodic soil conditions our two years findings; it is recommended that tuberose can be cultivated successfully up to pH 9.0 with proper manuring and cultural practices.

Key words: Tuberose, Sodic soil, ESP

SV/P-25

Nickel Induced Changes in Germination and Biochemical Parameters in *Vigna unguiculata* (L.) Walp.

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Public concern about environment is very important component necessary for the existence of both man and other biotic organisms. Quality of natural resources like soil, water and biosphere is greatly affected by environmental pollution. In view of the possible risk associated with soil-crop-food chain transfer, metal contamination in crop lands is

considered as a major topic of global concern. The accumulation of heavy metals in the aquatic system and also in soil can cause serious problems on environment and organisms affecting negatively on the stability of ecosystems and can also influence the animals and human health. Seed is the developmental stage that is highly protective against external stress in plant life cycle. However soon after adiateons and subsequent vegetative developmental processes, they become stress sensitive. Therefore, seeds are thought to be carefully monitored against such external parameters as light, temperature and nutrient in order to maintain the protective state although such critical regulatory mechanisms are likely to operate in seeds at the onset of imbibitions.

A germination study was conducted in Cow pea [*Vigna unguiculata* (L.) Walp.] in order to find out the effect of Nickel toxicity on germination, growth and biochemical alteration. The seeds of cow pea were germinated in six different concentrations of Nickel chloride solution having 0-100 mg/l of Nickel. It was found that seedling vigour index, metal tolerance index were reduced and the percentage of phytotoxicity was increased. The pot culture experiment revealed that, the growth parameters, percentage of moisture content in plant, total chlorophyll content, total protein content were decreased but free proline content was increased with increase in concentration of Nickel. It was also observed that seeds of cow pea showed better result in terms of growth, percentage of moisture content and different biochemical parameters in 20 ppm of Nickel at 10, 20 and 30 days of growth thereby indicating that Nickel within 20mg/kg has stimulating effect on the plants growth. From the result of this investigation, it can be concluded that Nickel at lower concentration has a stimulating effect on plant growth and will inhibit the same at higher concentrations.

Key words: Nickel, Cow pea, Germination, Growth, Biochemical parameters

SV/P-26

Impact of Addition of Soil Inputs of Varying Resource Quality on Microbial Biomass and Crop Yield in Tropical Dryland Agroecosystem

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Major objective of any agronomic management strategy is to enhance crop productivity. However, to sustain crop productivity and fertility for long-term poses a global challenge. Soil amendments are generally required for maintaining soil fertility. Soil microbial biomass, the labile fraction of soil organic matter has been considered as an index of soil fertility. The impact of addition of soil amendments having contrasting resource quality on soil microbial biomass dynamics and also their impact on crop productivity is needed in general and especially in dry tropics. This study was conducted to evaluate the effect of application of exogenous organic inputs on soil microbial biomass dynamics and crop yield under rice-wheat-summer fallow crop sequence in tropical dryland agroecosystem. The treatments involved addition of equivalent amount of N through chemical fertilizer (CF) and three organic inputs, viz. Sesbania shoot (high quality resource, HQR), wheat straw (low quality resource, LQR) and Sesbania+wheat straw (mixed quality, MQR) besides control (CO). Microbial biomass C and N (MBC and MBN) were analysed at vegetative, grain forming and crop maturity stages of both the cycle and also during summer fallow. Across all the treatments through the annual cycle considerable variation was found in levels of soil MBC and MBN; highest levels found during summer fallow followed in decreasing order in wheat crop and minimum in rice crop. In both the crops, the levels of MBC and MBN increased distinctly from seedling to grain forming stages, and then increased to maximum at crop maturity. Maximum MBC and MBN was found in HQR followed in a decreasing order by MQR>LQR>CF>CO in rice crop period. However during wheat period and summer fallow highest levels of MBC and MBN were found in MQR followed in decreasing order by LQR>HQR>CF>CO. Higher rice yield was obtained in CF and HQR whereas LQR showed highest wheat yield compared to other treatments. It was found that in MQR, the levels of MBC and MBN was higher throughout the annual cycle which in turn supported higher total yield. It may be concluded that application of MQR will be beneficial in sustaining long term soil fertility and productivity in tropical dryland agroecosystem.

Key words: Soil microbial biomass, Tropical dryland agroecosystem, High and low quality resource inputs

SV/P-27

Ultrastructural Alterations and Sensitivity of Cytoskeleton in Response to Arsenic Stress in the Root Cells of Mungbean

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Influence of arsenic (As) on growth and development of mungbean (*Vigna adiate*) was assessed in pot cultures with sodium arsenate ($Na_2HasO_4.7H_2O$) in concentrations ranging from 5 to 35 mg/kg of soil. Five kilogram of soil was used for each pot and each treatment was run in triplicate. Plant growth was progressively curtailed with increasing concentrations.

Soil-applied As in mung bean plants had an explicit effect on root development. An increase in soil concentration of the element enhanced its negative effect on roots. Root growth was affected with reduced number of lateral roots and nodules. Roots turned dark or yellow brown. Length of roots was found to be lower (pd"0.05) at a dose as low as 5 mg As kg^{-1} soil. Reduction in root length was more pronounced at pre-flowering and flowering stages than post-flowering stage with maximum decrease in root length at the flowering stage. At 30 mg As kg^{-1} soil, root length was reduced by 67.92, 77.34 and 70.24% at pre-flowering, flowering and post-flowering stages, respectively.

Ultrastructural studies of root cortex cells from plants exposed to arsenic revealed extensive damage to cells. Cortical cells of root of control plants contained only a few small vacuoles, dense cytoplasm with many organelles and a thick cell wall. A thin cell wall with a wavy appearance was seen in most of the root cells of mature root tissues exposed to As. There was increase in size of vacuoles. Fragmentation or vesiculation of ER cisternae was observed under As stress.

Arsenic affected arrangement of microtubules and inhibited cell division and elongation in root tissue. A low mitotic index in root meristem was recorded due to As. The treated root tip cells were shown to have disoriented microtubules as compared to control. Microtubules got shortened, disassembled and irreversibly depolymerized. In the treated root tip cells, epidermis and outer cortex cells were distorted. Most cells of middle cortex were deformed with disoriented cortical microtubules, and unusually large intercellular spaces develop. The study showed that cytoskeleton in root tip cells is sensitive to As and the growth and development of these cells gets affected due to disruption of microtubules and disorganization of tissues.

Key words: Arsenic, Mungbean, Ultrastructure, Mitosis

SV/P-28

Effect of Seed Rate and Weed Control Methods on Yield of Direct Seeded Rice *(Oryza sativa* L)

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A field experiment was conducted during kharif season of 2013-14 at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) to evaluate the efficacy of different herbicides *viz.*, pendimethalin @ 1.0 kg ha^{-1} (Pre.em.), bispyribac-sodium @ 25 g ha^{-1} (Po.em) at 30 DAS and ready mix chlorimuron-ethyl @ 4 g ha^{-1} (Po.em.) at 30 DAS with three seed rate 40,50,60 kg ha^{-1} to see their effect on weeds, crop growth, yield and economics of rice. Weed free and weedy check were also included in the experiment. The field experiment was layout in randomized block design (factorial) with three replications. Rice variety "NDR-97" was sown by direct line sowing method with recommended does of fertilizers, 120 kg N, 60 kg P_2O_5 and 60 kg K_2O per hectare.

Echinochloa colona and *E. crusgalli* among grasses, *Commelina benghalensis* among non-grasses and *Cyperus rotundus* among sedges were the predominant weeds in experimental field. Uncontrolled weeds in weedy check plots caused an average reduction in grain yield 66.07 per cent over weed free plots. The lowest weed population and dry weight and highest yield attributes and yield 25.39 q ha^{-1} were recorded under 60 kg ha^{-1} seed rate. In chemical control Post-emergence application of bispyribac-sodium @ 25 g ha^{-1} at 30 DAS, produced highest grain yield (24.45 q ha^{-1}). Followed by

Pendimethalin @ 1.0 kg ha^{-1} pre.em .reducing population and dry matter of weeds and it lead to highest grain yield which ultimately fetched highest net return.

Key words: Seed rate, Weed, yield, Direct seeded rice

SV/P-29

Dissipation Kinetics and Safety Evaluation of Emamectin Benzoate 1.5% + Fipronil 3.5% EC in Chilli Fruit

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Chilli (*Capsicum annum* L.) is an important vegetable as well as spice crop and almost cosmopolitan in distribution. The spicy vegetable is the inseparable component of Indian cuisine.It has medicinal properties as green chilli is enriched with vitamins (especially Vit-A and Vit-C), antioxidants and capsaicinoids. This commercial vegetable crop suffers from damage by number of insect pests (viz. mites, thrips etc) causing considerable yield.The mixed formulation of Emamectin Benzoate 1.5% and Fipronil 3.5% EC, is a mixture of Emamectin benzoate, a novel semi-synthetic epi-methyl amino derivative of the natural product of Abamectin consisting of 16 membered macrocyclic lactone, effective against Lepidopteron class of insect and Fipronil, a phenyl pyrazole, broad-spectrum insecticide, effective against thrips, mites and fruit borer etc.The Mixture formulation will provide a new option for the control of insecticides including those with resistance to other insecticides. To find out the persistence behaviour, a multilocational supervised field experiment at four different locations (viz., IGKV, Raipur; B.C.K.V., Mohanpur, Nadia, west Bengal and TNAU, Coimbatore and Dhakrani, Dehradun) in India were conducted during the season 2011-2013. The formulation was applied at field standard recommended dose of 750 mL/ha (T_1) and double the recommended dose 1500mL/ha (T_2).We developed an effective analytical method for the quantification of Emamectin Benzoate and Fipronil in chilli fruit sample using LC-MS/MS in MRM mode and GC-ECD respectively. The method includes extraction with acetonitrile: water (9:1) for Emamectin Benzoate and ethyl acetate for Fipronil as solvent for chilli fruit sample separately followed by clean up using dispersive solid phase extraction (d-SPE) with florisil and GCB. The average recovery percentage was ranged between 86-110% for chilli matrices. The developed method was sensitive enough to set the limit of quantification (LOQ) at 20 ng/g and 50ng/g for chilli fruit sample for Emamectin Benzoate and Fipronil respectively. The nature of dissipation of both the insecticides was followed by 1st order kinetics irrespectively of any doses. The half life of Fipronil was found between 0.74-0.98 days. There was no Emamectin Benzoate residue after 1st day of application and Pre harvest Interval (PHI) of it thus could not be calculated. PHI for Fipronil was determined in the range of 6.9-8.9 days considering the EU MRL value 0.005 mg/kg for chilli fruit sample. So, it is clear from the study that the application of the mixed formulation will not create any residual toxicity problem in chilli fruit.

Key words: Chilli, Emamectin benzoate, Fipronil, Lc-Ms/Ms, Gc-Ecd, Half-Life

SV/P-30

Cyto-Physiological Response of *Vigna radiata* var. IPM2-03 to Herbicide Glyphosate

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Herbicides are the most extensively used agrochemicals and almost all of them have been reported to persist in the environment as such or as breakdown products for several years causing adverse effects on human health and also growth and survival of other living organisms. Some herbicides are capable of producing adverse cytogenetic consequences in exposed non target plants. In addition, their physiological effects are also widely reported and many have been found limiting to plant growth and development as well as to some essential plant processes such as photosynthesis and enzymes activity The genotoxic and physiological effects of the

herbicides on plants are dependent on herbicides usage, herbicide concentration, treatment duration and also the genotype of the plant.

In the present study, the cytogenetic and physiological effects of glyphosate on cytological and physiological parameters of *Vigna radiata* variety IPM2-03 where seen. Glyphosate is a broad spectrum, non selective herbicide. It inhibits schikimic acid pathway, which prevents plant from synthesizing three aromatic amino acids which are useful for growth and survival of plants. Different doses of Glyphosate treatment were given to plants in the form of foliar spray on 21 day after sowing . Chromosomal anomalies like chromosomal bridges ,laggards, clumping and micronuclei were observed which are indicative of mutagenic potential of the herbicide. Photosynthetic pigments, protein content decreased significantly with increasing herbicide concentration , while the peroxidase, catalase, and superoxide dismutase activity increased by increasing the concentration of herbicide.

Key words: Herbicides, Glyphosate, *Vigna radiata*

SV/P-31

Response of Antioxidative Enzyme Activity in Rice when Planted along with Accumulators in Arsenic Contaminated Soil

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An experiment was conducted to study the antioxidative enzymatic response in rice planted along with accumulators in arsenic contaminated soil. For this study 2×2m plots were prepared and treated with 50 ppm arsenic (As) in the form of sodium arsenate. Three known accumulators viz. *Phragmites australis*, *Vetiveria zizanioides* and *Pteris vitatta* were planted along with rice in combinations (Pt+Os, Ph+Os, Vt+Os and Os) in treated and untreated plots. In this study, 75.5% survival of rice was found when planted along with accumulators whereas in the case of without accumulators, only 31% of survival of rice was observed. It was observed that there were significant differences in morphological as well as biochemical changes in rice with accumulators when compared with rice without accumulators. Enhancements in antioxidative enzymes (SOD, CAT, AR and APX) were found in case of rice without accumulators while there was no significant difference in antioxidative enzyme activity of rice along with accumulators. The accumulators with rice in treated soil showed an increased antioxidant response as compared to accumulators with rice in non-treated soil. Results of the present study suggested that these combinations of rice and accumulators will be useful for the crop survival and yield in As contaminated soils.

Key words: Antioxidative enzymes, Arsenic, Accumulators, Rice

SV/P-32

Effects of RuO_2 Nanoparticles on Rice Seedlings

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Anthropogenic activities have released metal oxide nanoparticles (NPs) into the environment which become a serious problem to the living systems including plants. The present study was conducted to investigate the impact of RuO_2 NPs on growth and metabolism of *Oryza sativa* cv. Pusa 1121 seedlings. The seeds were soaked for 3 h in different concentrations viz. 0.1, 0.2, 0.3 and 0.4 ml/L of RuO_2 NPs. The seeds soaked in distilled water were taken as control. Experiment was conducted in petri plate culture for germination and in pot culture for growth in triplicate. Seed germination (SG), radicle (RL) and plumule length (PL) were recorded in alternate days. Inhibition in SG, RL and PL was concentration dependent under NP treatment. Pre-treated rice seeds were grown in pot culture filled with sterilized sand and Hoagland solution was added as nutrient supplement. Twenty-one-days old seedlings were used for biophysical and biochemical analyses. Fresh (FW) and dry weight (DW) of the seedlings, pigment, sugar and protein content significantly decreased in seedlings treated with RuO_2 NPs as compared with control. Antioxidant enzyme activities viz. superoxide dismutase, catalase and peroxidase were stimulated under NP treatment to avoid the oxidative damage. The results evinced that the application of RuO_2 NPs suppressed the growth of rice seedlings.

Key words: Antioxidants, Nanoparticles, Oxidative stress, Rice seedlings, Ruthenium oxide

SV/P-33

Effect of Cement Dust Pollution on Biomass and Primary Productivity of *Cajanus cajan L.*

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The study area was confined to the *Cajanus cajan* situated in the prevailing wind direction of Kalyanpur Cement Limited, Banjari, Rohtas, Bihar to assess the effect of cement dust pollution on biomass and primary productivity of *Cajanus cajan. The* biomass and primary productivity were found to be higher at each sampling date of the control plant than polluted one.A maximum reduction of 23.01% of total biomass was recorded at the age of 210 days due to cement dust pollution.

Key words: Cement dust, Biomass, Primary productivity, *Cajanus cajan*

SV/P-34

Ecological Study with Refrence to Bloom Forming *Cyanobacteria* of River Ken in District Banda, U.P., India

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All aquatic ecosystems have ability to create balance their feasibility due to their potential to assimilate certain amount of pollution spills, but when these limits have been exceeded, the eco-system starts to loose their strength. In India every year, our rivers receive a lot of harmful domestic and industrial effluents. This condition of rivers supports the luxuriant growth of bloom forming of algae, which becomes extremely high in the summer season due to presence of excess amount of nutrients. The presence of cyanobacteria in such water bodies pose serious health hazards to humans and aquatic or non-aquatic life forms that live in or feed on the water. Blue Green algae or cyanobacteria have therefore been the subject of intensive study. During the present study in the summer 2014 we have identified 18 genera of cyanobacteria *(a) Anabaena, (b) Aphanocapsa, (c) Aphanothece, (d) Aphanizomenon, (e) Calothrix, (f) Cylindrospemum, (g) Chroococcus, (h) Gloeocapsa, (i) Gloeotrichia, (j) Gloeothece, (k) Lyngbya, (l) Microcystis, (m) Merismopedia, (n) Nostoc, (o) Nodularia, (p) Oscillatoria, (q) Phormidium* and *(r) Spirulina* form river Ken at Banda between Ganchha to Chillaghat. The major bloom forming cyanobacteria were *a, b, c, d, g, i, k, l, n, o, p* and *r* total 12. The effect of bloom forming cyanobacteria on river Ken and its effect on biota, and the role of meteorological changes and how we can manage bloom forming in a positive way in biodiversity of Ken. The approximate number of scattered water pockets of bloom beside the river bank is also important to know the stretch of blooming. In the stretch of studied area of river only reason of pollution is sewage, household waste, municipal waste and other common reason like washer men and crimination. The absence of chemical factory and industrial area makes this study more natural.

Key words: Cyanobacteria, River Ken, Water blooms, Biodiversity, Biota, Meteorological condition, Hazards

SV/P-35

Preference in Absorption and Biochemical Responses of *Salvinia molesta* and *Lemna minor* Species to Chromium in Industrial Effluent

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The free floating hydrophytes *(Salvinia molesta* Mitchell and *Lemna minor* L.) were exposed to various concentrations of industrial effluent (0, 25, 75, 50 and 100%) collected from outlet of common effluent treatment plant in Unnao district (U.P., India). Some potentially toxic heavy metals were determined in industrial effluent (Cr, 0.95; Cu,0.05;Ni, 0.75 and Zn, 0.38 mgl^{-1}). The hydrophytes *S. molesta* accumulated high concentration of Cr (4-5 times more) as compared to *L. minor* species. Whereas, *L. minor* accumulated higher content of Zn and Cu content as compared to *S. molesta* with exposure of some industrial effluent. When, these hydrophytes exposed to various concentrations of Cr, singly, *L. minor* accumulated higher content of Cr as compared to *S. molesta*, decrease in biochemical constituents such as total chlorophyll, protein and sugar contents and enzymes activity (catalase and peroxidase) was higher in *L.*

minor as compared to *S. molesta* species. The decrease in biochemical constituent (pigments, protein, sugar, contents and activity of catalase and peroxidase) due to excess Cr was more prominent in *L. minor* as compared to *S.molesta*. Therefore study concluded that, the factors of water affected accumulation of Cr in both macrophytes.

Key words: Chromium accumulation, *L. minor*, *S. molesta*, Biochemical constituent, Effluent

SV/P-36

Germination, Growth and Metabolism of Cabbage Plants Exposed to RuO_2 Nanoparticles

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The present study was aimed to observe the effect of ruthenium oxide nanoparticles (RuO_2 NP_S) on cabbage (*Brassica oleracia* var. Capitata). The seedlings were treated with four concentrations 5.4, 10.8, 16.2, 21.6 µg/ml of RuO_2 NPs in hydroponic culture. Germination, growth and biochemical parameters of the seedlings were recorded. Pigment contents and reflectance of leaves were recorded to measure growth and health of the the seedlings. It was observed that RuO_2 NPs stimulated germination of seed. Radical and plumule length, number of leaves, height of plant increased with the increasing concentrations of RuO_2 NPs upto 10.8 µg/ml and decreased at higher 16.2, 21.6 µg/ml concentrations. RuO_2 NPs stimulated pigments, protein, sugar content and nitrate reductase activity in lower concentrations. In the leaves percentage reflectance was maximum for plants treated with higher 16.2, 21.6 µg/ml concentrations while lower concentrations did not exhibit any significant difference in percentage reflectance in comparison to control. Antioxidant enzymes viz. SOD, CAT, POX activities and lipid peroxidase activity were lowest in 5.4 µg/ml concentration while highest in 21.6 µg/ml concentration. We can conclude that RuO_2 NPs in lower concentrations 5.4, 10.8 µg/ml is beneficial for germination, growth, and biochemical parameters while higher 16.2, 21.6 µg/ml concentrations are inhibitory.

Key words: RuO_2 NPs, Hydroponic culture, Biochemical parameters, Pigment content, Percentage reflectance

SV/P-37

Allelopathic Effects of *Eucalyptus* Leaf Residue on *Triticum aestivum* L. under Heavy Metal Stress

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The present study deals with allelopathic effect of *Eucalyptus* leaf residue on growth and metabolism of wheat (*Triticum aestivum* L.) seedlings grown under heavy metal (Cu) stress. The dried chopped leaves of *Eucalyptus* were left for one week for decomposition for residue preparation. Residue was mixed with garden soil in 1:1 was taken as 50% concentration. The residue of *Eucalyptus* leaf was considered as 100% concentration.Copper (Cu) was used for heavy metal treatment. The other set was prepared with combined treatment of residue and heavy metal. One set was 50% residue + Cu (1mM) and another was 100% residue + Cu (1mM). Garden soil and pure heavy metal treatment was taken as control. Seeds of wheat were soaked in distilled water for 3 hrs. Ten seeds of wheat were sown in each pot. Morphological and biochemical parameters of 21 days old seedlings were recorded. Root and shoot length decreased under allelopathic stress and combined stress of allelopathy and metal stress. The photosynthetic pigment, sugar and protein content decreased in single residue and Cu treatment, while decreased under combined treatments with maximum decrease in Cu+ 100% residue. Antioxidant enzymes viz. SOD, CAT and POX activities enhanced under all treatments with residue and maximum activity was observed in combined treatments due to the oxidative damage caused by two stresses. The allelochemicals present in decomposed *Eucalyptus* caused severe stress when combined with heavy metal.

Key words: Allelopathy, Antioxidants, *Eucalyptus*, Heavy metal, Stress, *Triticum aestivum* L.

SV/P-38

Impact of Ruthenium Oxide Nanoparticles on Germination, Growth and Metabolism of Broccoli (*Bsrassica oleracea* var Italica)

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Nanoparticles and its disposal via anthropogenic activities are new concern for the environment. Depending upon the concentration ruthenium oxide nanopartiles (RuO_2 NPs) have negative or positive effect on broccoli (*Brassica oleracea* var Italica) grown in hydroponic culture. Germination, radicle and plumule length were recorded in the petriplate culture. Growth of the plants improved at lowest 5.4 µg/ml concentration while inhibited at higher 10.2, 16.8, and 21.6 µg/ml concentrations. Root and shoot length, fresh and dry weight, biochemical parameters viz. protein, sugar, pigment contents , nitrate reductase , lipid peroxidation and total antioxidant activities of the seedlings were recorded to estimate the effects of different concentrations of RuO_2 NPs on the health of the test crop. Laser synthesized RuO_2 NPs inhibited germination of seeds, radicle and plumule length in all concentrations. All biochemical parameters decreased with increase in concentration while sugar content and CAT activitiy increased to maximum level in 21.6 µg/ml concentration. It is evident that RuO_2 NPs in lower concentrations resulted no or little affirmative effect while concentrations above 5.4 µg/ml exhibited adverse effect on growth and metabolism of the test crop.

Key words: Anthropogenic activities, RuO_2 NPs, Hydroponic culture, Biochemical parameters

SV/P-39

Selenium Ameliorates Arsenic Induced Oxidative Stress Through Modulation of Antioxidant Enzymes and Thiols in Rice (*Oryza sativa* L.) Plant

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Arsenic (As) contamination of rice is a major problem for South-East Asia. In the present study, the effect of selenium (Se) on rice (*Oryza sativa* L.) plants exposed to As was studied in hydroponic culture. Arsenic accumulation, plant growth, thiolic ligands and antioxidative enzyme activities were assayed after single (As and Se) and simultaneous supplementations (As+Se). The results indicated that the presence of Se (25 µM) decreased As accumulation by 3-fold in roots and 2-fold in shoots as compared to single As (25 µM) exposed plants. Arsenic induced oxidative stress in roots and shoots was significantly ameliorated by Se supplementation. The observed positive response was found associated with the increased activities of ascorbate peroxidase (APX; EC 1.11.1.11), catalase (CAT; EC 1.11.1.6) and glutathione peroxidase (GPx; EC 1.11.1.9) and induced levels of non-protein thiols (NPTs), glutathione (GSH) and phytochelatins (PCs) in As+Se exposed plants as compared to single As treatment. Selenium supplementation modulated the thiol metabolism enzymes *viz.*, ã-glutamylcysteine synthetase (ã-ECS; EC 6.3.2.2), glutathione-S-transferase (GST; EC 2.5.1.18) and phytochelatin synthase (PCS; EC 2.3.2.15). Gene expression analysis of several metalloid responsive genes (LOX, SOD and MATE) showed upregulation during As stress, however, significant downregulation during As+Se exposure as compared to single As treatment. Gene expressions of enzymes of antioxidant and GSH and PC biosynthetic systems, such as APX, CAT, GPx, ã-ECS and PCS were found to be significantly positively correlated with their enzyme activities. The findings suggested that Se supplementation could be an effective strategy to reduce As accumulation and toxicity in rice plants.

Key words: Antioxidant, Arsenic, Oxidative stress, qRT-PCR, Rice, Selenium

SV/P-40

Effect of Municipal Solid Waste Amendment on Germination and Biochemical Response of *Zea mays*

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Agricultural utilization of municipal solid waste (MSW) is one of the most promising and an alternative option for management of waste. However, there is always a potential threat as MSW may contain potential pollutants (eg. heavy metal, pesticides and other organic pollutants) and pathogens. Therefore, it is essential to check the quality of waste before its land application. In this study, the effect of MSW amendment on seed germination and biochemical response of maize (*Zea mays*) were investigated. A germination test was carried out to see the effect of different concentration (i.e. 25%, 50%, 75% and 100% denoted as T_1, T_2, T_3 and T_4, respectively) of MSW: water extract (1:6, w/v) on germination and seedling growth of maize plants. Apart from that a pot experiment was conducted by mixing MSW at 25%, 50%, 75% and 100% (w/w) amendment ratios to the agricultural soil.

The results showed a significant decrease of germination in all the concentration of MSW: water extract after 72 hrs, in which least germination was reported in T_3 (40%), which was followed by equal germination percentages in T_1 and T_4 (43.33%) as compared to the control i.e. distilled water (80%). Similarly germination index (GI) decreased in all the treatments with maximum decrease in T_4 followed by T_1 as compared to the control. The total chlorophyll, carotenoid and phenol content decreased significantly as compared to the control in all the MSW amendments ($p < 0.05$), however, lipid peroxidase content increased significantly as compared to the control plants ($p < 0.05$). The study concluded that the MSW amendment showed negative effects and is not a good option for growth of maize plant as it has inadequate tolerance mechanism shown by decreased germination rate, GI, chlorophyll content, carotenoid content and increased lipid peroxidase content. So, composting of MSW could be a good option for its agricultural utilization.

Key words*:* MSW amendment, *Zea mays*, Heavy metal, Germination, Chlorophyll, Carotenoid, Lipid peroxidase

SV/P-41

Effect of Salicylic Acid on Morphology, Physiology and Antioxidative Metabolism of Two Wheat Cultivars under Water Deficit Conditions

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Drought is a severe environmental constraint to crop productivity worldwide and India is no exception. Salicylic Acid (SA), a multifaceted plant hormone, regulates different plant defense responses under various stresses. In the present study, the effects of exogenously applied SA (0.05mM) was seen on two wheat cultivars (drought tolerant, Kundan and drought sensitive, LOK 1) undergoing drought stress. Two drought regimes were maintained (50% RWC and 75% RWC) with two different durations, vegetative phase drought starting from 45 days after germination and flowering phase drought from grain filling stages. Results showed that biomass allocation to root was more in SA treated Lok-1 under both vegetative and flowering phase drought as observed by root:shoot weight ratio. On the contrary, in case of Kundan, initially shoot biomass was increased in SA treated plants then increase in root biomass was observed. Harvest index increased in both vegetative and flowering phase drought for SA treatment in both the cultivars but 1000 grain weight increased in flowering phase drought but decreased slightly in vegetative phase drought because of more starch reserve mobilization to roots in SA treated cultivars. Physiological studies showed enhanced photosynthetic rate in SA treated Lok-1 as compared to Kundan initially but then decreased due to SA induced early senescence in Lok-1. Different antioxidative enzymes activity like superoxide dismutase (SOD), ascorbate peroxidase (APX), catalase (CAT) and glutathione reductase (GR) increased along with increased

antioxidants (glutathione and ascorbate) and decreased membrane injury in both cultivars at flowering phase drought. However, during vegetative phase drought activity of antioxidative enzymes, level of antioxidants and membrane stability was increased in both cultivars initially by SA treatment but then decreased in Lok1 due to senescence. SA treatment had more positive effect on sensitive cultivar than on tolerant one in ameliorating water stress and increasing yield in flowering phase drought.

Key words: Drought, Salicylic Acid (SA), Wheat, Sensitive and tolerant cultivar, Vegetative phase drought, Flowering phase drought

SV/P-42

Effect of Different Dosage of Gamma Radiation on Germination Percentage and Morphological Attributes in Different Varieties of *Tagetus patula*

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Floriculture is one of the most promising pillars for strengthening economy of a state. There is always demand and necessity of new and novel ornamental varieties in floriculture industry. Flower color and shape are the most important components of novelties in floriculture. In recent past, gamma rays (ë 10^{-12} meter) have been most successfully used to produce quite a large number of new floral varieties with improved economic value. *Tagetus patula* is one of the most important floricultural crop, cultivated widely throughout India. The present investigation was aimed to examine the effect of different dosage of gamma radiations (Source Co^{60}) *viz.*, 2.5, 10, 15, 20 and 25 Kr on seed germination percentage (%) and induction of morphological variations in different varieties of *Tagetus patula* (French marigold) *viz.*, Safari Red, Nana patula red, Guljafri yellow and Bonanza. The highest germination percentage (90%) was obtained by 2.5 and 10 Kr of gamma radiations in Safari Red. The percentage of flower color variation in different varieties increased according to the doses/ concentrations of the physical mutagens. The maximum (84.7%) and minimum percentage (35%) of flower color variation was recorded in 25 Kr and 2.5 Kr respectively, in Safari Red. However, low doses (2.5 Kr) of radiation increased number of flowers per branch and plant height while higher doses (25 Kr) decreased it in all the varieties. Number of branches per plant increased with increasing dosage of radiation. The present study clearly indicated that lower dosage of gamma radiation increased germination percentage, plant height and number of flowers per branch whereas higher dosage significantly increased flower color variation. In further course of study, if the changes become heritable, gamma radiation may definitely help in developing a new variety of this plant with improved commercial properties.

Key words: Gamma radiation, Germination percentage, Flower color variation

SV/P-43

Studies on the Physiological and Biochemical Changes in Two Species of Ferns under Elevated CO_2

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Rising global atmospheric CO_2 concentration is one of the major changes that have been occurring since last century due to anthropogenic activities and has been documented as well. How the plant community is responding to these changes needs intensive research. The effect of rising CO_2 on plant can be understood by using Free Air CO_2 Enrichment (FACE) technology, because in this setup we provide elevated CO_2 in natural environment, so the plant can grow naturally in elevated CO_2. Pteridophytes have been a prominent part of the earth's vegetation for millions of years. In fact, in the past, the relatives of the present day ferns and fern-allies dominated the vegetation and were the major living form of the plant. Two species of ferns *N*ephrol*epis tuberosa* (Bory ex Willd.) C. Presl. and *Microsorum alternifolium* (Willd.) Copel were selected for assessing photosynthetic

changes and biochemical responses. During the study period plants were subjected to 460 ppm of elevated CO_2. Net photosynthetic rate increased in both the species under elevated CO_2 as compared to ambient. Similar trends were found in stomatal conductance and Fv/Fm. Reduced MDA contents showed low sensitivity of cell membranes damage to elevated CO_2. Increased antioxidants and decrease in antioxidant enzymes activity were found in both the species. The present experiment indicates *Nephrolepis tuberosa* better adapted to elevated CO_2 as compared to *Microsorum alternifolium*.

Key words: Free Air CO_2 Enrichment (FACE), Elevated CO_2, Ferns, Antioxidants, Enzymes

SV/P-44

Biochemical and Molecular Evidences Suggest Positive Relationship between NO and SA Signaling during Arsenic Stress in Rice

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Arsenic is ubiquitous element in earth crust. In current scenario, Bangladesh and West Bengal (India) are worst affected areas globally where arsenic concentration has been documented up to 3200 μgl^{-1} in ground water that is far beyond the maximum permissible limit 10μgl^{-1}. In South East Asia, 40-60 million people are at risk for arsenic related health hazards. Unfortunately rice is major crop in this arsenic contaminated region. Nitric oxide (NO) and salicylic acid (SA) are important signalling molecules and show the protective role against arsenite (AsIII) toxicity (abiotic stress) in rice plants and enhance the plant growth when exogenously supplied. On morphological aspects maximum growth was found in SA treated plants. NO and SA also alleviated the arsenite mediated toxicity on seed germination. Exogenously supplied NO reduced the arsenic accumulation in rice roots and reduced its entry in shoot. Nitric oxide also enhanced iron accumulation in shoot. Under arsenite stress endogenous level of NO and SA get lowered and reverted by exogenous supplementation of NO and SA. From this study it is evident that NO and salicylic acid works in mutual coordination and supplement each other action.

Key words: Nitric oxide, Salicylic acid, Rice, Signalling

SV/P-45

Assessment of Antioxidant and Photosynthetic Behavior in *Lepidium latifolium* Linn.

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Lepidium latifolium L. is an ecologically important plant of Himalayan cold deserts that is used as 'phytofood'. Although, it is native to southern Europe and Asia but it has shown a widespread presence in most parts of world and has been recognized as noxious weed. Unlike its aggressive invasive character in riparian plains of North America, its growth is restricted in cold arid zone of Himalayan cold desert and it is present mainly in habited areas. Therefore, the present study was undertaken to understand the physiological and biochemical behavior of *Lepidium latifolium* from Himalayan cold desert. PPFD-photosynthesis light curves in three different native populations were analyzed, which shows that the saturating carbon assimilation found between 741 - 1100 µmol m^{-2} s^{-1} at different locations. Noticeable differences were observed in $P_{N,\ i}$ and I_c values that are independent of high light intensities. It suggests that plants have the potential for adapting itself to the high light. Efficient antioxidant system was observed in terms of metabolic content of phenols (26.89 - 50.51 mg GAE g^{-1} DW) and flavonoids (38.66 - 76.00 mg QE g^{-1} DW). Corroborating with these, superoxide radical scavenging activity was also found to be very high (41.3 - 83.9%). Linolenic acid (18:3) was found to be about 50% of the total content of unsaturated fatty acids. Such an efficient anti-oxidative system suggests that this plant can maintain reducing cellular environment despite photo-oxidative stress under high light intensities. Further, the data suggests that this plant has inherent plasticity to combat stress and can be a potential threat in ecologically sensitive high altitudes of Western Himalayas.

Key words - *Lepidium latifolium* L., Antioxidant, Photosynthesis, Invasive, Plasticity

SV/P-46

Yield and Quality of Two Varieties of Rainfed Ashwagandha (*Withania somnifera*) as Influenced by Different Levels of Sodicity

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Soil sodicity mostly in the arid and semiarid regions of the country affects plant growth, development and productivity, which leads to serious forms of agricultural land degradation. A pot experiment was conducted at Banthra Research Station of CSIR-National Botanical Research Institute, Lucknow during late kharif seasons (2011-12 and 2012-13) to study the effects of exchangeable sodium percentage (ESP) levels (10.0 as Control, 13.0, 17.5, 25.0, 30.0 and 35.0) on the growth, survival percentage, yield, quality, total chlorophyll and proline content of two ashwagandha varieties (NMITLI-108 and NMITLI-118, CSIR-NBRI) with three replications in the CRD arrangement of pots. Results showed that with increase in ESP levels all the parameters like plant height, plant spread, number of branches, number of leaves/plant, and fresh and dry biomass of the stem, and total chlorophyll content were decreased as compared to control in both the varieties. It was found that there was remarkable improvement in plant survival percentage, proline content, seed yield, root length, root diameter, dry root weight and total withanolide content (0.62%) for NMITLI-108 as compared to NMITLI-118 as ESP levels increased. It was concluded that NMITLI-108 variety was found to be more tolerant against soil sodicity stress as compared to NMITLI-118.

Key words: Soil sodicity, Exchangeable sodium percentage, ESP levels, Withanolide

SV/P-47

Air Pollution Monitoring in and around Faizabad City Utilizing Lichen Distribution Pattern

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Lichen diversity and distribution pattern is an important biometric tool to assess the prevailing environmental condition in an area. The areas near city centre or around industrial areas exhibit occurrence of few selective pollution tolerant species and the distribution pattern of tolerant and sensitive species provide a useful tool to measure the environmental condition of the area. The lichen diversity assessments carried out in and around Faizabad city indicate a distinct trend of increase in number of lichen species as the distance increases from the city centre while the city centre only shows occurrence of few pollution tolerant species.

More than 60 localities in the north, south, east and west direction of Faizabad city of Uttar Pradesh exhibit occurrence of 16 species belonging to 11 genera of lichens. Whole study area was grouped into the distance range between 0-5 kms, 6-12 kms and 13-20 kms within grid of 1x1 km. The study area showed dominance of crustose lichens represented by 13 species. The *Mangifera indica* tree bears the maximum growth of lichen species followed by *Artocarpous heterophyllus*, *Azadirachta indica* and Palm trees respectively. The well known toxi-tolerant lichen species *Pyxine cocoes*, *Bacidia submedialis* and *Rinodina sophodes* are the most commonly occurred lichen taxa in and around Faizabad city.

The study area at different distance range exhibit diverse species diversity and distribution pattern. The sites within the range of 0-5 km were devoid of epiphytic lichen growth indicate a polluted site whereas the localities situated between the distances of 6-12 kms exhibit presence of pollution tolerant species, which indicate a more or less moderate pollution. The range of 13-20 kms in all around of the city exhibit luxuriant and normal growth of lichens. The distribution pattern of lichens clearly divides the study area into three zones with different level of pollution indicated by different distribution pattern. The current lichen diversity and distribution status in and around Faizabad city, will act as a baseline data for carrying out future pollution monitoring studies in the area.

Key words: Lichens, Pollution, Distribution, Biomonitoring

SV/P-48

Evaluation of Antioxidant Potential and Minerals Content in Selected Strains of *Macrocybe giganteum*

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Macrocybe giganteum is a recently added in the list of cultivated mushrooms in India. Methanol extracts of two selected strains of *M. giganteum* namely MA1, MA2 were investigated for their antioxidant capacity by different assays namely, 1,1-diphenyl-2 picrylhydrazyl (DPPH) radical scavenging activity, ferrous chelating activity assay and reducing power activity; total phenolics and total flavonoids at two different stages *i.e.,* at mycelial and at mature fruiting stages. In addition, dry matter, moisture content, total sugars, reducing sugars and ash along with minerals P, K, Ca, Fe, Zn, Cu, Mg, Mn and Cr were analyzed only at fruiting stage. Among the values of different assays, MA2 showed greater activity than MA1 at mature fruiting stage. DPPH scavenging activity was 78.98 % and low 37.94 % in MA2 and it was 75.72 % and 40 % in MA1, respectively in fruiting and mycelial stages. Similarly, ferrous chelating activity was 88.55 % and 47.28 % in MA2 and 66.13 % and 28.89 % in MA1, respectively at fruiting and mycelial stages. The values of reducing power activity (µg/ml) was 129.33 and 85.5 in MA2 and 80.16 and 56.5 in MA1 at fruiting and mycelia stages, respectively. MA2 showed high moisture content 89.24%. Concentration of P, K, Ca, Fe, Zn, Cu, Mg, Mn and Cr (mg/100g) was 601.4±0.49, 3339.6±1.52, 26.56±0.13, 17.86±0.057, 13.36±0.251, 2.09±0.01, 10.84±0.098, 2.133±0.057 and 0.256±0.188 in MA1 and 945±1.25, 3422±1.52, 27.43±0.24, 14.4±0.435, 14.8±0.17, 2.14±0.015, 15.63±0.461, 2.23±0.115 and 0.24±0.01 in MA2, respectively. In general, MA2 showed comparatively high concentration of minerals than in MA1. Thus, the selected mushrooms can be used as dietary supplements and in development of nutraceuticals.

Key words: Antioxidants, *Macrocybe giganteum*, Fruiting bodies, Minerals

SV/P-49

Effect of Elevated CO_2 on Fatty Acid Concentration of Oil-Yielding Plant: A Brief Review

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Global atmospheric carbon dioxide (CO_2) concentration has risen from 280ppm to the current level of around 400ppm and projected to reach 421-936ppm by the end of 21st century (IPCC-013). The impact of elevated atmospheric CO_2 concentrations (e[CO_2]) on plant growth, metabolism and yield is considered as a major issue for the agriculture production in near future. Different FACE (Free Air Carbon dioxide Enrichment) studies have been conducted across the world to investigate different chemical and physiological responses, influence of e[CO_2] on defense mechanism and yield quality of economically important crops, including oil yielding crops. Defence metabolites such as antioxidants are, in part, directly linked to primary carbohydrate mechanism and so potentially impacted by e[CO_2]. In oil yielding crop whether photo protective and antioxidative defence systems, key to plant stress tolerance, will be affected, and if so, response will be strengthened or weakened by e[CO_2]. FACE studies have shown that under e[CO_2], glutathione reductase activity increases, while the concentrations of other antioxidants like Ascorbic acid decreases. In addition, protein concentration in seeds is significantly reduced. e[CO2] does not have much effect on total oil concentrations, but oil yield per unit ground area tends to increase. It is observed that CO_2 changed the composition of fatty acids on per dry weight basis, which was more pronounced for unsaturated fatty acids. The concentration of major unsaturated fatty acids such as oleic acid increases significantly, while linolenic acid and the group of essential fatty acids decreased in many oil-yielding crops. It is necessary to enhance the knowledge about how oil-yielding plants will cope with the climate change in future; concerning the oil yield, defense mechanism and fatty acid concentrations.

Key words: e[CO_2], FACE, Fatty acids, Antioxidants, Oil yielding crop

SV/P-50

Effect of Free Air CO_2 Enrichment on Litter Production, Chemistry and Decomposition of Trees of Tropical Forest

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Elevated CO_2 has been shown to stimulate plant productivity and change in litter chemistry. Increase in tree biomass may be an important sink for CO_2 as the atmospheric concentration continues to increase. Tree growth in tropical forest is limited by the availability of soil nutrients. To assess whether soil nutrient limitation will constrain forest productivity under high atmospheric CO_2, we studied the changes in forest litter production and nutrient cycling in trees of tropical forest grown under free air CO_2 enrichment. The objective of this paper is to present data on the chemistry of green leaves and leaf litter, above ground litter production, decomposition and N availability in response to growth under elevated CO_2.

Key words: Carbon dioxide, Decomposition, FACE (free-air CO_2 enrichment), Litter, Nutrient cycling

SV/P-51

Response of *Arabidopsis thaliana* Natural Variations under Low Phosphorous and Arsenate Stress

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Environmental stresses severely affects plant growth and development and thus reduces productivity and yield. Various studies have suggested that genetic variations within and in between the species play important role in establishing interaction and response of plants with the environment. In recent years, natural variation in different plant species such as *Arabidopsis* have been used to understand the genetic impact on plant development and the affect and response of accessions under different stress conditions. Toxic heavy metals cause drastic changes in the growth, physiology and metabolism of plants. Heavy metal toxicity not only hampers plant growth and productivity but also causes severe human health hazards when get entry into the food chain. Inorganic As form, arsenate As(V), is chemically analogous to phosphate (Pi) and therefore, is taken up by the plants via phosphate transport system. Phosphorus is an essential element which is critical for the plant growth and development. Pi deficiency negatively affects plant growth and metabolism and induces the expression of genes involved in Pi acquisition. Studies also suggests that during Pi deficiency, As(V) toxicity is enhanced. In the present study, the natural variations in *Arabidopsis thaliana* were utilized to study the combined effect of As(V) stress and limiting Pi. The natural variation in *Arabidopsis* was investigated for the growth response towards Pi availability and the interrelation of Pi and As(V) uptake and transport. The root morphology in terms of root length as well as metal accumulation was compared in the three *Arabidopsis* accessions (Col-0, Sij-1 and Slavi-1) to identify contrasting response. To study the molecular mechanisms responsible for contrasting response, expression profiling of the genes involved in uptake, detoxification as well as regulatory mechanisms was carried out. Our analysis suggests natural variation dependent regulatory mechanism leading to differential response of *Arabidopsis*. Therefore, it is hypothesized that dissecting the natural variation under combined stress conditions might help in better understanding of the biological processes involved in uptake, transport and detoxification of heavy metals and may provide powerful basis for plant adaptation towards stresses.

Key words: *Arabidopsis*, Arsenate, Detoxification, Natural variations, Phosphate transporters

SV/P-52

Biotransfer of Cadmium and Zinc from Sewage Sludge Amended Soil to Mustard-Aphid-Beetle Food Chain

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The aim of our study was to examine the uptake

and accumulation of cadmium and zinc from sewage sludge amended soil in Indian mustard (*Brassica juncea* L. cv Alankar) and their subsequent transfer to phloem sucking mustard aphid (*Lipaphis erysimi*) and eventually to its predatory beetle (*Coccinella septempunctata*). The plants were grown in pots filled with different rates of sewage sludge amended soil and at 40 days of growth stage, were allowed to infest with mustard aphids for three weeks. Zinc concentration in soil, mustard and aphids increased with sludge amendment rates and biomagnified during transfer along the food chain pathway. Cadmium concentration in the soil, mustard and aphid was significantly elevated by the addition of sludge at higher rates, but biomagnification was observed only at lower rates of sewage sludge amendment. Heavy metal concentrations in honeydew were also assessed and elimination of cadmium in honeydew was relatively higher than the zinc levels. Aphids fed on heavy metal accumulating plants were subsequently fed to fourth instar *Coccinella septempunctata*. There was no biomagnification of cadmium in newly emerged adult ladybirds, but appreciable biomagnification of zinc in the adult ladybirds was observed. This study demonstrates the route of exposure of heavy metals via the soil-plant-aphid system to predatory arthropods**.**

Key words: Mustard, Aphid, Cadmium, Zinc, Food chain, Biomagnification

SV/P-53

Impact of Iron Stress on Oxidative Metabolism in *Vigna radiata* (L) Wilczek.

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Iron (Fe) stress can induce production and accumulation of reactive oxygen species (ROS), causing oxidative damage. The objective of this work was to evaluate the impact of deficient and toxic concentrations of iron (Fe) on the protective role of antioxidative enzymes as well as antioxidant compounds in green gram (*Vigna radiata* (L) Wilczek) plants. Plants were grown in Hoagland nutrient solution and treated with four Fe concentrations (10, 100, 200 and 400 µM Fe) in the form of FeEDTA. At 20 and 40 days after treatment (DAT), the plants were harvested and growth, active Fe content, lipid peroxidation and enzymes and metabolites of the antioxidative metabolism were determined. Plants showed maximum growth at 100 µM Fe supply (control). Iron deficiency was observed at 10 µM Fe supply and resulted in chlorosis of leaves, inhibited plant growth and decreased concentration of active Fe and chlorophyll content. Apical chlorosis, marginal necrosis and decrease in chlorophyll concentration was also observed in plants treated with 400 µM Fe. High concentration of lipid peroxidation (TBARS) and H_2O_2 content in leaves were detected in Fe deficient and Fe toxic plants (200 and 400 µM Fe) as compared to control. The enzymatic activities of superoxide dismutase (SOD) and glutathione reductase (GR) increased with increasing Fe concentration at 20 DAT but the GR activity decreased at 40 DAT. The activities of Fe containing enzymes such as catalase (CAT), peroxidase (POD) and ascorbate peroxidase (APX) also increased with increasing Fe concentration at 20 days but values were lower at 40 DAT. The ascorbate (ASA) and non-protein thiol (NPT) contents in general, increased with increasing Fe concentration but decreased at 40 DAT in plants supplied 400 µM Fe. The results indicate that under deficient and toxic levels of Fe, plants suffer increased oxidative stress, which is regulated through changes in the activities of antioxidative enzymes and in the contents of the antioxidants ASA and NPT.

Key words: Antioxidative enzymes, Green gram, Fe stress, Oxidative damage, ROS

SV/P-54

Arsenic Toxicity: Responses of Rice Plants Inoculated with Microalga *Nanochloropsis* sp.

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Rice (*Oryza sativa* L.) is the staple food for more than half of the world's population. Arsenic in rice has been recognized as a serious global problem may induce human health hazard via water-soil-plant-human pathway. Many microorganisms have evolved

a series of mechanisms to cope with inorganic arsenic in their growth media. Capability of microorganism's for arsenic (As) bioaccumulation and biovolatilization is considered as a more attractive and potential technique for the biorestoration of As-contaminated water, sediment and soil.

To check As toxicity and accumulation in rice, a hydroponic experiment was performed on tolerant variety of rice Triguna inoculated with *Nanochloropsis sp*. Results revealed that rice plant inoculated with *Nanochloropsis sp*. significantly reduce toxicity in the form of root shoot growth, biomass and chlorophyll at 80 µM As III treatment. Toxic responses were also examined by cell damage in the form of lipid peroxidation (MDA) and enzymatic activity which showed a decreasing tendency of MDA and enzymatic activity of SOD, APX, and GR after 10 days of algal inoculation (Rice+ As 80 µM+ *Nanchloropsis sp*.) in comparison to As treated rice (Rice+As 80 µM). Further, work will focused on the strategies of application of algal sp. in As contaminated rice plant and enhancing the As voltalization and their possible use in the reducing As accumulation.

Key words: Arsenic, Biovoltalization, *Nanochloropsis* sp., Rice, Accumulation

SV/P-55

Nitrate Toxicity in Green Leafy Amaranthus

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Nitrate content in plants is an important quality characteristic of determining nitrate toxicity. Many genetic and environmental factors lead to nitrate accumulation in plants. WHO has established the Acceptable Daily Intake (ADI) of nitrate as 0-3.7 mg/ kg body weight and the permissible concentration of nitrate in drinking water as 50 mg/liter and beyond which it is considered toxic. *Amaranthus* is a versatile herb, consumed as a vegetable as well as a medicinal remedy and so has an interdisciplinary relevance in many aspects. They are the good source of dietary fiber and contain high amount of protein, vitamins, and minerals. It is a rich source of trocotrienol and squalene compounds which are known to affect cholesterol biosynthesis. *Amaranthus* oil prevents Cardio Vascular Diseases(CVD).

An extensive study was done for estimating nitrate content in ten different accessions of *Amaranthus cruentus*. A uniform basal dose of NPK along with zinc and sulphur were given as nitrogen @ 120 kg/ ha, phosphorous @30kg/ha, potassium @ 80 kg/ha, sulphur @ 40 kg/ha and zinc @ 10 kg/ ha. All the samples were analyzed for their nitrate content at three and six week stages. Genotypic variation in the nitrate content was apparent with the minimum in accession EC 359417 and the maximum being in EC 359420. Nitrate content was 1715.16 and 2762.41 mg kg^{-1}f.w., for EC 359417 whereas EC 359420 showed relatively higher levels of nitrate i.e. 3003.73 and 4500.47 mg kg^{-1}f.w. at three and six week stages. Variability of nitrate accumulation was observed in different accessions and also in different plant parts. The nitrate content was found increasing with the physiological age of the plant as most of the *A. cruentus* accessions were found exceeding the ADI limit by manifolds and so was found unfit for human consumption due to nitrate accumulation to toxic levels. This is a serious problem as it puts a question mark on the nutritional and medicinal aspect of *Amaranthus*.

Key words: Nitrate, ADI, Accumulation, Toxic, WHO, Accessions

SV/P-56

Role of Arsenic Tolerant Bacteria in Growth Promotion, As Accumulation and Reduction of As Toxicity in Rice Plant

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The toxicity of heavy metal like arsenic in soil and ground water is of major concern in Uttar Pradesh. The rice grain is a major source of arsenic accumulation, so to protecting crops is of major importance at these places. To this end, a gram positive bacterial strain resistant to high level of arsenic was identified to assess the role of As tolerance. The strain NBRIEAG-2 was charecterized as *Brivundimonas* sp. based on 16S rDNA Gene analysis, showed a specific tolerance against arsenic. In this study we investigated the consequence of bacterial inoculation on plant growth promotion, and As uptake on rice plant [*Oryza*

sativa (L.)] grown at three different concentrations of arsenic. Additionally, the bacterial strain evaluated for multiple plant growth promoting traits revealed the inherent ability to produce siderophores, 1- indole acetic acid (IAA), aminocyclopropane-1-carboxylic acid (ACC) deaminase production might be associated to increase biomass, chlorophyll and MDA content of rice plant and thereby promoting plant growth. Interestingly, significant morphological changes in As treated bacteria was observed by SEM analysis whereas the tolerant strain was also evaluated for ars gene, related to arsenic detoxification or high level of arsenic tolerance. The result signifies the phytostablization potential of As-resistant bacteria in As contaminated soils to reduce arsenic uptake in rice plant and help to promote plant growth.

Key words: Arsenic, *Brivundimonas* sp., Plant growth, *Oryza sativa*, SEM.

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Iron and Manganese Plaque Effect Arsenic Uptake in *Oryza sativa L.* Plant under Waterlogged Condition: A Mode of Metal Retention

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In paddy field mobilization of different types of metals is high and under anaerobic condition rice plant releases radial oxygen loss (ROL) through aerenchyma for internal respiration. As a result oxidation of ferrous iron Fe(II) and manganous Mn(II) occurs and Fe and Mn oxide/hydroxides complex deposited on the upper root surface which commonly referred as iron and manganese plaque. Iron plaque recognized as reddish orange colour coating while manganese plaque identified as a dark brown-black colour root coating. Iron and manganese plaque have a tendency to accumulate different types of heavy metals like arsenic, nickel, cadmium, copper etc. Root plaque act as barrier and reduces the bioavailability of potentially phytoxic metals under waterlogged condition. Manganese oxides induce the oxidation of As(III) and reduced its mobility and toxicity in arsenic contaminated soil. The formation of iron and manganese plaque in rice roots is responsible for the sequestration of arsenic and other heavy metals and enables to reduce its translocation in aerial part thus facilitate lower grain arsenic content. Therefore iron and manganese plaque reduced the risk of dietary arsenic exposure to human.

Key words: Iron plaque, Manganese plaque, Rice plant, Radial Oxygen Loss (ROL), Arsenic, Heavy metal

SV/P-58

Lead Accumulation and Toxicity in *Zea mays* Involves H_2O_2 Accumulation and Deactivation of Catalases

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The present study investigated the toxic effect of Pb^{2+} ions [16 mg l^{-1} (low toxic), 40 mg l^{-1} (moderately toxic) and 80 mg l^{-1} (highly toxic)] on seedling growth, root anatomy, generation of reactive oxygen species (both qualitative and quantitative), and the antioxidant enzymatic activities in hydroponically grown *Zea mays* (maize) at 24 h, 72 h, and 120 h after exposure. Toxic effects Pb^{2+} were more pronounced on root growth and it correlated with greater Pb accumulation in roots. Exposure to Pb^{2+} induced ROS generation in a time- and concentration-dependent manner as evidenced by greater superoxide anions, hydrogen peroxide (H_2O_2) and membrane peroxidation. Pb-caused membrane damage was confirmed by greater electrolyte electrolyte leakage. In vivo detection of lipid peroxidation, membrane integrity and superoxide ions corroborated the quantified observations. It suggested Pb^{2+}-induced oxidative damage and cellular injury. However, the increase in malondialdehyde content was not as pronounced as the H_2O_2accumulation. The activities of antioxidant enzymes, superoxide dismutases, peroxidases and glutathione reductases were enhanced in a concentration- and time-dependent manner under Pb^{2+} exposure. In contrast, the activity of catalases declined under Pb^{2+} stress, thereby suggesting its non-involvement in H_2O_2 detoxification. The study concludes that Pb^{2+} induced oxidative damage in *Z. mays* involves H_2O_2 accumulation and deactivation of H_2O_2 detoxifying enzyme- catalases.

Key words: H_2O_2 accumulation, *In vivo* ROS detection, Membrane peroxidation, Cellular injury, Catalases

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Radiotoxicity of Gamma Irradiation in *Trachyspermum ammi* (L.) Sprague

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The studies based on the interactions of radiations with biological systems have various applications, contributing to human welfare. From the past few decades, gamma rays have been extensively used for the varietal improvement of different crops of economic importance. The present study was conducted to evaluate the impact of different doses viz. 10kr, 20kr, 30kr and 40kr of gamma radiation from a Co^{60} source on different parameters of *Trachyspermum ammi* (L.) Sprague (ajwain). LD_{50} was scored on the basis of survival percentage. Cytologically, the PMCs of the plant in treated sets showed various chromosomal aberrations, such as unorientation, stickiness, precocious movement or fragmentation, univalents, asynchronous division, laggards, tripolarity and chromatin bridge. An increasing number of aberrant cells alongwith increasing dose of gamma ray were observed. Different parameters such as plant height, leaf length, primary branches per plant, chlorophyll content, and harvest index for different doses of radiation were also scored.

Key words: Gamma rays, Caberrations, *Trachyspermum ammi* (L.) Sprague (ajwain), LD_{50}, Radiation

SV/P-60

Dual Impact of Gamma Rays and EMS on Cytomorphological Parameters of Sunnhemp (*Crotalaria juncea* L.)

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The present study aims at assessing the impact of gamma rays and ethyl methane sulphonate in individual and combined treatments on sunnhemp. While gamma rays constitute a physical mutagen widely used for enhancement of desired agricultural traits in plants,ethyl metahnesulphonate is a biochemical research agent employed for a better understanding of DNA repair mechanisms *in vitro*. A very interesting finding of the present study was the antagonistic results observed in individual and combined treatments. The individual treatment of seeds with gamma rays at doses 10 kr, 20 kr, 30 kr, 40 kr, 50 kr, 60 kr resulted in statistically significant enhancement in various parameters including height , harvest index, chlorophyll content, seed yield, lateral branching. However the combined treatment with 0.3% ethylmethanesulphonate (duration of 4 hours) exhibited redundancy of most morphological parameters. The individual doses of gamma rays which seemed stimulatory manifested an augmneted mutagenecity in combination with ethyl methanesulphonate. Cytologically the frequency of chromosomal aberrations at meiotic level recorded in combined treatment was higher than individual gamma ray treatment. A range of chromosomal aberrations namely unorientation, asynchronization, disturbances in polarity were observed. Sunnhemp is a fibre crop with prospectives of a promising biofuel in the near future. Hence the study would provide a useful insight about the impact of such agents on crops of agricultural value.

Key words: Sunhemp, Gamma rays, Ethylmethane sulphonate, Cytological abnormilities, Meiosis

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H_2O_2 Pretreated Rice Seedlings Specifically Reduces Arsenate not Arsenite: Difference in Nutrient Uptake and Antioxidant Defense Response in a Contrasting Pair of Rice Cultivars

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The study investigated the reduction in metalloid uptake at equimolar concentrations (~53.3 ìM) of As(III) and As(V) in contrasting pair of rice seedlings by pretreating with H_2O_2 (1.0 ìM) and SA (1.0 mM). Results obtained from the contrasting pair (arsenic tolerant vs. sensitive) of rice seedlings (cv. Pant Dhan 11 and MTU 7029, respectively) shows that

pretreatment of H_2O_2 and H_2O_2 + SA reduces As(V) uptake significantly in both the cultivars, while no reduction in the As(III) uptake. The higher growth inhibition, higher H_2O_2 and TBARS content in sensitive cultivar against As(III) and As(V) treatments along with higher As accumulation (~1.2 mg g^{-1} dw) than in cv. P11, unravels the fundamental difference in the response between the sensitive and tolerant cultivar. In the H_2O_2 pretreated plants, the translocation of As increased in tolerant cultivar against AsIII, whereas, it decreased in sensitive cultivar both against AsIII and AsV. In both the cultivars translocation of Mn increased in the H_2O_2 pretreated plants against As(III), whereas, the translocation of Cu increased against As(V). In tolerant cultivar the translocation of Fe increased against As(V) with H_2O_2 pretreatment whereas, it decreased in the sensitive cultivar. In both the cultivars, Zn translocation increased against As(III) and decreased against As(V). The higher level of H_2O_2 and SOD (EC 1.15.1.1) activity in sensitive cultivar whereas, higher, APX (EC 1.11.1.11), GR (EC 1.6.4.2) and GST (EC 1.6.4.2) activity in tolerant cultivar, also demonstrated the differential anti-oxidative defence responses between the contrasting rice cultivars.

Key words: Hydrogen peroxide, Salicyclic acid, Arsenate, Arsenite, *Oryza sativa*

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Interactive Effect of Selenium on Arsenic Accumulation and Detoxification in Rice (*Oryza sativa* L.)

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Arsenic (As) is considered to pose the most significant potential threat to human health based on frequency of occurrence, toxicity and human exposure. Its occurrence in ground water has resulted in biggest calamity in South East Asia through water and food. Selenium is an essential element for human and shows an antagonistic effect on As with respect to uptake and translocation, as selenite (SeIV) is taken up by phosphate as well as silicon(Si) transporter. The main aim of the study is to see the interactive effect of Selenium (Se) on As accumulation and detoxification in Rice (*Oryza satiya)*. Rice plants were exposed to 25µM arsenite (AsIII) and supplemented with different concentration of Se(IV) (5µM, 10µM,25µM). Selenite supplementation decreased the accumulation of As with least As accumulation at 10 µM Se(IV), also the 10 µM Se(IV) was found to be optimal for plant growth, however, no significant toxicity was observed upto 25µM Se(IV), only beyond that toxicity was visible.Selenium supplementation along with As improved the growth of plant measured in terms of root, shoot length and biomass in comparison to As treated plants. Thiols play an important role against As toxicity.In As stressed plantsNon protein thiols (NPTs) and Cystein , were found to be increased following the application of Se..

Thus the present study concluded that As induced phytotoxicity can be reduced through supplementation of Se as evidentby enhanced plant growth, thiolic ligands, antioxidant capability and lowering the As accumulation in the rice cultivar.

Key words: Selenium, Arsenic, Rice

SV/P-63

Impact of Coal Mining on Surface Vegetation and Soil Quality in Kakri Mines of Sonbhadra, Uttar Pradesh, India

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Coal mining results in the destruction of land ecosystem by removing the aboveground vegetation and ultimately deteriorate the soil quality. A vast amount of overburden is dumped in the nearby areas which influences the soil nutritional property so that it is no longer supportive for plant growth. Soil microbial community and enzyme activity are used as an indicator of soil quality as it is involve in soil nutrient cycle. For maintaining a healthy ecosystem it is important to restore the ecosystem property. In the present study plant diversity, soil microbial diversity and soil enzyme activity was evaluated for mining and nearby natural soils to identify the current soil conditions. The total bacterial count was highest than the fungal count. Maximum numbers of bacterial colony were found in the unmined soil than the mined soil. For natural soils dehydrogenase and urease activity was higher than the dump soils whereas

catalase was found to be more in dump soils. The study discovered that the number of plant species present in the natural soils was more whereas number of plant species present in the dump soils is less. Soil enzyme activity was further estimated and compared for both the mined and unmined soils and lowest enzyme activity was observed in the dump soil which indicates the lack of nutritional component in mined soil.

Key words: Coal mining, Ecosystem, Dump, Plant diversity, Microbial diversity, Soil enzyme activities

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Detoxification of Fly-Ash Dykes with Metal Tolerant Ornamental Ferns for Sustainable Environment

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Fly ash (FA) a coal combustion residue becomes a major source of pollution for surrounding environment of thermal power stations due to presence of several noxious metals and metalloids. In context of these, the present study deals with the detoxification of toxic metals and metalloids of FA dykes with metal accumulator ornamental ferns. Three fern species viz.; *Ampelopteris prolifera*, *Diplazium esculentum* and *Thelypteris dentata* were grown on different amendments of FA and garden soil (GS) as well as GS alone as control. Physico-chemical properties of FA and GS used during experiment were done before plantation of fern species and also after harvesting the three months old ferns. All the target species were grown for three months and harvested tissues were evaluated in terms of plant growth, metal accumulation and antioxidant responses when grown on different amendments of FA and GS. All the species accumulated significant amount of metals in fronds and rhizome including roots; however the extent of metal accumulation varied. The significant increase in biomass and photosynthetic pigments were found in the test species grown on 50 % FA amendment in comparison to 100 % GS as control but further decreased at 100 % FA. It indicates that 50 % FA amendment did not generate oxidative stress in ferns and seems to be suitable substratum for healthy fern growth. The activity of antioxidant enzymes, like melanoaldehydes (MDA), superoxide dismutase (SOD), ascorbate peroxidase (APX) and guaiacol peroxidase (GPX) were induced in 50:50 ratio of FA and GS, and found maximum at 100 % FA, but even though no any phytotoxic symptoms was shown morphologically in target species. Results of physico-chemical studies done after harvesting of fern species also indicate the significant decrease in toxic metals in FA in comparison to raw FA before fern plantation. Results also showed usefulness of these species in phytoremediation of toxic metals from FA and their further implication in development of a vegetation cover on FA dykes for dust free, healthy and sustainable environment. Moreover the ornamental ferns grown on FA dykes may be source of income generation also because fern twigs are integral part of floral decoration in these days.

Key words: Heavy metals, Pteridophytes, NTPC, Photosynthetic pigments, Oxidative stress

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Impact of Vehicular Emission on Vegetative and Reproductive Characteristics of *Leucaena leucocephala* (Lam.) de Wit. Growing at Different Polluted Roads of Karachi City

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Vehicular emission showed toxic effects on vegetative and reproductive growth variables of *Leucaena leucocephala* (Lam.) de Wit. Morphology, vegetative and reproductive characteristics of *L. leucocephala* were significantly ($p<0.05$) affected in plants observed on the polluted sites of Board Office Road, University Road, Shaheed-e-Millat Road, and Shahrah-e-Faisal as compared to University Campus. The leaves, pods and seed samples of the *L. leucocephala* collected from the Karachi University Campus, which is considered as control site showed better growth as compared to city area. Higher reduction in vegetative part especially leaf concerned parameters such as leaf area, leaf fresh and dry weights was found for samples collected from Shahrah-e-Faisal, University Road, Board Office Road and Shaheed-e-Millat Road as compared to control. Along with Leaf area, leaf fresh and dry weights, reproductive characters such as pods and seeds were also highly

reduced for same species collected from Board office Road, University Road, Shaheed-e-Millat Road, and Shahrah-e-Faisal as that of control. Results demonstrated that due to pollution on different roads not only visual characteristics of roadside plants but their vegetative as well as reproductive characteristics were also inhibited. According to observation it was recorded that growth which constitutes both the vegetative and reproductive characters of *L. leucocephala* were highly affected in samples collected from Shahrah-e-Faisal as compared to other polluted sites of city as well as University Campus. Therefore, Shahrah-e-Faisal was found as most polluted site followed by University Road, Board Office Road, Shaheed-e-Millat Road while, University Campus (Control) as non polluted site of Karachi city.

Key words: Leucaena leucocephala, Vehicular emission, Karachi

SV/P-66

Assessment of Heavy Metals in Aquatic Plants of Kanjali Wetland, Kapurthala (Punjab)

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Wetlands, the biological filters of the earth play an important role in biochemical transformation of various types of pollutants. These low lying areas act as a sink for different pollutants including toxic metals that enter into water, sediments, plants or other organisms. Wetland plants have capacity to accumulate heavy metals from water. However uptake by plants is only temporary removal process and ultimately with decay of plants these toxic metals again find their way to water. The problem can be remediated by regular cleaning of wetland by removing exposed flora. Considering this, the present study was planned to evaluate heavy metal content in four aquatic plants viz., *Eichhornia crassipes*, *Lemna minor*, *Potamogeton crispus* and *Panicum sp.* collected from Kanjali wetland. Various heavy metals *viz.*, Cd, Cu, Cr, Fe, Pb, Zn were analyzed using Atomic Absorption Spectrophotometer. The ranges of heavy metals in studied plant samples were Cd (0.003- 0.0046 mg/g), Cu (0.0038-0.0462 mg/g), Cr (Below Detection Limit -0.0036 mg/g), Fe (0.141-4.882 mg/g), Pb (BDL-0.004 mg/g), and Zn (0.0505-0.37122 mg/g). The contents of heavy metals in various plant parts followed an order of roots > leaves > stem. The present study indicates that the contamination of Kanjali wetland and emphasis on regular monitoring of the same in order to understand a better view of the qualitative and quantitative nature of contaminants.

Key words: Flora, Heavy metal, Wetlands, Pollutants

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Effect of 24-Epibrassinollide Pretreatment on the Morphological and Biochemical Constitutions in UV-B (285-325 nm) Radiation Stressed *Vigna mungo* (L.) Seedlings

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The effect of UV-B enhanced radiation and 24-Epibrassinollide (eBR) treatments on the vegetative growth, photosynthetic and non-photosynthetic pigment composition, anti-oxidative enzyme activity and biochemical constituents were studied in the seedlings of *Vigna mungo* (L.). In this study, the seedlings were pre-treated with 24-Epibrassinollide and further exposed to 4.5 $kJ.m^{-2}.d^{-1}$ of UV-B (285-325nm) radiation. The eBR sprayed (control) *Vigna* seedlings were healthy and showed an increase in morphological parameters like plant height, leaf area and fresh mass. In the case UV-B irradiated seedlings, a 7-9% decrease in all parameters were noticed. Pretreatment with eBR was found to impose tolerance to UV-B stress as evident from morphological and biochemical changes. Thus, a UV-B tolerance mechanism was found to exist in seedlings which have received a foliar spray of 24-eBR.

Key words: 24-Epibrassinollide, biochemical, superoxide dismutase, UV-B, vegetative growth

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Effect of Salicylic Acid on Growth, Fluorescence and Antioxidant System of *Solanum melongena* L. Seedlings Grown under Cadmium Stress

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In developing countries urbanization and heavy industrialization has led to a major problem i.e. heavy metal contamination, which is a burning issue for the environmentalists. Among different heavy metals, cadmium (Cd) is one of the most toxic heavy metals, which deteriorates the quality and quantity of vegetables. In context with this the present study was carried out to understand the mechanism of protection of plants under cadmium metal stress by exogenous application of salicylic acid (SA). The brinjal (*Solanum melongena* L.) seedlings were pretreated with two doses (3 mg Cd kg^{-1} soil: Cd_1; and 9 mg Cd kg^{-1} soil: Cd_2) of Cd and grown in controlled plant growth chamber. After foliar application of salicylic acid, 30 days-old seedlings were used to analyze the various parameters. The results showed that both the doses of Cd declined the growth, photosynthetic pigments and chlorophyll fluorescence parameters such as Fv/Fm, Fv/F0, Fm/F0 and qP, while NPQ was raised significantly. Foliar application of SA alleviated toxic effect of Cd by increasing the growth and photosynthetic rate of test plant. In addition, SA also decreased oxidative stress by decreasing malondialdehyde content and super oxide radical ($O_2^{\cdot-}$) production rate in plants subjected to Cd stress. Further its application also increased the activities of superoxide dismutase, catalase, ascorbate peroxidase and NP-SH content. Overall results suggest that SA reduces the Cd toxicity by regulating the antioxidant defense system in *Solanum melongena* L. seedlings efficiently, hence increases the plant quality.

Key words: Cadmium stress, Chlorophyll fluorescence, Salicylic acid, Antioxidant system

SV/P-69

Physiological and Biochemical Responses of *Leucaena leucocephala* Seedlings to Heavy Metal Stress

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Metals are natural components of soil required by plants as micronutrients. However, heavy metal contamination of water and soil poses a major environmental and human health problem. The most common heavy metal contaminants are arsenic (As), cadmium (Cd), mercury (Hg) and lead (Pb). To combat toxic effects of the heavy metals, plants have developed potential mechanisms at the cellular level that could impart tolerance and also involve in the detoxification. *Leucaena leucocephala* is an economically important leguminous tree species with ability to grow in different environments. It is a potential pasture species for livestock production. So far, the intrinsic cellular mechanism behind its metal tolerance has not been explored. In the present study, we have determined the tolerance and accumulation levels of *L. leucocephala* to toxic heavy metals like cadmium, arsenic and essential nutrient zinc. The tolerance studies indicated that arsenic was comparatively more toxic than cadmium and zinc to *Leucaena* seedlings. The seedlings exhibited phenotypic features like retarded growth with low plant biomass, less leaf foliage, exhibited chlorosis and more number of nodes on the stem with shortened internodal distance. The metal accumulation in *L. leucocephala* was maximum in root followed by stem and leaf tissues and the rate of accumulation increased with the concentration of the treated metal. These seedlings also exhibited inhibition of photosynthetic and carotenoids pigment contents and increase in the proline and non-protein thiol contents. The seedlings exhibited low levels of lipid peroxidation when treated with arsenic compared to cadmium and zinc. This indicates that *Leucaena* has better survival ability under arsenic stress. Anatomical changes like decline in the cambial activity, decrease in xylem fibre length, increase in fibre wall thickness, decrease in vessel density and starch accumulation etc were observed. Further, we have isolated the two key genes related to heavy metal tolerance - *Phytochelatin synthase* (*PCS*) and *Metallothionein* (*MT*) from *L. leucocephala*. These genes have been functionally characterized in *E.coli* for their metal tolerance and accumulation abilities. Further, relative expression levels of these genes in *Leucaena* under metal stress have been studied.

Key words: Leucaena, Arsenic, Cadmium, Zinc, Tolerance, Accumulation

SV/P-70

Stimulatory Responses of Silver Nanoparticles on Some Growth Characters of *Brassica campestris* L.

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In present era, nanotechnology has emerged as a revolutionary science, having miscellaneous applications, covering almost each and every field. Despite its diverse applications, some reports suggest that excess use of nanoparticles may exert negative impact on organisms. On another front, if used in controlled way (at optimal dose), these particles could have significant impacts in agriculture. Thus present investigation is an attempt to understand the effect of nanoparticles on some growth characters of *Brassica campestris* L. Ablated silver nanoparticles were characterized in three different concentration viz. 12.5 µg/ml, 25 µg/ml, 50 µg/ml, using DDW (Merck) and seeds were treated with these three doses along with control. Treated seeds were placed in petriplates, separately for germination at room temperature (25ºC±2). The reduction in % germination showed that the phenomenon was dose dependent, except at 12.5µg/ml dose, which presented higher germination % even over control. A significant enhancement in root + shoot length of the seedlings was recorded at 12.5µg/ml of silver nanoparticles treatment as compared to control. However, seed vigour index (SVI) of the treated seeds has been compared with those of control and estimated to be significantly improved at 12.5µg/ml dose; represented an increment even over control seedlings. These observations clearly indicate that 12.5µg/ml dose of silver nanoparticles treatment improved the overall growth profile of the treated seedlings. Thus present finding suggests the stimulatory responses of silver nanoparticles in terms of seed germination potential of *B. campestris* L. at the lowest cum optimal dose.

Key words: *Brassica campestris* L., Silver nanoparticles, Germination %, Seed vigour index

SV/P-71

Ecological Significance of Road Side Plant Species in Urban Environment

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Road side vegetation puts up with continuous exposure to urban traffic pollution which makes them a crucial tool to study the air quality of the area. The response of plant to pollutant can vary from morphological changes to physiological and biochemical alteration and such response can provide simple, efficient and low cost method of monitoring atmospheric pollutants.

The present study tries to evaluate the significance of road side plants in indicating the air quality of different land use sites. For this, concentrations of pollutants like: particulate matter (PM), oxides of sulphur (SOx) and nitrogen (NOx), were calculated at three land use sites: Site I: vegetated area, Site II: commercial and Site III: traffic intersection. Significance of common road site plants species - *Cassia fistula, Morus alba* and *Pongamia pinnata* as indicator or remediator was studied by calculating foliar dust load and air pollution tolerance index (APTI). APTI classifies plants into tolerant or sensitive to pollutants. It is believed that tolerant plants can be used as remediator, whereas, sensitive as indicator of pollution. The outcome of the study depicted that out of all selected sites, Site II (PM: 424.02 ug/m^3, SOx: 112 ug/m^3, NOx: 115 ug/m^3) was the most polluted site followed by site III (PM: 368.99 ug/m^3, SOx: 123 ug/m^3, NOx: 134 ug/m^3) and Site I (PM: 322.84 ug/m^3, SOx:97 ug/m^3, NOx: 106 ug/m^3). Analysis of plant species showed that the foliar dust load was found to be maximum in *Morus alba* (Dust load: 0.067 g/cm^2, 0.12g/cm^2 and 0.08g/cm^2) and not much difference was recorded in *Cassia fistula* (Dust load: 0.022 g/cm^2, 0.068g/cm^2 and 0.03g/cm^2) and *Pongamia pinnata* (Dust load: 0.025 g/cm^2, 0.114g/cm^2 and 0.035g/cm^2) at all the three sites, respectively. Interestingly all three plants indicated maximum concentration at site II which was in accordance to the pollutant data. However, *Morus alba* came out to be better indicator of PM pollutant as compared to

other two plants. The APTI result showed that *Morus alba* and *Cassia fistula* came under tolerant range whereas, *Pongamia pinnata* fall in intermediate category. These tolerant plants can help in improving the quality of air and can be used as an important phytomonitoring tool.

Key words: Pollutants, APTI, Vegetation, PM, SOx, NOx

SV/P-72

Impacts of Enhanced UV-B Radiation on French Bean Cultivars Grown under Mountain Ecosystem

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Ozone layer is depleting due to contamination with chlorofluorocarbons, nitrogen oxides and methyl bromides, which further leads to an increase in UV-B radiation on the earth's surface. The present study was carried out to evaluate the effect of enhanced UV-B (ambient+10.2 kJ m^{-2} d^{-1}) radiation on two cultivars of *Phaseolus vulgaris*, a leguminous crop, most commonly grown in mountain areas of north western Indian Himalaya. The effects of enhanced UV-B radiation on tested cultivars were evaluated at growth, physiological and biochemical levels both at vegetative and reproductive stages of the development. The results reveal that enhanced UV-B radiation negatively affects the morphological traits, biochemical and physiological characteristics of tested cultivars as compared to ambient UV-B radiation at both the stages. Magnitudes of negative effects of enhanced UV-B radiation were found more in Pusa Parvati as compared to Pusa Himlata. Under physiological parameter Chlorophyll b was affected more than chlorophyll a upon UV-B radiation. Non-enzymatics and enzymatic antioxidants e.g. total phenolics and flavonoids contents, superoxide dismutase, catalase, peroxidase were increased in both the cultivars at both the stage of development upon UV-B treatment but the percent increase were more in cultivar Pusa Himlata as compared to Pusa Parvati. The results further showed that economic yield (g $plant^{-1}$) of Pusa Himalata and Pusa Parvati decreased by 14% and 44%, respectively due to enhanced UV-B radiation over ambient UV-B radiation. The higher decrease in economic yield of Pusa Parvati depicted that increased amounts of total flavonoids contents and stimulation of their antioxidant defense mechanism via increasing the activities of superoxide dismutase, catalase and peroxidase was not able to completely detoxify the produced reactive oxygen species under elevated UV-B radiation, and made it more sensitive to applied stress. The present study concludes that enhanced UV-B radiation in mountain areas could be one of the environmental causes for lower yield of crops. The study also suggests that cultivation of *Phaseolus vulgaris* L. cv. Pusa Himlata by local farmers may contribute towards the mitigation of UV-B induced crop yield loss in Indian Himalayan ecosystem.

Key words: Ultraviolet-B radiation, French beans, Growth, Biochemical, Climate change

SV/P-73

Selenite Supplementation Reduces Arsenate and Arsenite Uptake but Alters Phosphate Level in Hydroponically Grown *Oryza sativa* L.

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Arsenic is a toxic metalloid, disrupts biochemical and physiological process of both animals and plants. Arsenic (As) is present in the environment into two major forms, arsenite [As(III)] and arsenate [As(V)], among which As(III) is ten fold toxic than As(V). There are consorted efforts to minimize As uptake in rice by water management, breeding programmes and transgenic approach. The present study evaluates the reduction of As(III) and As(V) accumulation in rice seedlings through supplementation of selenite [Se(IV)] treatments under hydroponic condition. The As(III) (4 µg ml^{-1}) treated seedlings of rice (cv. MR-1) showed more reduction in shoot, root and fresh weight in comparison to As(V) (5 µg ml^{-1}) treated rice seedlings. The level of PO_4^{3-} decreased significantly with As(III) and As(V) treated rice seedlings. The application of selenite [Se(IV)] significantly reduced As accumulation in both As(V) and As(III) treated rice seedlings. However, selenite applied with As(III) enhanced PO_4^{3-} uptake, whereas, with As(V) it reduced PO_4^{3-} level in root and shoot of rice seedlings in a dose dependent manner. Selenite concentration above 1 µg

ml^{-1} was toxic to seedlings with both As(V) and As(III). Lipid peroxidation (TBARS level) increased with the combined treatment of As(III) and Se(IV), whereas, the lipid peroxidation decreased with As(V) and Se(IV) treatment in a dose dependent manner. However, the level of ascorbate decreased with As(III) and Se(IV) treated rice seedlings, whereas, ascorbate increased with a dose dependent manner of Se(IV) concentration in rice seedlings treated along with As(V).

Key words: Arsenic, Selenite, Phosphate, Lipid peroxidation, *Oryza sativa*

SV:P-74

Responses of Wheat and Chickpea to Reduced Levels of Solar Irradiances

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As a consequence of increases in aerosols, air pollutants and population density, dimming or shading (decrease in global radiation,i.e. the sum of the direct solar radiation and the diffuse radiationscattered by the atmosphere) have become major challengesto crop production in many areas of the world. Studies have shown that between 25?N and 45?N, global radiationhas been reduced by as much as 1.4- 2.7% per decade [Qian et al., 2006; Stanhill and Cohen, 2001]. With the increase in population, urbanization, industrialization and demands for energy, the aerosol load over India is gradually increasing having significant impact on continuation of the solar dimming phenomenon (Badarinath et al., 2010; Kambezidis et al., 2012). Niyogi et al. (2004) also indicates that the effect ofglobal dimming would be different depending on the landscape. For forests and croplands, increasing aerosol loading resulted in increasing net ecosystem exchange (NEE), while for grasslands this translated in lowered NEE. The main reasons for these differences are related to the canopy architecture and the photosynthesis pathways. In present study we investigated the growth, physiological and yield parameters under different irradiances of two wheat (HD 2643 and PBW343) and chickpea (BG1105 and BGD 72) varieties of northern India. Plants were grown under irradiances of 100, 80 and 65 % of the solar radiation. Height of plants and leaf area index (LAI) of both crop cultivars under 80 and 65 % of irradiance was more as compared to plants under 100% irradiance. HD 2643 variety plants of wheat and BG1105 variety plants in chickpea were exhibited more tallness as compared to PBW343 and BGD 72 variety plants under reduced irradiance. Tillering in wheat varieties and branching in chickpea variety were adversely affected by reduced irradiance. Reduced irradiance also adversely affects physiological processes and yield of both varieties of wheat and chickpea. Under 80% irradiance biological yield of HD2643 and PBW343 wheat varieties decreased by 40% and 37.8% respectively, whereas under 65% irradiance reduction was 45% and 41% in HD2643 and PBW343respectively. Similarly in chickpea crop varieties BGD72 and BG1105,under80% irradiance reduction in biological yield was 13% and 24% respectively. Reduction in biological yield under 65% irradiancewas 34% and 53.4% in BGD72 and BG1105 respectively. Results suggest that PBW343 and BGD72 cultivars exhibited comparatively less sensitivity to reduced irradiance than HD 2643 and BG1105 wheat and chickpea cultivars respectively.The existence ofintraspecific genetic variability among wheat and chickpea cultivars might be useful in selectingoptimal cultivars to increase agricultural production in climatic condition subjected to low irradiance.

Key words: Wheat, Chickpea, Irradiance, Photosynthesis rate, Stomatal conductance

SVI/KN-1

Bioremediation for Boosting Bioeconomy

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Land resources on a global perspective are under immense pressure. The pressure on available land resources is increasing because of land degradation, the growing world population, global economic development, irrational urbanization. Nature's cure using Biodiversity in the process of Bioremediation) is a sustainable solution for environmental decontamination. As of now about 20000 research papers have been published on various aspects of using biological resources for environmental cleanup starting with only 11 in the year 1989. Several strategies are being applied for phytoremediation of heavy metal contaminated sites.

Plant based remediation strategies [phytotechnologies] are emerging as viable alternatives to conventional remediation techniques. Based on small-scale studies perennial plants, annuals are relevant candidates for phytotechnologies. Plant-associated microbes have been integrated into phytotechnology options, enhancing plant performance, reducing contaminant phytotoxicity. These eco-innovative phytotechnologies can in-situ and ex-situ remediate soil layers, which can be explored by roots and at the same time provide plant biomasses, contributing towards achieving envisaged targets on the use of renewable plant-based feedstock for various purposes (renewable energy sources, ecomaterials, biomass for bio- refineries, green fine chemistry, bioplastics, etc.) in substitution to fossil fuels and other non-renewable raw materials. They can also reduce the diversion of croplands to bioenergy and other non-food crops. Conversion of phytoremediation-borne biomass forgreen-fine chemistry (catalyst production from metal accumulating biomass), biorefinery (prehydrolysis and organosolv pre-treatment from metal accumulating woody lignocellulosic biomass) and by increasing the panel of plant species cultivated on metal contaminated soils for value chain and value added products enhancing bioeonomy have been covered in this peper.

Key word: Phytoremidiation, Soil biorefinery, Phytotechnology, Heavy metals

SVI/L-1

Effect of Melanoidins and Phenols on Cellular and Biochemical Parameter of *Typha angustifolia* during *In situ* and *Ex situ* Phytoremediation of Heavy Metal from Distillery Effluent Contaminated Site

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Typha angustifolia was evaluated for various heavy metals (Cu, Pb, Ni, Fe, Mn, and Zn) bioremediation potential from aqueous solution containing variable concentrations of phenol (100–800mgl^{-1}) and melanoidin (2500–8500 Co–Pt) at 20, 40, and 60 days. The concentration of phenol (200–400mgl^{-1}) along with melanoidin 2500 Co–Pt showed optimum for phytoremediation of tested heavy metals While, higher concentrations of melanoidin (5600–8500 Co–Pt) showed toxic effect on *T. angustifolia* along with phenol. Phenol and melanoidin showed adverse effect on *T. angustifolia* up to 20 days incubation, but this leads to induction of peroxidase and ascorbic acid activity to cope with adverse conditions. The TEM observations of *T. angustifolia* showed clotted deposition of metals and shrinkage of cell in root, breakdown of spongy and palisade parenchyma of leaves at higher concentration of phenol (100mgl"1) and melanoidin (5500 Co–Pt). In addition a comparative bioaccumulation pattern and ultrastructural changes were studied in *Phragmites cummunis, T. angustifolia* and *Cyperus esculentus* in mixed metals solution of cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), manganese (Mn), nickel (Ni), lead (Pb) and zinc (Zn). *P. cummunis* was observed to be a shoot accumulator for Cr, Fe, Mn, Ni, Pb, and Zn. However, *T. angustifolia* was found to be a root accumulator for Cd, Cr, Cu, Fe, Ni and Pb. In addition, *C. esculentus* also accumulated most of the tested heavy metals in the roots, while Mn and Fe were translocated up to leaves. Ultra structural observation showed the cellular changes in wetland plants after longer exposure. Results revealed that *P. cummunis* and *T. angustifolia* had more potential for

tested metals than *C. esculentus*. Besides, the ex-situ study showed metal accumulation in *T. angustifolia* was found higher than *C. esculentus*, and accumulation pattern was Fe>Mn>Cr>Zn>Pb>Cu>Ni>Cd. Simultaneously, chlorophyll, protein, cysteine, and ascorbic acid were also induced in *T. angustifolia* than *C. esculentus*. In addition, formation of multinucleolus in shoot of *T. angustifolia* was found an evidence of extra protein synthesis for tolerance under stress conditions. Thus, this study concluded that *T. angustifolia* could be a potential phytoremediator for heavy metals from metal, melanoidins, and phenol containing industrial wastewater at optimized condition only.

Kew words: Phytoremediation, Cellular damage, Melanoidins, Phenol, *Typha angustifolia*

SVI/L-2

Ecosystem Services: Bioindication and Biomonitoring Technologies in Environmental Quality Assessment

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Environmental quality control by living or formerly living organisms, means by bioindicators or biomonitors, exists since decades and belongs to ecosystem services. Classical programs for environmental monitoring have been supplemented by bioindication measures for a number of years. Investigations on living organisms or their remains (e.g. peat) are frequently used to indicate the environmental situation in either qualitative (bioindication) or quantitative (biomonitoring) terms. This approach provides pieces of information on environmental burdens of a region at a given point of time or on its changes with time (trend analysis). Classical bioindication often deals with observation and measurements of chemical noxae (both inorganic and organic ones) in well defind bioindicator plants or animals (including human).

Global cooperation among various scientific teams throughout the world has produced common ideas, scientific definitions, and highly innovative results of this extremely attractive working field. The transdisciplinary approach of different and multifaceted scientific areas – starting from biology, analytical chemistry, via health physics, up to social and economic issues – have surpassed mental barriers of individual scientists, the "production" of straightforward common results related to the influence of material and immaterial environmental factors to the wellbeing of organisms and human life has now reached the forefront of international thinking.

Key words: Quality, Technologies, Bioindicators, Biomonitors, Environmental pollution

SVI/O-1

General Review: Fungal Bioremediation of Heavy Metals Contamination in Saudi Arabia

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Soils, waste, water, sediments and air are frequently contaminated with heavy metals. Heavy metal contamination in Saudi Arabia may be derived from petroleum and mines operations, refining ores, sludge, waste treatment, electrical equipments, paints, alloys, pesticides, batteries and fuel transportations.

Microbial processes lead to appreciable complete remediation of the heavy metals contaminated environments in Saudi Arabia .The chief ways by which such remediation may be accomplished include biosorption, bioadsorption, bioaugmentation, biostimulation, bioaccumulation, biosolubilization, biovoltailization, bioreduction, bioprecipitation, biocomplexation,and methylation. Technologies methods are fully developed and have now been used in practice such as nanotechnology bioremrdiation.

An area of fungal biotechnology currently using fungal biomass to adsorb metal ions from contaminated solutions. Such biological approaches to metal ion recovery can be used to clean up polluted effluents or to recover precious metal ions from solutions.

The present review might give a database on microbial bioremediation of heavy metal contamination for some future studies in Saudi Arabia as well as in the Arabian Gulf Region.

Key Words: Saudi Arabia, Fungi, Heavy metals, Contamination, Bioremidation.

SVI/O-2

Biological Wastewater Treatment using a Gram-Positive Bacteria Isolated from Wastewater

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A novel strain of the genus *Micrococcus* which was isolated from wastewater, has been studied for resistance to heavy metals (chromium, nickel, and cobalt), and its capacity to accumulate these metal ions. The isolate exhibited high minimal inhibitory concentration values for metal ions tested, and was able to accumulate more than 90% of chrome, 80% of cobalt and 70% of nickel during its active growth cycle. Study of pH effect on heavy metal removal showed that the accumulation of metal ions increased with increasing pH for both chrome and cobalt but decrease for the nickel. Due to its high metal accumulation capacity in aerobic conditions, this Gram-positive bacteria may be potentially applicable for *in situ* bioremediation of heavy metals contaminating aqueous systems.

Key words: Gram-positive bacteria, Heavy metals, Bioaccumulation

SVI/O-3

Phytoremediation is a Good Step for Protection of Soil and Crop

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An increased uptake of toxic metals by food crops grown on metal-contaminated soils together with human health risks are often recorded. Great efforts have been made in the decades (soil, water) to reduce pollution sources and remedy the polluted soil and water resources. Phytoremediation, being more cost-effective and fewer side effects than physical and chemical approaches, has gained increasing popularity in both academic and practical circles. More than 400 plant species have been identified to have potential for soil and water remediation. Recent progresses in research and practical applications of phytoremediation for soil and water resources are discussed in the paper.

Key words: Heavy metal effect, Phytoremendiation, Affected crop

SVI/O-4

Bioremediation of Pentachlorophenol Contaminated Soils: Microbiological Methods for Feasibility Assessment and Monitoring

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There is rising public concern as a wide variety of toxic organic chemicals are being introduced deliberately into the environment. Pesticides are one common example of these chemicals, which enter the soils frequently in recent years. Chlorinated phenols (CPs) are a group of ionisable organic compounds of major environmental concern. Chlorophenols, particular those with three or more chlorine atoms, have gained an increasing use as fungicides, herbicides and insecticides .Pentachlorophenol (PCP) from the category of CPs generated harmful effects in aquaculture or soil systems .Thus, the cleanup PCP contaminated soils is imperative and it is critical to develop efficient approaches to remove multiple contaminants from soils. The need to remediate these natural resources has led to the development of new technologies that emphasize the destruction of the pollutants rather than the usual approach of disposal. Bioremediation is the use of biological interventions of biodiversity for mitigation of the noxious effects caused by environmental pollutants in a given site .Bioremediation with divers' aspects more recently, phytoremediation has emerged as one of the alternative

technologies for removing contaminants from the soil. Phytoremediation, a plant based green technology, has received much attention after the discovery of hyperaccumulating plants which have the inherent ability to accumulate, translocate, and concentrate high amount of certain xenobiotics in their above-ground/ harvestable parts .This contribution provides background information on the PCP soil phytoremediation, discusses the prospective of using biological methods for addressing this approch and describes several microbiological methods which can be used for the feasibility assessment of soil phytoremediation .

Key words: Soil, Pentachlorophenol, Phytoremediation, Phospholipid fatty acids, Endoenzyme activity

SVI/O-5

Adsorptive Bioremediation of Heavy Metals from Gangetic Plains

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The pollution of aquatic ecosystem by heavy metals has become serious concern due to their toxicity and accumulative behaviour. Presence of heavy metals in river system has been reported by various workers. These metals are introduced to environment from variety of geological as well as human activities which includes untreated industrial discharge through various industries and use of excessive fertilizers in agricultural fields. These anthropogenic sources have tremendously increased the concentration of these chemical contaminants in river system in recent years which have become a serious threat to the aquatic ecosystem .The heavy metals are non-biodegradable and thus persistent in the environment. Hence their concentration are upto several thousand times higher than in primitive time. Water and sediment samples frommost of the river systemsshow presence of common heavy metals such as As, Cd, Cr, Cu, Ni, Sb and Zn. More than 100 million people are estimated to be at risk from these toxic pollutants at levels above international health standards.

Bioremediation of heavy metal pollution remains a major challenge which has lead to increasing concern about effect of toxic heavy metals as environmental pollutants. Thus, in this paper preliminary studies for bioremediation of these metals have been investigated using batch extraction process. The highest adsorption capacity for As was found to be 72.0% (35.1mgg^{-1}) using chitosan-montmorillonite beads from the ground water sample of Gangetic plains of Bihar at 300K. The results depict that the adsorption equilibriums could be achieved within a short contact period of 10 minutes only. The biosorbent show comparable high adsorption capacity for As in broad range of 0.004 mgL^{-1} (4 ppb) to 100 mg L^{-1} (100 ppm) of solution. The biosorbent show comparable appreciable adsorption capacity for As in broad range of 0.004 mgL^{-1} (4 ppb) to 100 mgL^{-1} (100 ppm) of solution.The FT-IR, SEM and XRD analysis of the adsorbents before and after metal interaction were also found to correspond the batch adsorption results obtained. The methodology is also been extended in our laboratory for the removal of other heavy metals such as antimony, chromium, copper and zinc present in Gangetic plains.

Key words: Heavy metals, Arsenic, Biosorption, Gangetic plains, Isotherm, Chitosan-montmorillonite

SVI/O-6

Evaluation of Phenol Remediation by Various Microalgal Strains

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Phenol is released in wastewater of a various industries as petrochemical, chemical, pharmaceuticals, coal industries etc. Phenol being highly water soluble easily reaches downstream water sources causing harmful effects on aquatic flora, fauna as well as humans. Owing to toxicity of phenol, various physical, chemical as well as biological methods were used for remediation of phenol in wastewater. Biological remediation of phenol has gained widespread attention owing to its advantages of complete mineralization and low cost. Microbial phenol remediation capabilities have been well studied in bacteria and fungi. However, algal phenol

degradation capabilities have not been well characterized. In the present work, phenol degradation capabilities of four algal strains was characterized, *Chlorella pyrenoidosa* (NCIM 2738), a novel diatom BD1IITG (GenBank Accesion no: KJ002533) isolated from petroleum refinery wastewater, spirogyra and closterium species isolated from sewage water. The isolate BD1IITG was identified as diatom on the basis of 16S rRNA gene sequencing. The spirogyra and closterium strains were identified on the basis of morphological characteristics. Out of the four strains,*C.pyrenoidosa* and the diatom BD1IITG was found to be capable of phenol degradation in the range of 25-250 mg/l phenol . The highest specific growth rate as well as degradation rate was found to be 125 mg/l and 100 mg/l for *C.pyrenoidosa* and diatom BD1IITG respectively. The practical applicability of both the potent algal strains was verified by applying them for remediation of phenol from real refinery wastewater. *Chlorella pyrenoidosa* mineralized 38.32 % while the isolated diatom BD1IITG mineralized 68.58 % of phenol in refinery wastewater. Growth kinetic modeling suggested that Haldane model could best represent the growth pattern of both the strains on phenol containing wastewater. High values of maximum specific growth rate (μ_{max}), higher substrate affinity (K_s) and higher tolerance to toxic effects of phenol (K_I) of diatom BD1IITG as compared to *C.pyrenoidosa* suggest that diatom BD1IITG has potential to be applied for phenol removal from refinery wastewater.

Key words: Phenol, Microalgae, Remediation, Degradation, *Chlorella pyrenoidosa*, Diatom, Kinetic modeling

SVI/O-7

Potentials and Limitations of Phytoremediation in Tropical Agro-Climatic Conditions

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Phytoremediation of toxic contaminants in soil and water ecosystems has been largely accepted as promising and emerging technique for the cleanup of contaminated site especially for toxic metals and contaminations in low to moderate levels in larger area. The technique has been commercialized in most of the developed countries as it is economical and aesthetically pleasant. The major concerns are yet to be resolved is the contaminations of food chain and plant biomass with toxic substances and problems related to the release of toxic metals on disposal of the plant biomass and management of contaminated microbes in the medium. However most of the tropical and subtropical countries, largely considered as developing countries including India have not yet appreciated and exercised to clean up their contaminated sites by this technique adequately. The initial work has been done to study the effect of these toxic metals in crop plants which is dominated by the studies on Indian mustard which was initiated in USA. The non-edible perennial plants e.g. energy producing plants and timber producing plants are seen as good option for long term fixation of the toxic substances in non-edible plants. Some studies have also been reported on use of bacteria, fungi, lichens and dead biomass/ natural fibres to degrade, absorb or adsorb toxic substances. Our studies on Jatropha, castor, crotalaria, pistia and trapa provide significant insight for potentials of heavy metals extraction by these value added plants. However, gene technologies can help a lot to enhance bioremediation potential of microbes and plants for higher efficacy and better adaptation to the contaminated environment. We have recently initiated to investigate the potentials of timber plants for phytoremediation of toxic metals.

Key words: Phytoremediation, *Brassica juncea*, Heavy metals, *Jatropha curcus*, *Riccinus communis*, Toxic chemicals

SVI/O-8

Monitoring of Herbicide (MH) Toxicity by Using Pollen as Indicators Pollen of Mung: A Critical Review

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Potentiality of the germinability of pollen of *Phaseolus aureus* Roxb. (var. J-781, mung) was noted in all the 4 series *i.e.* F, F-24, F-48, F-72 series investigated. Pollen of F-24 and F-48 series produced higher percentage of the germination with the longer tubes than those of F series. Foliar applications of all

the concentrations (5, 10, 25,50, 100, 200-200-1000, 1000-1000-5000 mg/ml) of maleic hydrazide (1, 2-dihydropyridazine, 3-6-dione) failed to suppress the cent percent pollen fertility. However, all the concentrations of MH above 400 $mgml^{-1}$ prevented the germination of pollen of all the 4 series investigated. When there is no germination of pollen the question of the transfer of the male gametes to the female gametophyte does not arises and when there is no transfer of male gametes to the female gametophyte the question of the fertilization and seed settings does not arises. Hence instead of suppressing the pollen fertility which is not possible even with such a high concentrations of MH we should suppress the germinability of pollen with such a low concentrations which gives the birth to the new method of plant breeding - 'Salgare's Method of Plant Breeding'. It is also confirmed that the pollen development and activity are more sensitive indicators of adverse factors in the botanical environment and the use of an entire vascular plant as an indicator of pollution is a very crud method and rather a wrong choice. There is no evidence of any entire vascular plant exhibiting this much degree of sensitivity.

Key words: Genetics and plant breeding, Palynology, Crop physiology, Herbicides, Toxacology, Environmental sciences

SVI/O-9

Hydro-Chemical Evaluation for Seasonal Variation of Fluoride in Agricultural Tubewells using Multivariate Statistical Approach

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Since a sizable amount of fluoride intake takes place through the ingestion of food that are grown in the fluoride contaminated soil and irrigation water besides fluoride contaminated drinking water. This may lead to higher toxicological risk from fluoride. Therefore, in the present study, a systematic delineation and characterization of fluoride in the agricultural tubewells in Unnao district was carried out to study seasonal variations of fluoride using graphical and multivariate statistical approach. The spatial distribution of fluoride concentration in agricultural tubewells during pre-monsoon and post-monsoon seasons was determined by geo-statistical method using semi-variogram analysis and kriging. The results of graphical and principal component analysis (PCA) suggested that different natural hydro-geochemical processes such as weathering of silicates, carbonates and various ion exchange processes are the key factors responsible for the geochemistry of the ground water besides alkalinity of water. Out of the sampled water, 27.3% and 18.2% of the were contaminated with fluoride exceeding the desirable limit of 1.0 mg l^{-1} as prescribed by Bureau of Indian Standards (BIS) during pre-monsoon and post-monsoon season, respectively. The fluoride had a significant positive correlation with pH (r=+0.57) during pre-monsoon and post-monsoon seasons (r=+54). The sodium adsorption ratio (SAR) had a significant positive correlation with fluoride (r=+0.51). The water type of majority of the samples in both seasons was found to be bicarbonate type suggesting its alkaline nature which is responsible for the dissolution of CaF_2 and thereby releases fluoride into groundwater.

Key words: Evaluation, Fluoride, Multivariate, Groundwater, Geochemistry

SVI/O-10

Phytoremedation of Heavy Metal Contaminated Soils: A Potentially Promising Clean-UP Technology

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Environmental pollution of the biosphere with toxic heavy metals has accelerated dramatically since the beginning of the industrial revolution. Contamination of soils with toxic heavy metals is a widespread environmental problem resulting from global industrialization. Some heavy metal

remediation technologies have been developed to treat contaminated soil, but a plant-based remediation technology, phytoremediation, is a new emerging technology. Phytoremediation is green technologies utilizing green plants to clean up the environment from contaminants and has been offered as a cost-effective and non-invasive alternative to the conventional engineering-based remediation technique. The advantage of the technique lie in making the living plants act as a solar-driven pump, which can extract and concentrate certain heavy metals from the environment. The process of hyperaccumulation of heavy metals by higher plants is a complex phenomenon. Phytoremediation process includes phytovolatilization, phytostabilization, and phytoextraction using hyperaccumulator plant species. Plants have a range of potential mechanisms at the cellular level that might be involved in the detoxification and tolerance to heavy metal stress. Phytoremediation technologies with the use of new transgenic plants have also improved the capacity of biochemical processes such as metal uptake, transport, accumulation and detoxification of metal pollutants. The recent research that certain chelating agents greatly facilitate metal accumulation by soil-grown plants can make this remediation technology a commercial in the near future. Thus the knowledge on the physiological and biochemical responses helps to adopt different strategies of purification and improvement of the environment through use of plants, which tolerate and accumulate high levels of heavy metals.

Key words: Phytoremediation, Heavy metals, Phytoextraction, Accumulation, Translocation

SVI/O-11

A Novel Approach to Modelling of an Aerobic Hybrid Bioreactor Treating Easily Biodegradable Substances

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Modeling of an aerobic hybrid bioreactor is done by a simple and fast method considering concurrent growth of both the suspended and attached biomass. Its main focus is on simultaneous uptake of easily biodegradable carbonaceous substances by the heterotrophic biomass present over the suspended and attached phase. The model applied the principle of external mass transport as per Fick's law, steady state carbonaceous substrate as well as biomass balance for both suspended and attached growths. Monod growth kinetic is followed for the utilization of carbonaceous substrate assuming no inhibition. The boundary condition for substrate uptake was considered for biofilm liquid interface and at attachment surface. The analytical solution is essentially done by Runge Kutta method and thus a computer programme is developed in FORTRAN language. The model has been examined with existing methods by solving a few sets of real data. It is found easier and faster than the existing methods and it can be extended to purely biofilm system also. The concept diagram of a typical hybrid bioreactor i.e. integrated biofilm activated sludge process is shown in figure 1. The substrate concentration profile across the biofilm present in the hybrid bioreactor is shown in Figure 2.

Key words: Hybrid bioreactor, Activated sludge-biofilm modelling, Monod kinetics, FORTRAN programme, Model performance

SVI/O-12

Synergistic Influence of *Vetiveria zizanioides* and Selected Rhizospheric Microbial Strains: Application to Enhance Remediation of Endosulfan Contaminated Soil

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Application of previously identified endosulfan tolerant rhizospheric bacterial strain in combination with *Vetiveria zizanioides* for the remediation of endosulfan is described herein. The dissipation of endosulfan from soil was considerably enhanced in the presence of bacterial strain and *Vetiveria zizanioides* together when compared to the dissipation in presence of either of them alone. Four strains-EAG-EC-12, EAG-EC-13, EAG-EC-14 and EAG-EC-15 were used for this purpose. *V. zizanioides* was grown

in garden soil spiked with 1500 µg g^{-1} of endosulfan and inoculated with 100 ml of microbial culture of above motioned strains. Effect of microbial inoculation on plant growth, endosulfan degradation, microbial biomass carbon, dehydrogenase activity and endosulfan removal percentage were analyzed. The microbial inoculation significantly enhances the growth of test plant, microbial biomass carbon, dehydrogenase activity and endosulfan dissipation from soil ($p<0.05$). Results of the present study suggested that the presence of *V. zizanioides* aided the bacterial degradation of endosulfan in soil, as the degradation percent of endosulfan was found to increase between 9.05 to 20.69% as compared with non -vegetative experiment. Formation of endosulfan diol and endosulfan lacone, the non toxic metabolites of endosulfan shows that, utilization of these microbes in combination with *V. zizanioides* will be very useful in the bioremediation of endosulfan contaminated soils/sites.

Key words: Rhizoremediation, Contaminants, Detoxification, Metabolites, Tolerance

SVI/O-13

Sustainable Phytomanagement of Fly Ash Dump based on Naturally Colonizing Plants

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The huge generation of fly ash (FA) from coal-based thermal power plants has become a major concern worldwide. The dumping of FA has encroached thousands of hectare land nearby coal-based thermal power plants. Countries like China, United States, India, Europe, South Africa, Australia, Japan, Italy, and Greece produces huge amount of ash. FA landfill contaminates both aquatic and terrestrial ecosystems due to presence of heavy metals and other pollutants. Some human health problems have been identified in residents of coal-based thermal power plant. Therefore, phytomanagement of FA landfill area is suggested due to its cost-effectiveness and holistic approach, which serves the purpose of stabilization, carbon sequestration and may provide a pleasant landscape.

In this context, several plant species has been found effective in re-vegetating FA landfills. But only limited research on spontaneous vegetation based remediation of FA landfills has been done. Therefore, it is urgently needed for scientific community to develop spontaneous plant based phytomanagement of FA landfills. Furthermore, economical plant species can be used for this strategy, of "sustainable phytomanagement" help in to restore our ecosystems nearby thermal power plants. The phytomanagement of FA dumps with multipurpose species will provide economic benefits and other ecosystem services.

Key words: Fly ash dumps, Heavy metals, Sustainable phytomanagement, Naturally colonizing plants, Multipurpose species

SVI/O-14

Biomixtures for Prevention of Point Source Pollution of Pesticides

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To overcome the problem of on farm point sources of pollution stemming from improper handling, spillages and leakages during filling and cleaning of spraying equipments, environmental friendly and low cost technology filter systems are under development. Biocharand digestate mixtures with two types of soil (sandy and silt loam) had been used as a biofiltertest material for a respiration study instead of conventional mixtures of soil, peat and straw. Theresults show that digestate is an easily available C-source leading to highest release of CO_2-compared to all other biomixtures used in the experiment. It was found that with the addition of even a small amount (1% W/W) of biochar led to a profound suppression in the CO_2-C release.

Further the fate of applied organic contaminants to biomixtures depends on factors like soilproperties and climatic conditions as well as biological degradation by the soil microbes. Toanalyze the degradation potential of the different soil/amendment

mixtures a long termdegradation study (approx. 6 month) is carried out with 3 different radiolabelled pesticides (Bentazone, Boscalid and Pyrimethanil). The results with 14C Bentazone show that 5% digestateand 5% biochar mixture (W/W) showed the highest (nearly 15%) and 1% biochar the lowestrate of mineralization (approx. 1% of applied radioactivity) compared to the other biomixtures. Itis clear that organic amendment except biochar increases the mineralization of bentazone.

Key words: Biochar, Biomixture, Degradation, Digestate, Point source of pollution, Respiration

SVI/O-15

Arsenic Toxicity in Soils: Need for Fractionation and Speciation

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Arsenic is a toxic metalloid of global concern. It is usually originated geogenically, but can be intensified by human activities such as applications of pesticides and wood preservatives, mining and smelting operations, and overuse of arsenic contaminated groundwater for drinking and irrigation purposes. Arsenic contamination and accumulation in soils, waters and plants poses many risks to human and ecosystem health and several major studies have been published on this subject. Arsenic is the element of most concern with regard to food-chain contamination. While, many researchers have attempted to develop the relationship between concentrations of arsenic in soils or plants and the effects on plants or other organisms, it is found that the total arsenic concentration is not a good predictor of its toxicity levels. The regulations or guidelines used to protect soil from arsenic pollution in most of the countries are still based on assessing the total concentrations of arsenic present in the soil. There is a growing consensus that the concept of arsenic bioavailability needs to be considered in environmental risk assessments. But, a framework of how metal(loid) speciation information can assist this assessment in soil systems is lacking. An appropriate assessment of environmental risks of arsenic must consider the speciation information in bioavailability-based rationale to actually investigate site-specific magnitude of arsenic toxicity. Apart from arsenic phytoavailability, arsenic bioaccessibility is an important parameter of measuring uptake and toxicity of arsenic, which distinctly depends upon arsenic speciation in soil-pore water. Such fact has led to suggestions that soil tests aimed at assessing hazard (bioavailability) of arsenic in soils should measure the arsenic speciation in different soil arsenic fractions rather than inappropriate tests based on total soil arsenic concentration that are still used in many countries.

Key words: Arsenic, Soil, Fractions, Speciation, Phytotoxicity

SVI/O-16

Assessment of Anthropogenic Metal Contamination in Mumbai City using Transplanted Lichens as Bioindicators

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Mumbai, in spite of most densely populated Indian city and over-burdened with thousands of industries and millions of vehicles, till date no attempt has been made to measure the heavy metal deposition using biomonitoring. Biomonitoring involves the use of biomaterials to obtain qualitative and quantitative information on the quality of the environment. In the present work, we investigated accumulation of heavy metals in transplanted lichens by active biomonitoring, in different regions of Mumbai as anthropogenic activities have altered balance of some heavy metals. Biomonitoring the quality of the environment, using lichens as bioindicators, has been studied word-wide as these symbiotic organisms lack significant cuticle, stomata and epidermis and devoid of a well-developed root system. Theyabsorb nutrient directly from the atmosphere along with pollutants far above their physiological requirements. Lichen transplants have advantage of exposing lichens in sites where they are naturally absent, influenced by geographical, temporal and pollution sources and provide a cost- and time-efficient means to assess the impact of environmental disturbances. Initially, lichen *Porina internigrans*

(Nyl.) Mull. Arg. was collected from Bhimashankar forests of Western Ghats, far from any polluting sources. After identification at Lichenology Laboratory, CSIR-NBRI, it was collected each year, December 2009 onwards, together with a small piece of the substrate and transplantedin total 30 locations and exposed for three months, collected, dried, cleaned, ground, digested and analyzed by ICP-OES for heavy metals by comparing with NIST SRMs. The correlations between exposure time and heavy metal concentration were statistically tested which showed a spatial distribution in the concentration of elements. The initial content has to be measured prior to each exposure experiment, as an inter-annual variability can be observed, mainly for anthropogenic elements. The accumulation of different metals decreased with increasing distance from the city center and all the sites exhibited an enhanced level of heavy metals. This study confirms ability of lichens for biomonitoring. To conclude, the use of lichens for transplants and the measurements allowed the interpretation of the accumulation trends and more systematic studies are required to be conducted in order to monitor the air quality and establish lichen biomonitoring.

Key words: Anthropogenic, Biomonitoring, Bioaccumulation, Transplanted

SVI/O-17

Constructed Wetland: Ecotechnological Approach of Sewage Treatment for Conservation of Ganga River Water Quality

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The river Ganga, an iconic status and religious heritage of India is facing formidable pollution pressures and associated threats to its biodiversity and environmental sustainability. In order to conserve river ecosystem, constructed wetland has been proven a best remedy which may act as biofilter at sewage confluence site along river Ganga and can remove high load of nutrients including heavy metals.

To revitalize the river Ganga ecosystem, a sub-surface flow constructed wetland (CW) has been developed at Shantikunj, Haridwar by raising potential aquatic macrophytes; *Typha latifolia, Phragmites australis* and *Colocasia esculenta* in gravel as medium. Sewage treatment potential of CW was evaluated by varying retention time at three different stages of plant growth and stabilization. Monitoring results at 6 months of operations revealed that CW can remove more than 90%, 65%, 78%, 84%, 76% and 86% of BOD, TSS, TDS, NO_3–N, PO_4–P and NH_4–N, respectively at 36 h retention time. Constructed wetland is particularly efficient in warmer climates and in the region with long day length in winter. In this regard, water samples in winter and summer from inlet and outlet of the CW were collected and analyzed. Significant variations due to the species and seasons were observed for removal of pollutants in CW. Results indicated that the average removal efficiency in physico-chemical characteristics i.e., conductivity, TDS, BOD, TSS, NO_3-N, NH_4-N and PO_4-P in summer and winter season were from 64.8-94.1% and 55.3-91.61%, respectively. Similarly, removal of metal were in order of Pb (86%) > Cu (84.01%) > Zn (83.48%) > As (82.23%) > Cr (81.63%) > Co (76.86%) > Ni (68.14%) > Mn (62.22%) during summer. While during winter it was Pb (78.59%) > Cu (72.50%) > Zn (68.40%) > Co (65.12%) > Cr (64.5%) > As (63.18%) > Mn (53.34%) > Ni (51.39%). In general, the selected macrophytes used herein showed higher BCF and TF in summer than winter. The study demonstrated that CW seems suitable ecotechnology for remediation of urban wastes containing metals before entering into river Ganga.

Key words: Ganga, Constructed wetland, Remediation, Sewage, Macrophytes

SVI/O-18

Rehabilitation of Sodic Waste Land through Agro-Forestry System

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Sodic soils are widely distributed in arid and semi arid regions of the world and suffer from high values of pH, exchangeable sodium percentage (ESP), sodium absorption ratio (SAR) and low fertility. In North India, Uttar Pradesh is occupying about 1.6 Mha of this type of sodic waste land. To alleviate the pressure of fulfilling the demand of wood, timber, fodder and food

for the enormous population of human and cattle, the vast sodic soil area has to be rehabilitated by planting trees or adopting agro-forestry system.

In this context, an attempt has been made to rehabilitate sodic waste land through the establishment of green cover, with diverse plant communities at Distant Research Centre of CSIR-National Botanical Research Institute, Lucknow during last few decades. A rehabilitated forest ecosystem was developed consisting of a number of herbs, shrubs and trees. *Derris indica*, *Dalbergia sisso*, *Azadirachta indica*, *Cassia siamea*, *Terminalia arjuna*, *Syzigium cumini* were the dominant species in this rehabilitated forest, resulting in significant amelioration process, influenced greatly by diversity of species and their productivity. A combined effect of both biomass productivity and species diversity contributed about 92% towards amelioration. There was reduction in soil pH and ESP and an increase in organic C and N contents showing that sodicity has receded in the forest soil. To meet the increasing demand of medicinal, aromatic, dye, gum, fibre, fodder yielding plants in the present scenario, the shade loving plants of these categories can be grown successfully in between the rows of economic trees like teak, poplar, Eucalyptus etc. Such agro-forestry models have been tried with various inter-crops like *Curcuma longa*, *Rauvolfia serpentina*, *Zingiber officinale*, *Desmodium gangeticum* and *Asparagus racemosus* etc. The findings of such studies are very useful for fulfilling the demand of economic plants by utilizing the wasteland and free spaces of trees cultivated in such lands.

Key words: Sodic soil, Agro-forestry, Medicinal and aromatic plants

SVI/O-19

Degradation and Decolourization of Distillery Wastewater Melanoidins by Manganese Peroxidase (MnP) Producing Bacteria

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Melanoidins are natural, dark brown to black coloured complex biopolymers of amino carbonyl compounds produced by non-enzymatic browning Maillard reactions. Melanoidins are the major colouring and polluting constituents in distillery wastewaters, which retains dark black colour even after anaerobic treatment and hardly changes in extended aeration tank due to its recalcitrant nature. In this study, two aerobic bacteria RNBS1 and RNBS3 capable to degrade and utilize distillery effluent melanoidins as carbon, nitrogen and energy source were isolated and characterized biochemically as gram positive, long rod shaped bacteria in chain giving positive tests for motility and catalase activity. However, both the strains have shown the negative tests for indol production and oxidase activity. Further, on the basis of 16S rRNA gene sequence analysis, bacterium RNBS1 and RNBS3 was identified as *Alcaligenes faecalis* (DQ659619) and *Bacillus cereus* (DQ659620), respectively. During the degradation and decolourization of distillery effluent melanoidins by the axenic and mixed bacterial culture, the mixed bacterial culture was found more effective compared to axenic culture RNBS1 and RNBS3 decolourizing 73.79, 66.80 and 62.56%, respectively. In addition, the HPLC analysis of control and degraded samples has shown the biodegradation as well as biotransformation of distillery effluent melanoidins by the bacterial catabolic enzymes, characterized by SDS-PAGE yielding a single band of 43 KDa. The LC-MS-MS and other spectrophotometeric analysis has also revealed that most of the distillery effluent melanoidins detected in control samples were diminished from the bacteria treated samples and the disappearance of distillery effluent melanoidins from bacteria treated samples could be related with the degradation and decolourization of distillery effluent melanoidins by the developed bacterial consortium.

Key words: Distillery effluent, Melanoidin. *Alcaligenes faecalis*, *Bacillus cereus*, Degradation, Manganese peroxidase

SVI/O-20

Simultaneous Removal of Chromium, Sulphate, Nitrate and Phosphate from Synthetic Tannery Wastewater by Phytoremediation using *Tradescantia pallida*

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Effluent from leather industry is a major environmental concern due to the presence of chromium and various other ions, such as sulphate, phosphate, nitrate, etc., which need to be removed prior to its discharge into the environment. Phytoremediation is an efficient method to remove and detoxify such pollutants from industry wastewater. *Tradescantia pallida*, is a plant species with low maintenance and capable of easy propagation even in areas with high pollution level, is known to bioaccumulate chromium and is also a bioindicator of environmental pollution. In this study, simultaneous removal of chromium, sulphate, nitrate and phosphate by *T. pallida* was evaluated. Different combination levels of Cr 6_+, SO_4^{2-}, NO_3 and PO_4^{2-} were planned as per the Plackett-Burman design of experiments and the plant species was grown in hydroponic system. The results revealed that removal of 85% chromium, 80% sulphate, 94 % nitrate and 100% phosphate could be achieved with no visible phytotoxicity to the plant species at an initial Cr(VI) different concentration in the range 5- 20 mg L^{-1}. The results on the effect of these co-ions on Cr uptake by *T. pallida* further revealed enhancement in the Cr(6+) uptake by sulphate and nitrate at a higher initial Cr concentration of 20 mg L^{-1}. On the other hand, Cr uptake was not affected due to phosphate both at high and low initial Cr concentration.

Key words: Phytoremediation, Chromium, Tannery wastewater, *Tradescantia pallid*, Co-ions, Plackett-Burman

SVI/P-1

Engineered *In situ* Bioremediation: An Emerging Technology for Contaminated Groundwater Remediation

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Groundwater contamination is one of the serious issues in the 21st Century. Due to over exploitation of groundwater by agricultural, industrial and domestic sectors, slowly and gradually, groundwater is polluting day by day. Ex-situ remediation of groundwater is costly and it can't check the migration of plume from one location to another. Groundwater remediation using the indigenous microorganism to degrade contaminants which are present in the aquifer materials is a fast emerging technology. In-situ bioremediation is one of the most successful technologies for groundwater remediation because it has the ability to remediate the contaminated at the site at low cost of remediation. A decade ago, in-situ bioremediation was used only for petroleum hydrocarbons, but with the advancement of technology, it is also used for remediation aquifer contaminated with other organic and inorganic contaminants. Engineered in-situ bioremediation system comprises of injection and extraction wells. By adding sufficient nutrient and oxygen through injection wells, biodegradation of contaminant with the help of indigenous bacteria is facilitated. Extraction wells on the other hand, check the movement of plume to migrate further in the downstream direction. In the present study, in-situ bioremediation technology for groundwater remediation has been elaborated. Further, a case study has been done which applied the mentioned technology on a hypothetical site. The results suggest that by adopting the proper pumping strategy for the injection and extraction wells, the aquifer can be remediated up to the desired permissible limit.

Key words: *In situ* bioremediation, Petroleum hydrocarbon, Groundwater, Injection well, Extraction well, Biodegradation

SVI/P-2

Estimation of Air Pollution Tolerance Index in Various Plant Species in Industrial Area, Gajraula, India

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To analyze the Air Pollution Tolerance Index (APTI) in various plant species, two sites have been selected in Gajraula *i.e.* Indra Chowk and Town Basti as industrial and control area respectively. Gajraula is an Industrial area and to ameliorate industrial air pollution only a suitable alternative way is, to grow tolerant plants in and around industries. For the purpose ten tree species along the roadsides were chosen to determine the APTI by calculating ascorbic acid content, chlorophyll content, leaf extract pH and relative water content. The highest APTI was observed in *Saraca indica* (49.36), and lowest in *Tectona grandis* (9.68). The results of the present study indicate

that *Saraca indica, Alstonia scholaris* and *Ficus rumphii* are found tolerant and can be planted along the industrial belt while *Mangifera indica, Polyalthia longifolia, Cassia fistula* are sensitive and can be used as bioindicator to air pollution.

Key words: Air pollution tolerance index, Industrial area, Air pollution, Biochemical parameters

SVI/P-3

Removal of Lead (II) from Aqueous Solutions using *Carissa carandus* and *Syzygium aromaticum:* A biosorptive Study

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Biosorption rightly follows the basic philosophy of Green Chemistry. It is very promising and environmental friendly approach in which utilization of bio-based adsorbents is promoted. Biosorptive removal of Lead (II) from aqueous solutions by *Carissa carandus* and *Syzygium aromaticum* was carried out in batch mode and investigated further. Biosorptivity of both of these biosorbents has been correlated with the concentration of metal ions, pH change, agitation time, dose of adsorbent under identical experimental conditions. The results observed from both *Carissa carandus* and *Syzygium aromaticum* were compared and analyzed for the better removal of lead from the aqueous solutions. SEM images were recorded to visualize the sorption behavior of *Carissa carandus* and *Syzygium aromaticum*. Also, the adsorption of Pb(II) was discussed by the *Langmuir* and *Frenduilich isotherm* models and the comparative results are presented in the present paper.

Key words: Green Chemistry, Heavy metals, Adsorption, Biosorption, *Carissa carandus*, *Syzygium aromaticum*, Langmuir isotherm, Frenduilich isotherm

SVI/P-4

Controlling Heavy Metal Soil Pollution by Phytoremediation: A Greener and Sustainable Approach

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With increasing pollution and rapid industrialization, there is a need to assess the effects and relative sensitivity of plants to different pollutants. The careless handling of heavy metals has increased their quantity in soil and water, thus severely affecting the environment and organisms.Phytoremediation is considered to be a "green revolution" in the field of innovative clean up technologies. It describes the treatment of environmental problems through the use of plants that mitigate the environmental problems without the need to excavate the contaminated material and dispose it elsewhere. Some plants proved to be popular organism for bio-monitoring to determine and identify the sources of heavy metal soil pollution and their detoxification by phytoextraction techniques. In the present study, we have collected soil samples and some of the efficiently growing plant species from the polluted sites to find out the extent of heavy metal accumulation in plant and soil samples besides identifying thehyper-accumulators.Soil and plant samples were digested using green analytical technique for metal analysis and analyzed the heavy metal content using Atomic absorption spectrophotometry (AAS). We found *Saccharum*, *Brassicajuncea*, *Tamarix* and *Ricinus* as efficient accumulators of heavy metal from the soil. The general trend of heavy metal accumulation pattern in soil samples from all the sites was found out to be in order of: Zn>Mn>Pb>Cu>Ni>Cr>Cd. The concentration of Mn and Zn were higher in all the sites studied and Zn was the most accumulated heavy metal on an average. *Saccharum*and *Brassicajuncea* were found out to be good accumulators of heavy metals viz. Zn, Mn, Pb,Cr, Cu,Cd followed by *Ricinus*and *Tamarix*species. The wild plants are good accumulators as found in the greenhouse experiment and it may minimize chances of biomagnification of heavy metals in food chain and further reduce the consequent chances of health hazards.

Key words: Phytoremediation, Hyper-accumulator, Heavy metal, AAS, Soil pollution, Phytoextraction, Biomonitoring, Biomagnifications

SVI/P-5

Isolation, Physiochemical Analysis and Biochemical Characterization of Petroleum Hydrocarbons Degrading Microorganisms

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Petroleum has been used for many decades for illumination and, on a smaller scale, as lubricant. Environmental pollution by petroleum hydrocarbons has become a serious problem all around the world. The contaminations caused by petrol and petroleum products have been proved a great disaster on ecosystem. Bioremediation is one of the economical methods used to treat this threat and an approach to save the environment from petroleum related issues. The present work has been focused on this approach, aiming to isolate novel bacterial strains capable of petroleum hydrocarbon degradation *in situ* conditions. In this study, physical analysis of the contaminated soil samples was done and chemical analysis by GC-MS was performed and the isolates capable of degrading a wide spectrum of hydrocarbons efficiently were isolated by enrichment culture technique by Bushnell Hass medium (BHM).

Key words: PAH, Bioremediation, Hydrocarbons, Biodegradation

SVI/P-6

Aglonema commutatum as Bioindicator for Indoor Pollutants

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Chinese evergreen (*Aglonema commutatum*) was tested as bioindicator for pollutants released from household products. Potted plants were exposed to the pollutants released from mosquito coil, naphthalene balls and joss sticks. The indoor pollutants released from these products are very dangerous to our health. These gases may affect our respiratory system, nervous system etc. After exposing these plants in exposure chamber to all indoor pollutants under consideration, they were monitored w.r.t. visible symptoms, PII , site experiments and GLC. The experiments were repeated thrice. Amongst all products tested, *Aglaonema* was found more tolerant to pollutants released from mosquito coil than other two products studied.

Key words: *Aglaonema commutatum*, Mosquito coil, Naphthalene balls, Joss sticks, Bioindicator

SVI/P-7

Toxicological Assessment of Industrial Effluent using *Lemna minor* as an Aquatic Toxicity Test Tool

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Lemna minor is very commonly used as a tool for wastewater toxicity and environmental pollutant assessment. This study aimed to assess the toxic effect of industrial effluents using duckweed (*L. minor*) and to evaluate its applicability for industrial effluent testing. Industrial effluents from pulp-paper mills, tanneries and pharmaceutical industries were assessed using 7-day static renewal test with *Lemna minor*. The toxicity test end-point was inhibition of growth as determined by frond (leaf) produced from mother plant by exposing them to various concentrations of these three industrial effluents. Sodium chloride was used as reference standard toxicants. Plant growth decreased progressively with the increased concentration of industrial effluents compared to the control. The tannery effluents showed toxicity range 12-18.0%, and 95% confidence interval ranged (15.5-23.0%). The pharmaceutical effluents showed wide range of toxicity (75.7-24.4%) having 95% confidence interval ranged (65.5-90.8 and 9.8-37.7%). A relationship between exposure concentrations and growth inhibition was observed (R2=0.87; R2= 0.95) for pharmaceutical effluents, and for tannery effluents (R2=0.92; R2=0.99). However, the pulp-paper mill effluents did not show any acute toxic response. The results of the study revealed that treated effluents from both the pharmaceutical and tannery industries were toxic to *Lemna* and have phytotoxic property. The tannery effluent showed highest toxicity followed by pharmaceutical effluent and no or little toxicity by paper mill effluents. The results suggest that duckweed should be used as a tool in the bio-monitoring of industrial effluents because of its simplicity, sensitivity and cost-effectiveness.

Key words: *Lemna* bioassay, Growth inhibition, Industrial effluents, Phytotoxicity

SVI/P-8

Biometabolic Estimation of Changes Led by Butachlor Induced Toxicity and their Degradation by Rice Field Cyanobacterium *Nostoc muscorum*

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In the present study, butachlor (5, 10, 20, 40 and 80 ppm) induced toxicity in *Nostoc muscorum* and their degradation was evaluated. The dose of butachlor dependent decreased in the cell survival and growth of *N. muscorum* was noticed. Scanning electron microscopy revealed the adverse impact on the cell size and shapes. Low concentrations of butachlor (10 and 20 ppm) induced the over expression of a polypeptides of 31.0 K Da and 42.7 K Da, respectively which could be responsible for developing resistance in the organism up to certain level. Further, the degradation product of butachlor as a result of metabolic activities of *N. muscorum*, identified by GC-MS analysis includes phenols and benzene dicarboxylic acid indicating the utilization of herbicide during active growth.

Key words: Bioremediation, Butachlor, ppm, GC-MS, SDS-PAGE, SEM

SVI/P-9

Transformation and Stabilization of Chromium during Composting of Tannery Effluent Phytoremediated Biomass of *Bacopa monneiri* L.

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An aquatic macrophyte (*Bacopa monneiri* L.) was used to remediate the tannery effluent for 14 d showed significant improvement in physico-chemical properties and reduction in Cr concentration. Accumulation of Cr was found maximum in roots (358 µg g^{-1}dw) as compared to shoot (62 µg g^{-1}dw) of the plant. A laboratory scale composter was designed to study physico-chemical changes and role of microbes in stabilization and transformation of Cr during composting of treated biomass. Results revealed that the composting process were quick within 7-21 d as indicated by peak time for various physico-chemical parameters and drop in C/N ratio up to acceptable limit. The profile of microbial communities also indicated that population of anaerobic, aerobic and nitrifying bacteria was increased quickly at the initial phase, and reached a peak level of $4.2x10^6$, $9.78x10^8$ and $9.32x10^9$ CFU g^{-1}, respectively at 21 d; while population of actinomycetes and fungi was maximum i.e. $3.29x10^7$ and $9.7x10^6$ CFU g^{-1} ,respectively after 35 d of composting. Overall bacterial population dominated over the actinomycetes and fungi during the composting process. $Cr^{(VI)}$ was transformed to $Cr^{(III)}$ during compost maturity. Sequential extraction of Cr fractionation showed its stabilization via changing into organic matter-bound and residual fractions during composting.

Key words: Chromium, Composting, Stabilization, Transformation, Phytoremediation

SVI/P-10

Study on Role of *Pseudomonas aeruginosa* on Heavy Metal Bioremediation

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Targetted removal of environmental toxins by use of biological processes is termed as bioremediation. It could either be intrinsic or engineered depending on the requirement of the conditions. Steep industrialization has led to a large amount of effluents being let off into the environment. A major part of these effluents contain heavy metals. This research was aimed at quantifying the bioremidiative capabilities of *Pseudomonas aeruginosa*. The experiment was carried out as a two phase study; the first phase consisted of quantifying the bioremediation for Cu, Cr, Fe and Zn at three different concentrations such as 5%, 10% and 15%. Maximized results were obtained with 15% solution of Copper, Zinc and

Chromium which showed reduction of free ion concentration approx. 88.4%, 52.4% and 42.5% respectively at 72 hrs of incubation, while 53.7% reduction of free ion concentration of iron was observed in 10% solution at 72 hrs of incubation. Phase two experiment was carried out on actual on site conditions with effluents from leather, paper and steel industries to validate the research. The organism showed maximum bioremediation of 44.6% for Cr in the effluents from the leather industry and 18.0% for Cr in effluent of pulp and paper industry where as the Cr concentration was very low in effluent of steel industry still bioremediation was taking place. In effluent of steel industry the maximum bioremediation of iron was 37.3%, followed by 11.1% in pulp and paper industry, where as iron bioremediation was very less in leather industry almost 3.5%. The Cu concentration in effluent of all the three industries was almost negligible, although *Pseudomonas aeruginosa* was remediating metal even at very low concentration. The results obtained from present investigation indicate that *Pseudomonas aeruginosa* could be an effective measure for remediation of heavy metals.

Key words: *Pseudomonas aeruginosa*, Bioremediation, Heavy metals, Resistance, Environment, Effluent

SVI/P-11

Evaluation of Genetic Variability in *Trichoderma/Hypocrea* spp. using RAPD and its Molecular Markers

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The genus *Trichoderma/Hypocrea* is soil borne fungi and is well known for their immense potential in controlling plant pathogens and making soil more productive. Various molecular markers are being used for assessing genetic variations in various living organisms. In the present study, an attempt has been made to isolate and characterize arsenic tolerant *Trichoderma/Hypocrea* spp. by treating them with different arsenic (inorganic sodium arsenate, AsV) concentration. Efforts were also made to evaluate genetic variation among various strain for generating valuable genetic information using internal transcribed spacer region (ITS) and random amplified polymorphic DNA (RAPD) molecular markers. ITS results revealed that among six, three stains belongs to different species of *Hypocrea* (*Hypocrea nigricans* and *Hypocrea lixii*) from Uttar Pradesh and (*Hypocrea orientialis*) from West Bengal and remaining three *Trichoderma* species (*Trichoderma harzianum* and *Trichoderma longbrachiatum*) from Uttar Pradesh and one species of *Trichoderma longbrachiatum* from West Bengal. The 10 RAPD primers produced a total of 150 scorable bands with average polymorphism of 97.33%. The Jaccard's similarity coefficient varied between 0.12 and 0.68 with maximum between FNBR_L46 and FNBR_L61. A high intra and inter specific variations was observed in conjunction with ITS and RAPD assay together. The study supports in monitoring highly arsenic tolerable fungi and their subsequent use can help developing in bioremediation technology.

Key words: Arsenic, *Trichoderma/Hypocrea*, Genetic variability, ITS, RAPD

SVI/P-12

Comparative Analysis of Arsenic Removal from Aqueous Solution using Immobilized Fungal Biomass of Different Fungal Strains in Batch Mode

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Fungi are effective bisorbents for the removal of heavy metals from aqueous solution. In present study, immobilization of fungal biomass in a solid polymer matrix (alginate) was done to enhance their adsorption capacity. In the study, biomass of four fungal strains FNBR_FA3, FNBR_FA6, FNBR_FA13 and FNBR_FA19 were immobilized in sodium alginate for the preparation of beads. Individual fungal beads containing 1 g biomass of fungal strain was subjected to batch experiment in 100 ml flask containing 50 ml of 50ppm arsenic solution (pH 6.0). Flasks were incubated at 30±2, 120 rpm and removed at an interval

of 5 min upto 30 min, and then at 15 min interval upto 4h. Arsenic concentration in aqueous solution sample was estimated using ICP-MS. The equilibrium of arsenic uptake was attained at 90 min with arsenic removal of 58.0, 55.6, 53.5 and 39.5% by FNBR_FA13, FNBR_FA6, FNBR_FA3 and FNBR_FA19, respectively. The arsenic biosorption by different fungal strains was ranging 5-30 mg g^{-1}. The most consistent arsenic biosorption was observed in the case of FNBR_FA13 followed by the FNBR_FA6, FNBR_FA3 and FNBR_FA19.

Key words: Bioremediation, Biosorption, Arsenic, Fungi, Alginate bead

SVI/P-13

Species of Lichen Genus *Usnea*: Most Suitable Organism for Long Term Pollution Monitoring

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Lichen genus *Usnea* is characterized by fruticose growth forms having long shrubby and thread like thallus structure. Among the different growth form of lichens, the species of *Usnea* are conspicuous and easily recognized on the substratum in nature. Owing to the highest sensitivity of *Usnea* to environmental changes, most of the species demonstrate sensitivity to disturbances caused by changes in microclimatic and environmental conditions of an area. Some species of *Usnea*, like *Usnea longissima*, grow luxuriantly in higher temperate forests and gives spider-web like appearance. *Usnea* species have frequently been used as air-pollution monitoring tool in different parts of the world. The density and abundance of the species can be correlated with the changes in the forest ecosystems. The preference of species to grow in temperate to higher temperate regions again helps to estimate the shifts caused due to climate change.

The distribution pattern of *Usnea* species may play an important role in bio-monitoring studies of an area. India is represented by the occurrence of more than 60 species of lichen genus *Usnea* of which both the Himalayan and Western Ghats regions share equal distribution of about 40 species in each. Thus the mapping of distribution pattern of different species in both the regions will provide an early indication concerning the potential air-pollution damage or micro-climatic change in the area.

Key words: Air-pollution, Lichens, Monitoring, *Usnea*

SVI/P-14

Trace Metal Speciation in Dust Deposited on Plant Leaves and their Foliar Uptake Pattern in a Representative Subtropical Environment of Central India

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Foliar dust on urban roadside plant leaves was analyzed with respect to their metal content in a representative subtropical industrial environment of India (Bilaspur, Chhattisgarh) from six diverse locations. In order to study their foliar transfer, both dust samples and plant leaves were analyzed for six target metals such as Fe, Mn, Pb, Cu, Cr, and Cd. The study revealed that vehicular as well as industrial emissions were responsible for these deleterious heavy metals. These metals were mainly derived from the heavy traffic, impurities in fuels, residual friction, industrial emission, corrosion of metallic parts of vehicles from engine wear, brushing and bearing of metals and street dust. The distribution of selected heavy metals were at the order of (1) in foliar dust: Fe > Mn > Pb > Cu > Cr > Cd and (2) in leaves: Fe > Mn > Cd > Cu > Pb > Cr. The present study demonstrated differential pattern of metal distribution in dust and plant leaves. For instance, *Mangifera indica, Calotropis procera,* and *Kigelia pinnata* showed efficient accumulation potential for Fe. On the other hand, *Mangifera indica, Pongamia pinnata, Kigelia pinnata* and *Alstonia scholaris* were found to be good accumulators for Mn. For Cr, *Pongamia pinnata, Calotropis procera, Kigelia pinnata* and *Butea monosperma* showed good results, while *Mangifera indica, Pongamia pinnata, Calotropis procera* and *Butea monosperma* were found suitable for Pb. Moreover, *Mangifera indica., Calotropis procera* and *Kigelia pinnata* showed relatively better accumulation

potential for Pb. In contrast to other metals, Cd showed significant accumulation in leaves with relatively high concentration in leaves compared to their respective dust samples. The results of this study suggested that plant growing near the affected areas should be properly screened for their biomonitoring as well as foliar transfer potential. This is because the foliar uptake pattern seems to be intricate considering its dynamic interplay between metal *vs.* plant species.

Key words: Toxic metals, Source apportionment, Urban roadside, Foliar uptake, Phytomonitoring

SVI/P-15

Comparative Efficiency of Phytoremediation Potential of *Azolla pinnata* and its Floating Associates for Decontamination of Municipal Waste Water

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Phytoremediation is an emerging, attractive and effective means of remediation technology for reclaiming contaminated municipal and industrial waste water, but when floating macrophytes are employed as the agents of phytoremediation, this becomes more interesting due to their luxuriant growth and adaptability. In the present study the phytoremediation potential of four floating macrophytes namely *Azolla pinnata, Spirodela polyrhiza, Salvinia molesta* and *Pistia stratiotes* were studied for a period of 15 days. During the experiment the morpho-biometric parameters of the plants and hydrological parameters were studied before and after treatment. By comparing the different growth parameters it was found that the biomass of *Azolla, Salvinia, Spirodela* and *Pistia* increased 15 fold, 8 fold, 6 fold and 4 fold respectively. Similarly the PO_4 content of the waste water was reduced to the tune of 94%, 92%, 92% and 95% wherein *Azolla, Spirodela, Salvinia* and *Pistia* were cultured. The NH_3-N content was also reduced to 95%, 92%, 92% and 95% in *Azolla, Spirodela, Salvinia, Pistia* treated pots respectively. The study revealed that pH, dissolved oxygen and percentage oxygen saturation value had increased, while the values for other physico-chemical parameters decreased significantly after 15 days of culture of these floating macrophytes. An increase in value of pH, dissolved oxygen and decrease in value of alkalinity, carbon dioxide concentration, C.O.D., hardness, Nitrogen and Phosphorus value indicated an improvement in water quality. An increase in fresh weight and chlorophyll content of these macrophytes have suggested its potential in phytoremediation for removal of pollutants with special reference to nutrients like Nitrogen and Phosphorus from domestic wastewater. Hence, water purification may be possible by periodic culturing of aquatic macrophytes especially *Azolla, Spirodela, Salvinia* and *Pistia* in ponds or lagoons made for the treatment of waste water before discharging the effluent into the main water streams. The significance of the present study, therefore, envisages the implementation of a biological system of water purification through the use of macrophytes which will be eco-friendly as well as economically viable as compared to the cost intensive commercial physico-chemical methods.

Key words: Phytoremediation potential, *Azolla pinnata,* Municipal waste water

SVI/P-16

Cyanobacterial Modulated Changes and Its Impact on Bioremediation of 'Usar' Soils

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'Usar' soils have high pH and undesirable salts on their surface. A halotolerant, heterocystous and nitrogen fixing cyanobacterium *Nostoc calcicola* grow successfully on 'Usar' lands. A soil pot experimentation has been conducted in laboratory condition to study the reclamation of 'Usar' soils collected from investigated site. Both sterilized and natural soils were taken in earthen pots to observe the changes in soil properties inoculated with cyanobacteria and gypsum. A significant decrease in pH, ECe and Na^+ has been observed with cyanobacterial application in treated soils and increase in organic carbon. Experimental reclamation of such

soils has been found with cyanobacteria with or without gypsum. *Nostoc calcicola* + gypsum seem to be a suitable combination for reclamation of 'Usar' soils. This study highlights that a biological amendment with halotolerant cyanobacteria and gypsum in combination shows better option for bioremediation of 'Usar' lands.

Key words: Cyanobacteria, *Nostoc calcicola*, Bioremediation, 'Usar' soils

SVI/P-17

Phytoremediation of Chromite-Asbestos Mine Waste: A Case Study of Blighted Hills of Roro, Chaibasa, India

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Roro mines of Chaibasa, West Singhbhum, Jharkhand were mined for several decades for extraction of magnetite, chromite and asbestos and left abandoned since 1983. Chromite-asbestos mine waste and agricultural soil were found poor, both in physical and chemical properties such as sandy texture, low electrical conductivity, organic carbon, available nitrogen and phosphorous. Total and DTPA extractable metal concentrations were found in the order of Cr > Ni > Mn > Cu > Zn > Pb > > Cd > Co. The total metal concentrations were found high in the mine waste (2555 mg Cr kg"1 and 1160 mg Ni kg"1) and agricultural soil (1983 mg Cr kg-1 and 1100 mg Ni kg"1) and above the threshold toxicity limit, however only small proportion of these elements were found plant available (0.07% and 0.038%). Pot scale study was conducted using two aromatic grasses, *Cymbopogon citratus* and *Chrysopogon zizanioides* by applying different proportions of organic manures (chicken manure and farmyard manure). Application of manures resulted in significant ($p < 0.05$) improvements of mine waste characteristics and plant growth, reduction in the availability of total extractable metals (Cr and Ni) and increase in Mn, Zn and Cu concentration in the substrate. The maximum growth and biomass production for *C. citratus* and *C. zizanioides* were found in T-IV combination comprising of mine waste (90%), chicken manure (2.5%), farmyard manure (2.5%) and garden soil (5%). Metals were mainly accumulated in the below ground part of *C. citratus* (523 mg Cr kg-1 and 140 mg Ni kg-1) and *C. zizanioides* (475 mg Cr kg-1 and 112 mg Ni kg-1). Addition of combination of organic manures resulted in lower metal accumulation in roots and reduction in translocation to shoots in compare to the control plant. Study indicates that, *C. citratus* and *C. zizanioides* are excellent grass species for the phytostabilization of chromite-asbestos mine waste and it can be added in the enhancement of aesthetic and commercial value.

Key words: Phytoremediation, Heavy metal, Aromatic grasses, Organic manures, *Cymbopogon citrates*, *Chrysopogon zizanioides*

SVI/P-18

To Decontaminate Wastewater Employing Bioremediation Technologies

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Bioremediation is an ecologically sound and state-of-the-art technique that employs natural biological processes employing microorganisms, fungi, green plants or their enzymes to return the natural environment altered by contaminants to its original condition. to completely eliminate toxic contaminants occurring in sludges, and ground water contaminated with petroleum hydrocarbons, solvents, pesticides, wood preservatives, and other organic chemicals, especially effective for remediating low level residual contamination in conjunction with source removal. Compared with other technologies, such as thermal desorption and incineration (which require excavation and heating), thermally enhanced recovery (which requires heating), chemical treatment (which may require relatively expensive chemical reagents), and *in situ* soil flushing (which may require further management of the flushing water), bioremediation may enjoy a cost advantage. Not all contaminants, however, are easily treated by bioremediation using microorganisms. For example,

heavy metals such as Cd and Pb aren't easily absorbed or captured by organisms. The assimilation of metals such as Hg into the food chain may worsen matters. While bioremediation (nor any other remediation technology) can't degrade inorganic contaminants, can be used to change the valence state of inorganics and cause adsorption, immobilization onto soil particulates, precipitation, uptake, accumulation, and concentration of inorganics in micro or macroorganisms. These techniques, while still largely experimental, show considerable promise of stabilizing or removing inorganics from soil. This manuscript delineates the general processes of bioremediation within the soil environment, factors of bioremediation strategies, genetic engineering approaches, monitoring bioremediation, and further, the *pros* and *cons* of the technique, limitations and potential of both *ex situ* and *in situ* bioremediation as viable alternatives to conventional remediation are explained and addressed.

Key words: Bioremediation, Heavy metals, Contaminants, Adsorption

SVI/P-19

Eggshell as a Heavy Metal Adsorbent from Waste Water

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Most of the heavy metals are found toxic and carcinogenic and cause a serious threat to the human health. And due to their non-biodegradability and persistence, can accumulate in the environment elements such as food chain. Heavy metals in industrial effluents include copper, nickel, chromium, lead, zinc, arsenic, cadmium, selenium and uranium. The dried, crushed and powdered eggshell material has the potential to be used as bio-sorbent for adsorption of heavy metals from waste water. Eggshell powder is a cheapest waste material and can easily be used for the treatment of industrial wastewater containing heavy metals. This waste treatment method is found to be a cheaper, quicker and more efficient method than any other techniques. The adsorption rate is dependent on the adsorbent quantity, initial concentration of metal and type of metal. The eggshell helps in the adsorption of heavy metals in wastewater because of its calcium carbonate, magnesium carbonate and calcium phosphate content responsible for metal adsorption. Adsorption process further described through *Freundlich and Langmuir* isotherm models. So the use of egg-shells can be a better and cheap option for the removal of heavy metal pollutants from the waste water.

Key words: Heavy metal, Adsorption, Bio-sorption, Eggshell, Freundlich isotherm, Langmuir isotherm

SVI/P-20

Mycoremediation of Cypermethrin from Different Regions of Punjab

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Cypermethrin is a synthetic pyrethroid insecticide, extensively used in cotton, fruit and vegetable crops as well as in animal health, home and garden pest control worldwide. A current environmental concern is the contamination of aquatic ecosystem due to pesticide discharges from manufacturing industries, agricultural runoff, leaching, accidental spills and other sources. The objective of this study was to isolate the competent strains of fungi and to examine the potential of fungi for the Mycoremediation of Cypermethrin. The isolation and characterization of such fungal strains is essential because of the environmental pollution, caused by leaking of chemical fertilizers and pesticides to surface and groundwater, which causes serious environmental and social problems throughout the world. Fungal isolates were isolated from agricultural soil; two of them were shown to degrade Cypermethrin (100 mg L^{-1}) within 5 days and identified by using of 18S rRNA. The results showed 97% resemblance with *Fusarium oxysporium strain 8-11P* and *Fusarium sp. zzz1124*. Both qualitative and quantitative investigations were conducted on the pesticide's residues using FTIR set-up and HPLC analysis respectively. These results show that the fungal strain may possess potential to be used in bioremediation of pyrethroid-contaminated environments.

Key words: Bioremediation, Mycoremediation, Cypermethrin, Pyrethroids, Pesticides

SVI/P-21

In vitro Degradation of Hexacosane by Bacteria Isolated from Petroleum Sludge

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Alkanes are main constituents of natural gas, petroleum, petrochemical products and coal. They are produced in the biological and geochemical processes and released into the environment by anthropogenic activities. These are generally classified into linear (n-alkanes), cyclic (cyclo-alkanes) or branched (iso-alkanes). Low molecular weight alkanes are usually volatile in nature and easily degradable, while high molecular weight alkanes are highly persistent in the environment. Alkanes are aliphatic compounds and chemically very inert their metabolism by microbes faces challenges of water solubility and accumulation in the cell membranes and the energy to activate the molecule. Low molecular weight alkanes are directly taken up by microbes from the water phase and easily transported into the cells, while medium and long chain alkanes uptake is facilitated by the hydrophobic cell surface or biosurfactant produced. A key process for alkane degradation is oxygenation of terminal methyl group. Since alkane-degrading bacteria possess multiple genes for alkane hydroxylases, they are highly capable of degrading a wide range of alkanes. Alkane degradation is initiated by alkane hydroxylase to transform alkane to alkanols. In vitro degradation of hexacosane ($C_{26}H_{54}$), a HMW n-alkane, was studied in MSM by two bacterial strains i.e., *Pseudomonas* sp. BP10 and *Stenotrophomonas nitritireducens* E9, isolated from petroleum sludge, in isolation and combination. The results revealed that both the strains were able to metabolize hexacosane by 82% in isolation and 98% in their consortium after 7 days. An enhancement of 16% in hexacosane degradation by the consortium indicated an additive action of bacterial strains. However, in control, a degradation of 21% was attributed to abiotic factors. During incubation with hexacosane, both the bacteria continued to multiply in isolation and consortium, which reflected that hexacosane was utilized by bacteria as a carbon and energy source. Activities of alkane hydroxylase and alcohol dehydrogenase were differentially expressed in isolation and combination, indicating their involvement in hexacosane degradation. Enhanced cell surface hydrophobicity and emulsification index and reduced surface tension also supported the degradation process.

Key words: Alkanes, Bacteria, Hexacosane, Degradation

SVI/P-22

Adsorption Kinetics for Hexavalent Chromium Removal from Aqueous Solution on Low Cost Bio-Chars

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Heavy metal contamination pose a serious threat to the environment. High level of heavy metals are discharge into aqueous bodies due to improper treatment of the industrial toxic wastes. Due to their high solubility in the aquatic environments, heavy metal affects to the public health. Hence, it is necessary to remove such hazardous heavy metal ions from wastewater prior to its discharge to the environment. The current work focuses the application of oak wood and oak bark chars obtained from fast pyrolysis at 400–450p C.These chars were characterized to identify their particles size, surface morphology and chemistry, composition, mineralogy, and surface area and applied for removal of hexavalent chromium from aqueous medium through batch sorption techniques. pH study was carried out at pH range of 2-10. It confirmed that maximum chromium removal was found to occur at pH 2.0and it decreased rapidly as pH increased. Sorption kinetics were performed to evaluate the effect of time on adsorption of chromium with an adsorbent dose of 10 g/L. Kinetic studies were further investigated to find the sorption equilibrium of chromium on the adsorbents over an initial concentration range of 1–100 mg/L. The experimental results suggest that byproduct chars from bio-oil production could be effectively employed as inexpensive and promising adsorbent for the removal of chromium from contaminated water.

Key words: Heavy metals, Bio-char, Remediation, Fast pyrolysis, Batch study

SVI/P-23

Green and Instant Synthesis of Gold Nanoparticles by *Trichoderma* sp. and its Heterogeneous Catalysis in Degradation of 4 Nitrophenol

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Nanotechnology has revolutionized the concept of catalysis making it highly desirable for efficient and rapid organic transformations. Gold nanoparticles have emerged as an excellent heterogenous catalyst with their highly active solid surface and recyclability. Though there are several modes of synthesis of gold nanoparticles, the biological method has attracted a lot of attention because of its simple, ecofriendly and cost effective approach. The present study aims to biosynthesize the nanoparticles within minutes with well-known bio control agents, *Trichoderma viride* and *Hypocrea lixii*. The biosynthesis of the nanoparticles was very rapid and took a minute at 30°C when cell-free extract of the *T. viride* used , which was similar by *H. lixii* but at 100°C . The biosynthesized nanoparticles were stabilized by the metabolites present in cell free extract of *Trichoderma* sp. The synthesized gold nanoparticles were characterized by visual observations, UV-vis spectroscopy, Zeta sizer, Transmission Electron Microscopy (TEM), Selected Area Electron Diffraction (SAED) and energy dispersive X-ray spectroscopy (EDAX). UV-Vis spectrum was observed at 528 nm after one min of addition of $HAuCl_4$ to the cell free extract of *T. viride*. It yielded mixed population of spheres, rods, triangles, hexagons of size 10-80 nm at 30ÚC while spherical particles of size 2-40 nm were obtained at 100°C by *T. viride* and *H. lixii*, respectively. In the presence of biogenic gold nanoparticles, yellow color of 4-nitrophenol disappeared within 30 min into colorless indicating its degradation to 4- aminophenol. In accordance with the visual observations, the absorbance decreased from 400nm to a new peak at 260nm indicating formation of 4 –aminophenol. The small quantity of gold nanoparticles required and its reuse for bioremediation purposes not only makes it a substitute for catalyst matrix but also provides a new hope to green and low cost bioremediation. To the best of our knowledge, this is the first report of such rapid biosynthesis of gold nanoparticles within min by *Trichoderma* having plant growth promoting and plant pathogen control abilities, which served as an efficient biocatalyst.

Key words: Catalysis, Gold nanoparticles, Biosynthesis, *Trichoderma viride, Hypocrea lixii*

SVI/P-24

Decomposition of Agroindustrial Wastes and its Impacts on Soil Properties

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Decomposition of Agroindustrial wastes – PMC, Flyash, distillery spentwash (DSW) and aquatic weed (*Eichhornia crassipes*) inoculated by *Trichoderma viride* and mixed in treatments viz – PTDE, T_1, T_2, T_3, T_4 and over control. Its impacts on soil properties pH, EC, N.P.K. and S. content in soil was also been studied after pre-sawing and post harvesting. The decomposed material compost (150 gm) was mixed with soil (5 kg) @ 5 qt/acres on the seeds of *Coriandrum sativum* L. cv. Kalmi and *Phaseolus aureus*. Roxb. cv K-851 was sawn in treated soil with compost. The results revealed that the physiological effect on both test crops has been observed and categorized efficiency in T_4 compost enhanced growth and yield and soil properties significantly increased due to higher nutrient status which gradually decreased in T_3, T_2, T_1, PTDE treatments. It is not only produces beneficial effects on crop productivity but also on soil fertility as well as for sustained growth. However, reuse the agroindustrial wastes control the pollution of river and land but also would have leap frog in curtaining demand of chemical fertilizers.

Key words: Decomposition, PMC, DSW, Trichoderma, Coriandrum

SVI/P-25

Role of Vermicompost in Biodegradation of Crude Oil Contaminated Soil

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An extensive use of petroleum oil and its products leads to the contamination of most parts of our environment. Crude oil spilled soil contains a mixture of hydrocarbons (alkanes, aromatics, NSO and asphaltenes) in which various compounds are considered as a major environmental threat because of their potential for toxicity, mutagenicity and carcinogenicity. Microbes are natural agents that lead to complete mineralization of petroleum hydrocarbon and that's why bioremediation is considered as a technology of less complexities, high efficiency, eco-friendly and cost-effectiveness. In present microcosmic study, 4 set of treatments i.e. S1, S2, S3 and S4 were prepared in twelve pots (three in replicates) to monitor the role of microbes and vermicompost in the degradation of petroleum hydrocarbons. Each pot was filled with 2 kg of soil spiked with 10% of crude oil. Vermicompost was applied to S3 and S4, while bacterial combination of *Pseudomonas* sp. BP10 and *Acinetobacter* sp. PSM11 were augmented in S2 and S4. Uninoculated pots (S1) were treated as control. The results revealed that presence of bioaugmented bacterial consortium and vermicompost could enhance the degradation of TPH up to 39% and 80%, respectively in isolation and 77.8% in combination where as natural attenuation was only 34% after 6 months of incubation period. Based on the LSD (13.37) analysis at $p < 0.01$, it is clearly indicated that augmentation of vermicompost significantly enhanced the degradation of TPH whereas bioaugmentation of microbes without any biostimulant (vermicompost) could not boost the degradation process significantly. Maximum increase in soil bacteria count in control and S2 was only 4-9 folds while presence of vermicompost enhanced the soil bacteria count up to 1000 folds. Maximum induction of degradative enzymes like catechol dioxygenase in S3 and S4 also supported the application of vermicompost in the degradation of petroleum hydrocarbons. Vermicompost is organic manure which enriches the soil with NPK and reduces the bulk density of soil that enhances the soil porosity for better air diffusion and water holding capacity. Due to these qualities, vermicompost stimulates the soil microbes for longer period and hence, boost the biodegradation process for faster reclamation of petroleum hydrocarbon contaminated soil.

Key words: Biodegradation, Petroleum hydrocarbons, Microbial combination, Degradative enzymes

SVI/P-26

Microbial Diversity in Fluoride Contaminated Sites and their Role in Bioremediation

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Fluoride contamination is presently one of the most vital problems in the world. The presence of fluoride in groundwater is mainly due to specific fluoride rich minerals such as mica and amphiboles. Different scientists had worked on fluoride degrading microorganisms like *Arthrobacter*, *Aspergillus penicilloides* and *Mucor racemosus, Micrococcus luteus, Aeromonas hydrophylla, Micrococcus varians and Pseudomonas aerogenosa*, *Paenibacillus, Stenotrophomonas, Rhizobiales* Strain F11 and *Ralstonia , Ancylobacter, Burkholderia, Cupriavidus and Staphylococcus* , The enzyme fluoroacetate dehalogenases has been isolated from *Moraxella* sp. B, *Pseudomonas* sp. and *Fusarium solani, Burkholderia* sp. FA1, *Pseudomonas fluorescens* DSM8341 .This enzyme is known for its ability to cleave the highly stable carbon-fluorine bond. Fluoride degrading microbes *Pigmentiphaga* sp. ECPB08 *and Ancylobacter* sp. ECPB09 are closely related to each other. Study of fluoride degradation through functional analysis will help in determining the biodegradation of fluoride concentration. Protein/Enzyme characterization of fluoride degrading microorganisms will help in studying the diversity of potent isolates. Identities of the 16S rRNA gene sequences can be determined in Green genes software. Restriction Fragment Length Polymorphism (RFLP) analysis enables to rapidly assign putative identities based on a database of fragments produced by known 16S rRNA sequences. Phylogenetic analysis of isolates can be studied with the help of PAST and MEGA Software. Identification and Characterization of potent isolates will help in understanding their diversity and their conserved regions which have been there from their evolution. The *in-silico* study of these enzymes and their molecular interaction will be advantageous in

understanding their toxicity and efficiency. Microorganisms are vital resource for bio prospecting novel/ exceptional species which could yield valuable bioactive molecules necessary for eco friendly remediation of fluoride.

Key words: Fluoride, Contamination, Microorganisms, Biodegradation, Characterization, *in-silico* study

SVI/P-27

Arsenic Phytoremediation in Rice Seedlings through Cyanobacteria

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Arsenic (As) is a non threshold carcinogen, present in ground water and agricultural fields of Indian subcontinent in large extent. Arsenic affects human health adversely by consuming rice cultivated in As contaminated regions. Rice being a major dietary food for more than 110 million of people in the world its remediation and management has now become a matter of great concern. Since As cannot be removed from the contaminated soil. Minimization of As uptake through cyanobacteria could proved a feasible and environmental friendly techniques. Cyanobacteria are prokaryotic algae which known for its tremendous adaptability, metabolic versatility and capability of both photolithotrophic and heterotrophic growth. Cyanobacteria have been well known to tolerate and survive in heavy metals polluted water and soil. Arsenic biotransformation by cyanobacteria may play a critical role in the fate and toxicity iAs (inorganic As) to methylated As. Experimental study shows tolerance of cyanobecteria against high concentration of As, and its ability to convert the toxic iAs to relatively less toxic oAs (organic As) i.e., Monomethylarsenate [MMAs(V)], dimethylarsenate [DMAs(V)], trimethylarsine oxide [TMAsO(V)] and finally volatilizes As by releasing trimethylarsine [TMAs(III)]. Our results showed that As tolerant cyanobacterial strain *Anabaena* sp. not only grow at high concentration 1000 µM of arsenate [As(V)], but also have the ability to accumulate the high (3556.1 µg g^{-1} DW) concentration of As(V) (500 µM). Experiment was carried out on Arsenic tolerant cyanobacterial *Anabaena* strain, to quantify the reduction of As toxicity in rice cv saryoo-52 seedlings inoculated with *Anabaena* which treated with arsenate and arsenite (30-60 µM), under hydroponic growth conditions. The As uptake was found to reduce in rice when grown with 10% *Anabaena* strain, by 48.79 % and 33.25 % against 60µm As(III) and 60µm As(V) respectively.

Key words: Cyanobacteria, Phytoremediation, As biotransformation, Methylation

SVI/P-28

Influence of Heavy Metal Toxicity on Plant Growth, Metabolism and its Alleviation by Phytoremediation: A Promising Technology

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Heavy metal pollution like contamination of water and soil are problems in recent time and causes serious effects to humans and animals which ultimately results in destruction of environment. Heavy metals such as Cd, Cr, Pb, As, Co, Cu, Ni, Zn, Mn, etc. are considered as environmental pollutants due to their toxic effects. Heavy metals alter the plant growth, physiology, metabolism and also involve in the production of reactive oxygen species which leads to subsequent cell death, eventually results in reduction in crop growth and yield. To sustain the agricultural environment, it is necessary to alleviate the toxicity of heavy metals from the environment, there are number of technologies evolved but, phytoremediation is an emerging technology that uses plants to clean up pollutants from the environment. Phytoremediation is the promising technology for the remediation of contaminated soil because for its low cost, non intrusiveness, aesthetically pleasing and sustainable features. Hyperaccumulator plants absorb, accumulate and decontaminate very high concentration of metals in their above-ground tissues from natural contaminated site such as mining, smelting, compost, sewage sludge, wastewater, flyash producing areas.

Key words: Phytoremediation, Heavy metal, Hyperaccumulator

SVI/P-29

Sonchus asper (L.) Hill: A Suitable Vegetation Cover on Red Mud Deposited Site for Enhancing the Soil Quality and Potential Phytoremediator of Iron

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Bauxite residue is alkaline, insoluble, iron rich, major waste product of making alumina by bayer process and also known as red mud. Disposal of this red mud requires larger areas which poses serious environmental problems through wind erosion, abundant dust, air and water pollution. To overcome from these problems, effective restoration of the disposal land through naturally growing vegetation is important to maintain the environment quality. So for this purpose we investigated out the frequency (F),density (D), abundance (Ab) and important value index (IVI) of naturally growing vegetation on abandoned bauxite deposits to assess metal toxicity tolerance capacity of naturally growing vegetation. Greatest IVI index and visual observation represent that Sonchus asper can be identified as ecological tool for the restoration of barren red mud (RM) land. Along with these studies, also examine the rhizosphere RM characteristics of *S. asper*, comparing it with other two dominating species present in this RM. Remarkable changes were found in microbial and enzymatic activities of the rhizosphere RM and compared with nonrhizosphere RM (adjacent non vegetated area).This soil analysis would confirm *S. asper* has maximum ability to grow on derelict bauxite deposits and also enhance the biological activities of abandoned red mud. Translocation factor of iron in *S. asper* was found maximum (2.5) and can be reported as iron hyperaccumulator on the respective site. These results suggest that *S. asper* can be used in effective restoration of bauxite deposited land without any inputs or maintenance.

Key words: Bauxite residue, *Sonchus asper*, Derelict red mud, Ecological tool, Restoration

SVI/P-30

Fly-Ash Augmented Soil Enhances Heavy Metal Accumulation and Phytotoxicity in Rice (*Oryza sativa* L.); A Concern for Fly-Ash Amendments in Agriculture Sector

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Utilization of fly-ash (FA) in the agriculture sector is very common now-a-days due to presence of beneficial elements required for plant growth. Besides, it also contains excessive amount of toxic metals. To investigate the effect of FA on soil health, plantgrowth, toxic metal accumulation and antioxidants responses, rice (*Oryza sativa* L.) was grown onsoil amended with 50% FA in natural condition. FA application resulted inreduction in soil enzymatic activities *viz.*, dehydrogenase (DHA), acid phosphatase, â-glucosidase and urease than garden soil (GS). FA amendments significantly decreased the root, shoot and panicle length and augmented sterility in rice. The total accumulation of toxic metals, particularly Cd, Cr, Pb and As were 14-15 fold higher in roots and shoots and 4-20 fold higher in grains for the plants grown on FA amended soil than GS. The levels of nutrient elements *viz.*, Mn, Co, Cu and Se were lesser in grains of FA treated soil than GS. Lipid peroxidation wasincreased in root and shoot of FA treated plants indicating oxidative stress. Activities of various antioxidant enzymes *viz.*, SOD, APX, GPX, GR and their isozymeswere correlated to each other and also increased against heavy metal induced toxicity. Human associated risk analysis revealed that the calculated maximum tolerable daily intake (MTDI) values for toxic metals (µg d^{-1}) *viz.*, Cr, As, Cd, Hg and Pb was beyond the safe limit in the rice grown in FA implicated soil. In conclusion, 50% FA implication deteriorates the soil quality, rice production and elevates the toxic metals in grains, which may be a concern for human health.

Keyword: Antioxidant, Fly-ash, Heavy metals, Isozymes, Rice

SVI/P-31

Decolorization of C.I. Acid Red 131 by Bacterial Strain Isolated from Effluent Contaminated Soil of Bhadohi, Uttar Pradesh using Sequencing Air-lift Bioreactor

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The dye wastewater from carpet industry is big challenge due to its recalcitrant nature. Present paper deals with the biodegradation and decolonization of C.I. Acid Red 131 dye using indigenously isolated bacterial specie *Microbacterium* sp. BHUMSp X4. The bacterial strain was isolated from discharged effluent site near Carpet industry cluster of Bhadohi, Uttar Pradesh. Experimental investigations were made in a Sequencing Air- lift bioreactor using synthetic solution of Acid Red 3BN. The effect of several operating parameters such as flow rate, pH, temperature, initial dye concentration and inoculums size on removal of dye was investigated. The results showed that dye removal followed pseudo-first order kinetics and percentage removal increase with increasing pH upto 8, temperature 35 °C and initial concentration of 200 mg/l. The degraded metabolites were also studied by using UV-VIS spectrophotometer, HPLC and FTIR. The intermediates were identified and degradation pathway was proposed by using GC-MS analysis. Toxicity test with *Vigna radiata* showed that the acute toxicity increased during the first stage of the reaction, and then gradually decreased after treatment.

Key words: Carpet industry, *Microbacterium* sp. BHUMSp X4, *Vigna radiate*, GC-MS, Sequencing Air-lift bioreactor

SVI/P-32

Pollen Viability and Germination as Bioindicator of Air Pollution

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Aim of the present investigation is to assess the impact of air pollution on pollen viability and germination. The sites with different intensity of road traffic (heavy traffic, moderate and no traffic) and common plant species were selected for the study. Pollen viability and *in vivo* pollen germination of four plant species viz. *Catharanthus roseus* (L.) G. Don, *Datura inoxia* Mill., *Martynia annua* L. and *Tridax procumbens* L. was evaluated. The pollen of these species were treated with TTC (2, 3, 5-Triphenyl Tetrazolium Chloride) solution for estimation of pollen viability and anilin blue fluorescence staining was used to estimate *in vivo* pollen germination. Mean pollen viability was observed to be reduced from control area to heavily traffic area as 80.64 to 70.42% in *C. roseus*, from 89.74 to 86.39% in *D. inoxia*, from 67.93 to 21.40% in *M. annua* except *T. procumbens* which showed 84.31% viability in heavy traffic area and 83.90% in no traffic area. The percentage of *in vivo* pollen germination also showed reduction from 63.12 to 45.38 % in *C. roseus*, from 58.54 to 30.14% in *D. inoxia*, from 76.06 to 35.26 % in *M. annua* and from 46.11 to 45.97% in *T. procumbens* pollen collected from the control area than the heavily traffic area respectively. Highest percentage of pollen viability and *in vivo* pollen germination was found in pollen collected from control area than heavily traffic area. Pollen viability and *in vivo* pollen germination were significantly ($P<0.05$) decreased with increasing traffic load. *T. procumbens* pollen were not influenced by air pollution; indicating some kind of resistance to the pollution. Pollen viability and *in vivo* germination were significantly differ with area of collection and traffic intensity.

Key words: Air pollution, Biomonitoring, Pollen viability, Germination

SVI/P-33

Phytoremediation of Crude Oil Contaminated Soil Employing *Crotolaria pallida* (Aiton)

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The present investigation deals with the phytoremediation of crude oil contaminated soil employing *Crotolaria anagyroides* as the experimental

plant. The different concentrations of the crude oil applied to the plant were 10000, 20000, 30000, 40000, 50000, 60000, 70000, 80000, 90000 and 100000 ppm respectively. A control setup was also maintained without adding oil. The duration of the experiment was fixed for six months. The results showed that uptake of hydrocarbon by the plant were increased with increasing the concentration of the crude oil in the soil up to 60000 ppm. After that uptake of hydrocarbon by the plants were found lower with the increasing dose of crude oil concentration. Uptake of hydrocarbon by the shoot was found maximum in the 60000 ppm concentration. Dissipation of total petroleum hydrocarbon (TPH) from the soil was also gradually increased with increasing the concentration of crude oil in the soil up to 60000 ppm. Results also demonstrated that there was a reduction in plant shoot and root biomass with the increase of crude oil concentration. Furthermore, results also revealed that the shoot biomass is higher than root biomass in control along with all the treatments

Key words: Phytoremediation, Crude oil, Biomass, Uptake, Dissipation, *Crotolaria pallida*

SVI/P-34

Growth Fitness and Final Yield: Experimental base Characterization of Metal Tolerance

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An experiment was conducted during winter season to determine the growth effectiveness by evaluating the tolerance of four oilseeds *Brassica* genotypes grown in soil mixed with fly ash and irrigated with waste water under N, P and K fertilization. The result showed that four genotypes were found significantly different for growth and yield contributing characters like shoot and root fresh weight, shoot and root dry weight, length of siliquae, siliquae per plant, seed number per siliqua, seed yield, oil content and oil yield. Phytoremediation indices like bioaccumulation factor, translocation factor, uptake rate, remediation factor and tolerance were also different in all the four species which indicated their genetic variation and ability which dependent on cytogenetic makeup of the particular species. Further, Amphidiploid genotype AABB (*B. juncea*) and AACC (*B. napus*) outperformed due to their high seed yield and metal accumulation as compared to rest of the two parent genotype i.e. AA (*B. campestris*) and BB (*B. nigra*). Thus, both amphidiploid species can be recommended for the general cultivation in soil mixed with fly ash and irrigated with waste water as well as for further use in improved breeding programme. While it is need to understand in future to study the effect of both the wastes on the genes helps in accumulating the heavy metals.

Keyword: Tolerance, *Brassica* species, Wastes, Heavy metals, Phytoremediation

SVI/P-35

Ganga River Pollution Management by Green Clean Technology

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The Ganga River is the largest and very important river basin of country as well as the world. The Ganga River has been considered as the most sacred river of India in Veda and Puran. It is called as “Ganga Maa” or “Mother Ganga” or “Ganga Ji”. People of world believe that bathing in the holy water of Ganga washes all the past sins of a person. It has a symbol of purity, and for Mokshha. It has long history of reverence in India and it is often called Holy Ganga. The total length of the river is about 2510 K.M.; one of the largest groups of human population belts on earth is built around the Ganga. It is originated from Bhagirathi from Gangotri glacier in the Uttarakhand. The level of pollution in the Ganga River has reached alarming proportions. Two types of point sources like, surface drains carrying municipal sewage or industrial effluent, pumping stations and sewage system from industries etc are found. The point source can be measured. Second is non point source which cannot be measured such as runoff agriculture field carrying chemical and fertilizers, run off from area used for dumping of solid waste and open defecation, mass bathing, floral offerings etc. According to study nearly 89 million

liter of sewage is disposed into Ganga River from the 12 municipal towns that fall along its route till Haridwar. A constructed wetland is an artificial marsh or swamp, created for anthropogenic discharge such as waste water storm water runoff or sewage treatment and as a habitat for wild life, or for land reclamation after mining or other disturbances. Natural wetland act as a biofilter, removing sediments and pollutants such as heavy metal from water, and constructed wetland is designed to emulate these featureas. Constructed wetland is built by humans. These constructed wetlands are primarily built to clean up waste water and create wild life habitat. Constructed wetlands naturally filter and treat waste water and are often less expensive than traditional treatment plants. CSIR-NBRI has undertaken a research project to treat domestic sewage with aquatic plants before allowing them to flow into the river as a low cost, eco friendly and sustainable solution. Under this project municipal sewage were treated by constructing constructed wetland together with aquatic plant viz., *Typha latifolia, Phragmites australis, Colocasia esculenta, Polygonum hydropiper, Alternanthera sessilis* and *Pistia stratoites,* which removed significant quantities of pollutants. Use of this technology for the bioremediation of sewage pollution and disposal into the river Ganga will be discussed in detail during the conference.

Key words: Sustainable, Aquatic plants, Bioremediation

SVI/P-36

Heavy Metal Evaluation in Some Therapeutically Important Medicinal Plants

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Global climate change has become one of the most apparent environmental concerns of the 21st century. A major concern is the effects of climate change expressed in terms of the real and potential cost in human lives and suffering. Climate change is currently affecting public health through myriad environmental consequences. Medicinal plants are the basic raw material for many nutrient and health supplements. World Health Organization (1998) recommends that medicinal plants which forms the raw material for the finished product must be checked for presence of heavy metals (As, Cd, Hg and Pb,), pesticides, bacterial or fungal contamination, Heavy metals, in general, are non-biodegradable, have long biological half-lives and have the potential for accumulation in the different body organs. Consumption of food crops and plant based medicaments contaminated with heavy metals is a major root cause for human exposure leading to acute as well as chronic toxic effects. Thus it becomes mandatory to ensure the quality of the plant material and detect the presence of contaminants. Hence in the study heavy metals particularly Cd and Pb are assessed in some therapeutically important medicinal plants for their quality evaluation and surveillance to standardize the real material for its sustainable utilization in development of plant based eco-friendly natural products.

Key words: Climate change, Health, Heavy metals, Medicinal plants, Quality evaluation

SVI/P-37

Induced Genomic Alterations through Impact of Fly-Ash in *Phaseolus vulgaris* L.

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In the present scenario, environmental pollution is a major threat being posed by human being all over the world. Rapid urbanization, industrialization and anthropogenic activities are the key factors responsible for the deterioration of environment. Fly-ash is a by-product released from the combustion of coal in industrial areas into the environment and consists of complex particles of variable composition. The proper management of fly-ash is a matter of serious concern in developing countries. It imposes serious health hazards on the people residing in adjoining areas near the industrial site as well as on the flora growing nearby. Plant assays have been widely used as an important indicator of environmental pollution and is used to gauge the range of toxicity of pollutants on the genome. The present study has been carried out to assess the impact of different concentrations of fly-ash on the chromosomal behaviour of *Phaseolus vulgaris* L. Different concentrations of fly-ash viz. 100%, 75%, 50% and 25% have been amended in the

soil. One set has been maintained as control without implementing fly-ash in the soil. The different morphological parameters have been taken into consideration for evaluating the effect of fly-ash on the plants during the present investigation. It has been found that higher concentration of fly-ash beyond the optimum level is capable of inducing alterations at the genomic level and varying level of chromosomal aberrations such as scattering, precocious movement of chromosomes, stickiness, laggards, spindle disturbance, micronuclei etc. have been found.

Key words: Fly-ash, Chromosomal aberrations, Plant assays, *Phaseolus vulgaris* L.

SVI/P-38

Strain Improvement for the Production of Biosurfactants from *Pseudomonas* Species Isolated from Oil Contaminated Sites of Ajmer (Rajasthan) and Analysis by HPLC

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Biosurfactants are produced mainly by microorganisms such as bacteria, fungi and yeasts. They have a surface active property which is mediated by amphiphilic nature of molecules. Biosurfactantshave hydrophobic and hydrophilic regions which allowing them to act assurfactants. This action of surfactant is mediated at the interfaces between aqueous and non-aqueous components in a complex system and at the liquid gas interface. Recently biosurfactants gained importance in various fields because of their low toxicity, high biodegradability and powerful surfactant properties.The present study was aimed to improve production of biosurfactants from *Pseudomonas species* which mainly produce rhamnolipid biosurfactantwhich provide significant opportunities to replace chemical surfactants with sustainable biologically produced surfactants. In continuation of these studies, the present work intended to purify characterize the biosurfactant produced by the bacterial species *Pseudomonas*.

Key words: Biosurfactants, Amphiphilic, Hydrophobic and Hydrophilic regions, Rhamnolipid, *Pseudomonas* species

SVI/P-39

Plant Leaves as Urban Aerosol Bio-Monitor Indicator

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Increasing aerosol concentration in urban areas has raised a serious concern for the human and environment health specifically by the related metal any organic or inorganic embedded in the matter. Particulate matter (PM) is emitted by anthropogenic sources such as vehicle exhaust, road dust, coal burning, industrial processing, cement and fertilizer production along with some natural sources such as soil and rock erosion. The studies have shown the effect of PM in human lungs till the alveoli-sacs which affects the respiration process, causing fatal respiratory diseases. To understand this situation, we need continuous monitoring of particulate matter in air to regulate its concentration and provide for proper abatement techniques. One of cost effective technique could be the plants which absorb, accumulate and integrate the pollutants impinging on their foliar surface and show diverse response. Various studies have indicated that roadside vegetation has the potential to capture road generated air pollution and subsequently lessen their concentration before dispersion in adjacent surroundings. Urban green spaces while can be defined as the raising and management of trees, gardens and roadside avenues on public and privately owned lands in and around urban centers. The clear understanding for the value of urban tress in removal of particulates requires the study of plant characteristics, particle size, climatic factor, safety considerations and aesthetics which determine their capture efficiency. The present study investigates the scope of using plant leaf behavior as accumulative bio-monitors of PM in urban areas. The ambient air was monitored for a week in May, 2014 at one of the traffic site – Rajendra place marg in Delhi for the particulate matter $PM_{2.5}$ and PM_{10} concentration for eight hours representing time for major traffic commuting. The leaves of two commonly found plants-*Alstonia scholaris* and *Polyalthia longifolia* were collected with utmost care for the study of dust

deposited on the surface. Further Scanning Electron Microscopy (SEM) was used to study the morphology and size particle deposited and Energy dispersed X-rays analysis (EDX) for the chemical composition of dust matter.

Key words: Urban Green Space, PM, Dust deposition, SEM-EDX, Bio-monitor

SVI/P-40

Antibacterial Activity of some Potential Algal Strains of Bundelkhand Region of Central India

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Microalgae are highly potential source of bioactive molecules, able to produce active substances like antibacterial, antiviral, antifungal and anticancer. As the pathogenic microbes are becoming resistant to the synthetic drugs or becoming multi drug resistant, algal bioactive compounds are started investigating for their antimicrobial activities. In the present study some region specific, indigenous algal samples were collected from different sites of Bundelkhand region of Uttar Pradesh. A total of three algal strains such as *Oscillatoria* sp., *Scenedesmus* sp. and N*annochloropsis* sp. were isolated and screened for their antimicrobial activity against pathogenic bacteria *Staphylococcus aureus*, *Escherichia coli* and *Bacillus cereus*. Algal strains were cultured in haffkins flasks using BG11 media, centrifuged and lyophilized. The algal extract was taken out from 250 mg dry algal powder mix in 15ml four different solvents ethanol, methanol, acetone and diethyl ether, shaken overnight, centrifused and the supernatant was used for the antimicrobial activity. Extract was preserved in 4p C for further use. Disc diffusion method was used for antibacterial activity. The antibacterial activity was using (ethanol, methanol, acetone and diethyl ether) algal extract was control. The result showed that ethanol extract of *Oscillatoria* showed maximum zone of inhibition against *Bacillus cereus* and *Staphylococcus aureus*, where as acetone and ethanol extract of *Scenedesmus* revealed maximum zone of inhibition against *Bacillus cereus*. Ethanol extraction of *Nannochloropsis* shown maximum zone of inhibition against *Bacillus cereus* and *Staphylococcus aureus*. Research methodology and results were discussed in detail in the full paper.

Key words: Antibacterial activity, Algal strains

SVI/P-41

Seasonal and Annual Atmospheric Elemental Survey by Mosses: A Conceptual Approach

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Atmospheric contamination is one of the most pressing problems fa-cing by the world at present. The emission of contaminants has been increasing ever since the industrial revolution. To meet this challenge European Union has issued directives to initiate intensive atmospheric monitoring in Europe (first 96/62/EC and later 2008/50/EC). Every year in February all European workers meets together in Europe to discuss its trend. In India and its adjoining states, there is an alarming increasing trend of the atmospheric metals. Contrary to Europe where lead (Pb) value is close to 2 ppm or less, same is in the ranges from 28 to 60 ppm even some time more. This has enabled the establishment of large and small scale net-works for extensive studies (e.g. regional or national studies). Taking into ac-count all of the above, there is currently a need to develop new specifica bio-tools, which would enable the simple, economic and robust monitoring of air quality. Of the monitors available, instrumental monitoring is very expensive, requires lot of instruments, power and man power to run the instrument. It is quite cumbersome to carry large number of instruments in fields. On the contrary amongst Plant Kingdome, the use of terrestrial mos-ses has certain advantages over instrumental monitoring, such as simplicity, reliability, cost effectiveness and no need power to run instrument. Their properties confer mosses as an excellent biomonitor of air quality. The main advantages of the biomonitoring of metals

by mosses technique are that it does not require any source of energy, therefore it is inexpensive, thus enabling inten-sive surveys to be carried out and the monitoring of a large number of different contaminants, both organic and inorganic, in the same sample. A conceptual approach has been proposed for annual, seasonal and retrospective atmospheric elemental monitoring by mosses given below.

Key words: Metals, Moss, Biomonitoring, Conceptual approach

SVI/P-42

Bioremediation of Urban Pollution by Greens and Landscapes

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Urban pollution is a global problem and a growing concern for all. Steep urbanization has aggravated the problem to an alarming level. The consequences of rapid urbanization are quite prominent and have several adverse effects on environment. In developing countries like India, where population pressure is much more, the environmental pollution has multiple ill effects on human health and society. According to a report by United Nations, 61% of the population will live in urban areas by 2025 especially in the developing countries. Controlling urban pollution to make the environment clean, is a huge task. This needs multilateral approach to curb this menace. There are well established approaches and methods for achieving this task. Bioremediation, using trees and plants in various scientific and effective way, is one of the simple method for amelioration of the urban pollution. Plantation pattern, selection of plant species and designing of green space are decided according to the situation. Landscapes and urban green space plays a critical for keeping our cities clean and healthy. Scientific studies all over the world have already proved the efficacy of the bioremediation and recognized that as a global tool. Studies have revealed that a green area having 500 sq. m width surrounding a factory is capable of reducing SO_2 concentration by 70%. Woodland over a hectare absorbs 3.7 tonnes of CO_2 from atmosphere and supplies 2.5 tonnes of oxygen. A single row of trees can reduce particulate matter by 25%. Nevertheless, urban green space of one hectare produces oxygen to keep 45 persons alive. Significant reduction in urban heat island can be obtained by proper planning and designing of greens belt and landscapes. Reduction of surface temperature by 30-40% by a space planted with trees above 75% of the total area is also achievable. Therefore, all types of urban pollution including reduction of surface temperature can be achieved by proper plantation of greens and development of landscapes. Above all, urban greens and landscapes provide a platform for outing and recreation for the urban people.

Key words: Bioremediation, Urban pollution, Greens, Landscapes, Environment

SVI/P-43

An Identification of Metabolite Formed During an Aerobic Bacterial Degradation of Pentachlorophenol Screened from Tannery Effluent Sludge of Jajmau, Kanpur

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The leather tanning industry, regulations to reduce pollution have been in place since 1986, but measurements of the effluent from the industry still show that the concentrations of chemicals and organic matter are too high. In India, tannery industries have occupied a significant place in economic. It is the 7th major sector of earning foreign exchange in India. Export of leather goods comprises of several leather products of economical values which reclaimed new height of $2.8 billion in 2007-08, comparing with 1965-66 which was $65.5 million and still increasing rapidly. Chlorinated xenobiotic compounds tend to persist in the environment and may become environmental and public health hazards. Pentachlorophenol (PCP) is a priority pollutant that has been used widely as a general biocide in commercial tannery industries. Owing to rapid industrial growth, serious soil and water pollution by PCP has been reported in Jajmau Kanpur, India, present investigation an aerobic bacterial strains were isolated from two different sites PSCS1 and PSCS2

(Kanpur, Jajmau, U.P., India) and screened for their PCP degrading potential by using minimal salt agar medium containing, sodium salt of pentachlorophenol (NaPCP) as sole source of carbon and energy along with bromothymol blue as screening agent. Strains utilizing PCP were characterized morphologically and biochemically. For identification of metabolite during PCP degradation, two types of pathways for aerobic degradation of PCP have been described, one is through formation of chloro-catechols and other is through formation of subsequent hydroquinone. In pathway of chloro-catechols, the subsequent chlorophenols formed are further metabolized via ortho or modified-ortho ring cleavage pathways. In the hydroquinone pathway, subsequent dechlorination leads to formation of hydroquinone, which is subsequently cleaved by *ortho* ring cleavage enzyme. Further, hydroquinone pathway form protonated tetrachlorohydroquinone which is further converted into trichlorohydroquinone and 2,6-dichlororohydroquinone. The HPLC profile of noble metabolite formed during PCP degradation by an aerobic bacterial consortium was studied by justifying the hydroquinone pathway.

Key words: Bioreactor, Chemostat, Consortium, Pentachlorophenol (PCP), Ring cleavage, Trichlorohydroquinone

SVI/P-44

A Comparative Study of Metal Uptake by *Eichhornia crassipes* Growing in Ponds from Mining and Non-Mining Area - A Field Study

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Toxicity of heavy metals is well known due to their long term persistence in nature, bioaccumulation and biomagnifications abilities. The main sources of heavy metals into water systems are generally natural (volcanic eruptions) or anthropogenic such as industrial effluents, agricultural runoff (containing pesticides and fertilizers), sewage effluents, burning of fossil fuels and mining activities. This study deals with an aquatic plant; water hyacinth (*Eichhornia crassipes*) and accumulation of metals like Mn, Cu, Pb and Cd into its leaves. Four ponds, one from non-mining area (P1) and three from mining area (P2, P3 and P4) were selected for water, sediment and plant leaf sampling. Chemical properties and metal concentration in water and sediments were analysed and the water was fit for domestic uses, but needed treatment if used for drinking. Elevated levels of Mn in sediments of P2 and P4 and Cu in P1 may be due to contaminated discharge from the townships. Sediments from mining areas had significantly higher metal concentration than non-mining areas and this lead to a differential response in percentage accumulation in leaves for different metals. Average Mn concentration in sediments from non-mining and mining region was 244 mg kg^{-1}; and 255 mg kg^{-1} respectively while percent of total metal accumulated in leaves was 28% and 27%, respectively, Similarly for Pb an increase in concentration from non-mining (21 mg kg^{-1}) to mining (74 mg kg^{-1}) leads to corresponding decrease in percent accumulation in leaves from 21% to 7%. This may be due to limited capacity of leaves to uptake Pb. On the other hand Cu concentration of 29 mg kg^{-1} and 63 mg kg^{-1} in non-mining and mining sediments respectively lead to an accumulation of 13% and 16%, respectively. Although Cd detection in sediments was not observed but leaves from mining area had accumulated significantly high concentration of Cd than of non-mining area; 42%; which may be due to high Cd concentration in sediment of mining areas. High concentration of Metals in leaves with respect to the corresponding concentration in the substrate showed that the plant water hyacinth (*Eichhornia crassipes*) has ability for bioaccumulation. Thus bioaccumulation of metals in water hyacinth in natural environment makes it a very helpful plant for detecting pollution levels and can be used for phytoremediating aquatic environments as well as manage water quality.

Key words: Water hyacinths, Heavy metal, Bioaccumulation, Biomagnifications, Phytoremediation

SVI/P-45

Plant Uptake of BTEX Contaminated Groundwater using the Wetland Plant *Canna generalis*

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To perform a general assessment of treatment efficiency of wetland plants an experimental study to

quantify the plant uptake of a BTEX compound was undertaken using three cases of constructed wetlands with gravel and polluted groundwater under laboratory conditions. In this study residual toluene concentration in water was measured in all the wetlands using plants of *Canna generalis* over a period of 96 hours. Three cases of wetland with shoot biomass, without shoot biomass and unplanted were investigated. Mass balance calculations showed that in the wetland with shoot biomass the contaminant loss was due to plant uptake, biodegradation and evapotranspiration. In the wetland without shoot biomass, the loss of toluene was mainly due to rhizodegradation and volatilization and the adsorption of toluene on root biomass was negligible, while loss of toluene in unplanted case was due to natural attenuation and volatilization. The total time for biodegradation of toluene was found to be in the order: Unplanted> Wetland without shoot biomass> Wetland with shoot biomass. This result can be used to frame in-situ plant-assisted bioremediation techniques for BTEX contaminated sites.

Key words: BTEX, *Canna generalis*, Plant uptake, Rhizodegradation, Plant-assisted bioremediation

SVI/P-46

Recent Advances in the Bioremediation of Organic Pollutants via Enzymatic Processes

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Widespread environmental pollution by inorganic and organic chemicals posing immense risk for survival of mankind itself on earth. Owing to the relatively high cost and the non specificity of conventional techniques, bioremediation involves microorganism mediated transformation or degradation of contaminants into non-hazardous or less-hazardous substances and meant to be promising alternative technology for pollutant clean up. Among biological agents, microbial enzymes have a great potential to transform and detoxify polluting substances effectively because they have been recognized to be able to transform pollutants at a detectable rate and are potentially suitable to restore polluted environments.A large number of enzymes from bacteria, fungi, and plants have been reported to be involved in the biodegradation of toxic organic pollutants. Bioremediation is a cost effective and nature friendly biotechnology that is powered by microbial enzymes. The research activity in this area would contribute towards developing advanced bioprocess technology to reduce the toxicity of the pollutants and also to obtain novel useful substances. The information on the mechanisms of bioremediation-related enzymes such as oxido-reductases and hydrolases have been extensively studied. This review attempts to provide descriptive information on the enzymes from various microorganisms involved in the biodegradation of wide range of pollutants, applications, and suggestions required to overcome the limitations of their efficient use.

Key words: Organic pollutants, Microbial enzymes, Biodegradation, Bioremediation

SVI/P-47

Phyto-Extraction of Heavy Metals by Mosses

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Bryophytes are proved to be popular organisms for bio-monitoring to determine levels and identify sources of heavy metal pollution. Chemical analysis of mosses has proven to be a rapid and inexpensive method of monitoring of heavy metal deposition in the terrestrial ecosystem. The present work was carried out with a view to carry out comparative study for the element accumulation in the collected samples from five different sites namely Srinagar (Garhwal), Bhawali, Chakrata, Shimlaand Munnar. The samples of plant materials and their substrata were analysed for exchangeable metallic cations- Cadmium, Chromium, Copper, Lead, and Nickel(using Atomic Absorption Spectrophotometry). Highest concentration of Cd in both the plant sample and its supporting substratum was observed in *Entodonprorepens* (42.60 µg/g in plant sample and 297.50 µg/g in substratum).The highest concentration of Cr was observed in *Campylopusgoughii*. As

compared to all other heavy metals studied, Cu was found in much higher concentrations both in plant samples and supporting substratum in all the five sites. The highest content of Cu was found in *Trachypodopsisserrulata*. Pb content in plant sample and its supporting substratum was found to be the highest in *Campylopusgoughii* (24 µg/g in the plant sample and 387µg/g in the substratum). *Ditrichumtortipes* was found to have the highest Ni content (24.60 µg/g in the plant sample and 262.51µg/g in the substratum)These taxa have great capacity for heavy metal accumulation and can be considered suitable species for bioaccumulation studies. The present study also indicates that the area of Bhawali is heavily polluted by heavy metal and the taxa growing there have a good tolerance to heavy metals. The results highlight the sources of pollution and the extent of contamination allowing immediate appraisal of variability of harmful elements in the area and enabling informed decision-makers for setting soil protection guidelines and determining the suitability of particular land-use.

Key words: Bio-accumulation, Phyto-extraction, Heavy metals, Mosses

SVI/P-48

Bioremediation of Agro-Waste on Edible Mushroom *Agaricus bisporus*

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Management of waste is a major problem in tropical countries like India. Thousand tones of waste disposed every year from agricultural field, industries, houses etc. Present paper deals with the use of different agro-waste materials for the cultivation of edible mushroom *Agaricus bisporus*. Four different types of compost were used for the cultivation of *Agaricus bisporus*. These composts used different agro-waste like wheat straw, wheat bran, seed meal, saw dust etc. Among these composts, compost-1, gave best results which contain wheat straw, wheat bran, saw dust, ammonium sulphate, super phosphate and gypsum. Thus this study will help to reduce environmental pollution by waste disposal.

Key words: *Agaricus bisporus*, Compost, Straw, Bioremediation, Agro-waste

SVI/P-49

Biodegradation of Soil Polycyclic Aromatic Hydrocarbons using Bacterial Consortium

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Pollution due to oil industry is a permeating global problem due to its toxic constituents like Polycyclic Aromatic Hydrocarbons (PAHs). PAHs are a class of diverse organic compounds with two or more fused benzene rings in a linear, angular or cluster arrangement. The significance of PAHs removal lies in the fact that they are persistent pollutants in the environment, which have ubiquitous occurrence and detrimental biological effects. Conventional (physical and chemical) methods are less eco-friendly and require more expenses. Therefore, we reviewed several biological methods and found microbial degradation as one of the most suitable process for PAHs degradation in soil. Microbial Degradation involves the conversion of toxic and complex compounds into non-toxic and simpler ones using naturally occurring microbes like algae, bacteria and fungi. Pure bacterial cultures can metabolize only a certain range of PAHs. Therefore, use of bacterial consortium (assemblage of mixed populations) has gained popularity as it performs synergistic interactions amongst its population increasing the rate and extent of PAHs degradation. This review mainly focuses on the degradation of ecologically toxic PAHs using different bacterial consortium.

Key words: Polycyclic aromatic hydrocarbons, Biodegradation, Bacterial consortium, Microorganism

SVI/P-50

Kinetic Behaviour of Activated Sludge Process Treating Composite Chrome Tannery Wastewater

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Chrome tannery wastewater causes serious environmental problems arising out of its high

Chemical Oxygen Demand (COD), Bio-chemical Oxygen Demand (BOD_5), Nitrogen and Total Suspended Solids (TSS) together with significant chromium, sulphide and chloride. Therefore, treatment of composite Chrome tannery wastewater becomes difficult due to various toxic/inhibitory substances. Among different biological methods available for the treatment of composite chrome tannery wastewater, activated sludge process (ASP) is a widely accepted biological system. The process design of the ASP reactor using rational approach always requires for realistic values of kinetic co-efficients related to substrate removal and biomass growth. In view of that, the kinetic behaviour of substrate (i.e. COD) removal and biomass growth must be established prior to applying a model. Moreover, the biodegradation potential of the concerned wastewater should also be estimated to take appropriate measures during treatment. The present study was undertaken to examine the treatability of the composite Chrome Tannery wastewater using an acclimated suspended biomass under batch mode of operation. The objective also included determining the kinetics co-efficients for the biodegradation, based on most favourable kinetic model. A laboratory scale ASP reactor was employed for conducting the batch study on the performance of COD removal from a composite tannery wastewater and also for determining the kinetics coefficients. The results of several batch experiments highlighted the efficacy of the ASP system in treating composite Chrome Tannery wastewater, but experienced with an inhibition. Thus, the Haldane growth kinetic model was found best-fitting for biodegradation performance using mixed culture microorganisms. The batch study was performed under varying batch periods to determine five kinetics constants, viz. Ks, k, k_i, Y and k_d from the experimental data. The values of all the kinetics co-efficients are in a good agreement with the earlier kinetic studies on composite tannery wastewater.

Key words: Tannery, Sludge, Chrome, Wastewater

SVI/P-51

Assessment of Rhizosphere Soil Health for Evaluation of Reclamation Success

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Globally surface mining causes tremendous land degradation by removal of vegetation cover and topsoil, creation of huge overburden dumps and voids, destruction of landform and habitat. However proper reclamation can restore the productivity of land and may bring better landscape. Establishment of tree cover in the mine degraded land aims to accelerate soil-forming processes,to control erosion,to buildup organic matter, to develop microbial communities, to initiate nutrient cycling and enhances overall aesthetics of the area. Scientific reclamation is a big challenge as adverse physico-chemical properties tend to inhibit soil forming process and plant growth. The challenge lies in the selection of appropriate tree species, which have higher ameliorative capacity on mine spoils. The survival and sustainable growth of tree species largely depends on the rhizosphere microbial processes of the tree species.

Rhizosphere soil samples collected from commonly growing tree species in the reclaimed coal mine overburden dumps of Jharia coalfield, Dhanbad, India, were analyzed for physico-chemical and microbial properties. Maximum improvements of pH were observed in the rhizospheric soil of *Gmelina arborea* while least in *Acaccia auriculiformis*. Highest accumulation of soil organic carbon was observed in *Cassia siamea*, *Dalbergia sissoo* and *Leucanea leucocephala* and lowest in *Terminalia arjuna*. A similar trend in variation was observed for microbial parameters, higher values were observed under *C. siamea* followed by *D. sissoo*, *L. leucocephala* and lowest under *T. arjuna*. Principal component analysis (PCA) was employed to derive a mine- soil index which was used for ranking the suitability of the species. Soil CO_2 flux, dehydrogenase activity, organic carbon, soil coarse fraction and moisture content are the most critical properties controlling health of reclaimed coal mine soil. The observed values of the above properties were converted into a unitless score (0–1.00) and the scores were integrated into rhizosphere mine soil index. Tree species having higher index values (*C. siamea and D. sissoo*) could be recommended for reclamation of degraded lands.

Key words: Reclamation, Coalmine overburden dumps, Principal component analysis, Rhizosphere, Mine soil index

SVI/P-52

Pesticide Waste Management: A Successful Strategy

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Most pesticide active substance are hazardous. They have been designed to control living organisms, such as weeds, plant diseases and pests. Use of pesticide therefore involves theoretical risks to both those who apply them and to those who consume treated produce. This risk can be managed by taking sensible precautions and reducing exposure .Besides positive effects of pesticide, uses like better weed control, releasing of pesticide into the environment can be harmful, such as crop-fields' run off can move a herbicide away from target weeds. Along with pollution of soil and water. Many chemical processes include adsorption, transfer, breakdown and degradation may regulate pesticide fating to environment Transfer includes processes that keep pesticide away from the target site, this include volatilization, spray drift, runoff, leaching, absorption and crop removal.

Pesticide wastewater from crop-fields contains toxic and inhibitory compounds, which adversely affect biological growth. This paper is concerned with exploring the role of nutrients and bioaugmentation towards pesticide waste management. Isoproturn is a phenyl urea herbicide, the production of which generates effluent with high C.O.D. Successful treatment (91% COD reduction) of such a stream was achieved using bioaugmentation techniques. The initial biomass in the reactor was systematically augmented with a special culture for 1 month. Regular monitoring and biomass addition further stabilized the bacterial population. The reactor consistently gave high COD reduction (80-90%) during its operation.

Key words: Isoproturon, Pesticide, Effluent, COD, Herbicide

SVI/P-53

Microbial Biomass Act as Functional Indices in Ecological Restoration of Degraded Soil: A Case Study

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Present study was conducted on a degraded ecosystem in a dry tropical region of India where mining is one of the serious problem. Mining operation not only degrade the forest cover even degrade the soil composition. Soil restoration is a really challenging ecological problem; moreover, their recovery into previous normal version by natural succession is very slow. Therefore, ecological soil restoration by establishing desirable plant species is cost-effective and more stable technique than physical and chemical procedure. Re-colonization of diverse group of soil organisms is a part of successful restoration effort, as biological activity of soil is also disrupted during the process of mining and rehabilitation.

Eighteen plantation sites Were selected in different ecological models (mono- and mixed culture) for analyzing microbial biomass carbon, nitrogen, phosphorus and their total nutrients with respective age of each plantation for assessing restoration properties on coal mine spoil. Fourteen plantation stands selected as mono-cultured and four were selected as mixed culture. Of which, eight woody species were indigenous and hard, and in which, four of them were leguminous tree and short stature in size; and four were non-leguminous. Remaining four woody species were exotic in nature. The objective of the present study was to examine restoration potential and their role in soil restoration with respective time.

Results indicated that soil microbial biomass was closely linked to soil organic C, which further showed a positive exponential relationship between soil organic C and microbial biomass C, and soil N and microbial biomass N by native woody species. However, this was not clearly developed in exotic plantations.In comparison to mono-culture plantation stands, mixed culture either legume or non-legume combination showed a strong relationships for corresponding confirming strong role of microbes in enhancing biological fertility of soil in a short range of time, it confirms role of microbial biomass as functional indices of satisfactory soil restoration.

Key words: Coal mine spoil, Microbial biomass, Soil redevelopment, Restoration

SVI/P-54

Honey as Indicator of Environmental Quality and Floral Diversity

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Honey is a valuable bio-product known for its nutritional and medicinal properties. It is also recognized as a biological indicator of environmental quality and floral diversity. Honey contains pollen grains from the flowers visited by bees collecting nectar and also the minerals that plants receive from soil, water and air. The determination of mineral contents in honey is essential for the quality control and nutritional aspect. The present investigation is undertaken to determine pollen and mineral contents in four honey samples of *Apis dorsata* collected from Varanasi district. Pollen analysis of honey sample has been done following the methodology suggested by International commission of Bee Botany. 21 pollen types were recovered from the microscopic examination of 4 honey samples. Pollen diversity ranged from 10-11 pollen type per sample. Out of the four honey samples two were unifloral and rest two were multifloral in nature. *Brassica compestris* and *Ageratum conyzoides* were the predominant pollen types in unifloral honeys. Pollen grains registered as secondary pollen types include *Brassica campestris, Callistemon citrinus, Coriandrum sativum, and Parthenium hysterophorus. Benincasa hispida, Prosopis juliflora, Phyllanthus emblica, Coriandrum sativum, Carica papaya, Ageratum conyzoides and Eucalyptus globulus* were registered as important minor pollen types while those of *Ageratum conyzoides, Coronapus erecta, Eucalyptus globulus, Pheonix, Cassia sp. Parthenium hysterophorus, Pisum sativum, Rorippa indica, Azadiracta indica, Coriandrum sativum, Lathyrus odoratus, Citrus sp. Brassica campestris, Phyllanthus emblica, Madhuca indica,* and Poaceae were the minor pollen types. Analysis of honey samples for 10 mineral contents viz. potassium, sodium, calcium, magnesium, iron , zinc, cadmium, lead, arsenic and copper was done using Inductively Coupled Plasma Atomic Emission Spectrophotometer (ICP-AES).The minerals of honey were categorized as essential minerals (potassium , calcium, sodium, magnesium, iron) and heavy metals (Zinc, cadmium, lead, arsenic, copper). The results revealed that in the honey samples K was present in the highest concentration ranging from 11.559 to 47.664 ppm followed by Ca (3.497 to 7.708ppm), Na(6.828 to 7.404 ppm), Mg (0.694 to 1.797 ppm,), Fe (0.053 to 0.656 ppm),) while concentration of heavy metals- Zn, Pb As, Cu and Cd was less than the 0.05ppm. The level of heavy metals in the honey samples was below the permissible limit set by WHO/ PFA Rule1955. Analysis of pollen and mineral contents of the honey samples indicates good environmental quality and floral diversity of the region for the production of honey free from heavy metals.

Key word: Honey, Pollen analysis, Unifloral honey, Multifloral honey, Heavy metals

SVI/P-55

Remediation of Heavy Metals through Aquatic Macrophytes from Water Bodies of Bundelkhand Region of Uttar Pradesh

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The Bundelkhand region – approximately an area of 70,000 square kilometers with 21 million people, comprising 13 districts of Madhya Pradesh (MP) and Uttar Pradesh (UP) – is facing its worst ever drought spell in last deacades . There are numbers of century old historical lakes in this region which are getting polluted day by day due to the growth of the small scale industrial corridor, nutrient loading and rapid anthropogenic activities. The increasing levels of metals in the aquatic ecosystem, their entry into food chain and the overall health effects are of major concern to researchers in the field of ecology. Out of twelve existing plants in different water bodies, four aquatic macrophytes namely *Eichornia crassipes, Pistia stratiotes, Lemna minor* and *Vallisneria spiralis* were selected for phytoremediation study on the basis of their abundance in selected study areas. Concentration of six trace metals have been estimated in above mentioned macrophytes i.e., Copper (Cu), Chromium (Cr), Iron (Fe), Manganese (Mn), Lead (Pb), and Zinc (Zn). From a phytoremediation perspective, *E. crassipes* and *Pistia stratiotes* are promising plant species for remediation of polluted water bodies of Bundelkhand region.

Key words: Bundelkhand region, *Eichhornia, Pistia, Lemna, Vallisneria*, Heavy metals

SVI/P-56

A Biomonitoring of Algae to Assess Quality of Water in the River Yamuna at Hamirpur, U.P., India

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Biological assessment is generally considered useful to determine the quality of water. Algae are frequently found in polluted and unpolluted water and are useful alternative for the assessment of water quality. Algal samples were collected at monthly intervals from different sampling stations (New Tehsil Ghat, Purana Yamuna Ghat, Chaura Devi Ghat and Singh Maheswar Ghat) of river Yamuna at Hamirpur during the period of April, 2013 to March, 2014. The most pollution tolerant genera and species of four groups (Chlorophyceae, Bacillariophyceae, Euglenophyceae and Cyanophyceae) of algae were recorded from different sampling sites of river. Phytoplankton encountered in the water body reflects the average ecological condition and therefore, they may be used as indicator of water quality. During the present study the algal flora of polluted water of river shows the dominance of cyanobacteria like *Anabaena, Aphanocapsa, Aphanizomenon, Cylindrospermum, Chroococcus, Microcystis, Nostoc, Nodularia, Oscillatoria, Phormidium* and *Spirulina* along with diatoms like *Asterionella, Cymbella, Fragilaria, Gomphonema, Melosira, Synedra, Navicula, Nitzschia* throughout the investigation. Many green algae like *Ankistrodesmus, Cosmarium, Closterium, Chlorella, Coelastrum, Hydrodictyon, Pediastrum, Scenedesmus, Spirogyra, Stigeoclonium and species of Euglena* and *Phacus* also occur abundantly.

Key words: Algae, Water quality, River, Utter Pradesh, Phytoplankton

SVI/P-57

A Critical View on Scope of Biodegradation of Slurry Explosives

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Coal and lignite is the prime source of energy used in different applications such as power generation, steel manufacturing, construction industries etc. due to its cost effectiveness. Coal is mostly produced from opencast and underground coal mines and blasting is an essential part of the mining cycle. Mining explosives and initiating accessories are utilized for removing overburden rocks and to produce coal. Ammonium Nitrate Fuel Oil (ANFO), emulsion (Water-in-Oil) and water gel slurry explosives along with blasting accessories are used in the blasting operations. Cartridge slurry and bulk slurry explosives products chargeable to blast holes contribute approximately 30% explosives consumed for blasting in India. Sometimes large fragments fly rocks, back breaks and toe problem are observed after blasting of rock. It may due to deterioration of explosive properties of the slurry explosives due to prolonged storage or due to manufacturing defects. Disposal of deteriorated slurry explosive is difficult and done by burning process only. No other scientific disposal method for slurry explosive is developed and available in India. This paper reviewed the characteristics of uni-molecular and mining explosives and their available disposal methods. This paper also reviewed the literature and knowledge base available for decomposition of uni-molecular and mining explosives. Water gel slurry explosives are selected for review of state of art and application of different types of decomposition methods specially using microbial means.

Key word: Coal, Biodegradation, Slurry explosives, TNT, RDX, HMX

SVI/P-58

Bioaccumulation of Toxic Metals in Native Plants from Arsenic Affected Area of West Bengal, India

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Concentration of Arsenic (As) and other toxic metals; Selenium (Se), Cadmium (Cd), Chromium

(Cr), Nickel (Ni) and Lead (Pb) has been determined in soil and plants samples collected from different sites Beliaghat, Pokharpara, Ambikapur, Vijaynagar, Barasat and Kanchrapara in North 24 Pargana district and Kalyani mode, Sona daunga and Ranaghat of Nandia district of West Bengal. Metals concentration in soil found to vary with sites and maximum concentration of Arsenic (17.2 mg Kg^{-1}) was recorded in agricultural soil at Barasat followed by Beliaghat (13.6 mg Kg^{-1}) of North 24 Pargana, however, lowest As concentration (10.9 mg Kg^{-1}) was recorded at Ranaghat, Nandia. Similarly, Se, Pb and Cr were also found maximum in soil collected from agricultural field of Barasat and recorded 4.92, 7.95 and 13.84 mg Kg^{-1}, respectively. Metal concentration in plant samples were found differentially with respect to plant species and their root and shoot. Arsenic accumulation was recorded maximum (18.2 mg Kg^{-1}) in root of Rice plants (*Oryza sativa*) as compared to shoot (6.4 mg Kg^{-1}) at Barasat site. However, Selenium (Se) was found to accumulate maximum (1.7 mg Kg^{-1}) in root of Rice plant at Barasat site among metals studied. Similarly, the plant *Colocasia esculanta* collected from Barasat showed maximum concentration of Cr (15.45 mg Kg^{-1}) followed by As (4.51 mg Kg^{-1}) in the root. Among aquatic plants, *Eichornia crasipis* found more dominating species in As contaminated area and maximum As concentrations (15.82 mg Kg^{-1}) recorded in root of *Eichornia crassipes* followed by *Lemna minor* (10.3 mg Kg^{-1}) at Barasat. Diatom found to accumulate maximum As (7.6 mg Kg^{-1}) followed by *Oscillatoria* sp. (6.4 mg Kg^{-1}) among algal species at Kanchrapara site.

Key words: Metals, Bioaccumulation, Tolerance, Contamination, Phytoremediation

SVI/P-59

Determination of Concentration of Heavy Metals using Moss as Bioindicator in the High Vehicular Traffic Zone of Western Express Highway of Mumbai

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Environmental pollution is a series problem which affects the human being, economy of the countries, loss in crop production and their by affects the population of the world. Mumbai is one of the most densely populated city of India and is over-burdened with thousands of industries and millions of vehicles. In the present investigation the western express highway of Mumbai which has one of the high vehicular traffic zone in Mumbai is selected to estimate the amount of atmospheric heavy metals in the mosses. Since mosses lack significant cuticle, stomata and have poorly developed root system therefore they absorb nutrients mainly from the atmosphere along with the pollutants which is much higher than their physiological requirements. The moss species selected for the study is *Barbula indica*. Twenty four moss samples were collected from the vicinity of Western express highway of Mumbai. The collected moss samples were air dried, digested using nitric acid and hydrogen peroxide. The concentrations of elements in digested moss species were determined by using inductively coupled plasma-optical emission spectrometry (ICP-OES) by comparing with NIST SRMs. The concentrations of elements were compared with the concentration of elements in the moss samples collected from the forest of Bhimashanker, Maharashtra. The result shows the spatial distribution in concentration of metals, which also indicates the correlation of the concentrations of elements in mosses to the distance from the road for most of these metals. The result thus indicates road traffic as the source of these elements.

Key words: *Barbula indica*, Heavy metals, Bioindicator, Western express highway.

SVI/P-60

Bioremediation of Cobalt by Metal-Resistant Bacteria Indigenous to Serpentine Outcrops of Andaman

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Industrial applications of cobalt compounds in alloy production, electroplating and ceramic plants has led to discharge of untreated effluents in the

environment leading to Co(II) pollution and toxicity. Although Co(II) is an important micronutrient, it is also a potent carcinogen when exposed to concentrations above admissible limits. Cobalt-resistant bacteria native to polluted sites or naturally metal-percolated serpentine habitat may provide an effective solution towards bioremediation of Co-pollutants. Serpentines or ultramafic soils form natural metalliferrous ecosystem enriched with ferromagnesium minerals of nickel, cobalt and chromium. The rhizobacterial isolates (162 including 32 filamentous forms) obtained from underneath metal-hyperaccumulators growing over serpentine soils of Andaman demonstrated varying degree of sensitivity towards Co(II) and only 4.3% of 162 strains grew at 4mM level. The potent Co(II)-resistant (MIC 7.6 mM) bacterium identified as *Cupriavidus pauculus* KPS 201 (MTCC 6280) showed inducible Co(II) resistance and metal accumulation during growth. Metal loading equilibrium was attained after 52 and 60 h of growth at 1 mM and 2 mM Co(II) respectively. Co(II)-loading capacity amounted to 524 µM/g protein after 60h of growth at 2 mM Co(II). Lyophilized biomass of KPS 201 showed rapid appreciable sorption of cobalt from aqueous solution which attained equilibrium after 60 min of contact between metal ions and cell mass. Cobalt biosorption onto lyophilized biomass was enhanced by increasing metal ion concentration up to 7 mM level where a maximum sorption of 1528.3 µM Co(II) /g biomass was achieved. However, biosorption rate declined with increase in biomass concentration and presence of additional heavy meal ions. The optimum pH and temperature for Co(II) biosorption were 7.0 and 30 ^{0}C respectively. FTIR spectra of Co-loaded biomass indicated coordination of C $\underline{=}$ C or C $\underline{=}$ N with Co(II) as well as esterification and amide formation in Co-treated cells. Langmuir and Freundlich isotherms appropriately described *Cupriavidus* KPS 20 biomass as an efficient biosorbent which may be utilized for development of microorganism based waste water treatment system.

Key words: Bioremediation, Cobalt-resistance, *Cupriavidus*, Serpentine ecosystem, Biosorption

SVII/L-1

Biodiversity Scenario, Conservation Management and Environmental Sustainability in Bangladesh

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The flora of Bangladesh was initially a part of the then flora of British India until 1947 and thereafter flora of Pakistan until its independence in 1971. The plant biodiversity in Bangladesh has been analyzed since William Roxburgh who for the first time in 1814 listed *c.*766 species of angiosperms in his *Hortus Bengalensis* from Chittagong, Sylhet and other parts of Bengal. Thereafter Nathanial Wallich (1828-48) in his famous *Wall. Cat.*, Joseph Dalton Hooker (1872-97) in his great monument of the *Flora of British India* and David Prain (1903) in his *Bengal Plants* reported about 296, 1437 and 2221 species respectively from the area now in Bangladesh, especially from Sylhet and Chittagong. Later, Robert Lawrence Heinig (1925) reported 1559 species in his *List of plants of Chittagong collectorate and Hill Tracts* and James Sinclair (1956) listed 756 species in his *Flora of Cox's Bazar*. Since its independence in 1971, another *c.*300 species have been added to the account and estimated *c.*5000 species to be represented to the flora although inventory of the flora has not yet been completed. In Ahmed *et al*. (2006-1009), *Encyclopedia of Flora and Fauna of Bangladesh*, a total of 3611 species of angiosperms have been recorded. Only 11% of the estimated species of the flora have been inventoried and till today *c.*4000 species of angiosperms, so far, have been recorded from the flora of Bangladesh. Inventory of the flora for threatened taxa are also in progress and presumed *c.*44.53% species threatened under various IUCN Red List Categories of which *c.*20.54% species have already been extinct from the flora. In this communication, the detailed scenario of plant diversity since Roxburgh (1814), the rate of depletion and the conservation status for sustainability of the environment are stated with updated data obtained from field investigations, literature survey and examination of the herbarium specimens.

Key words: Biodiversity scenario, Conservation status, Environmental sustainability, Bangladesh

SVII/O-1

Diversity Analysis and Characterization of *Nostoc* Strains of North-Eastern Region of India

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The North-Eastern region of India located between 87°32'E to 97°52'E longitudes and 21°34'N to 29°50'N latitudes is a Biogeographical Gateway to India that finds place in part of two-biodiversity hotspots in India. Cyanobacteria are impressive ecosystem engineers with an evolutionary history stretching back at least 3.5 billion years. Cyanobacteria are often referred to as 'miniature factories' of the biological world and represent an alternative source of a variety of bioactive compounds, lipids/fatty acids, proteins, enzymes, pigments and compounds of pharmaceutical and nutraceutical value. *Nostoc*, a genus belonging to family Nostocaceae of order Nostocales is a filamentous cyanobacteria with intercalary heterocyst and akinetes formed centrifugally in series between the heterocyst. *Nostoc* strains shows great potential application as biofertilizers, animal feed, biocontrol agents. Some of them appear to be good candidates for biofuel industries and a few species are gaining recognition as highly nutritive food supplements as well as therapeutic agents.

Fresh water cyanobacterial and microalgal repository, a national facility created by Department of Biotechnology, Govt. of India vide ref. no. BT/PR11323/PBD/26/171/2008 dated 31-03-2009 at IBSD, Imphal, Manipur. A total of 1135 cyanobacterial strains were encountered from entire NE region of India and deposited in the designated repository with accession number. One hundred eighty five (185) *Nostoc* strains from different habitats of north-eastern region of India were established as unialgal culture and maintained at FWCMR with international standard. These *Nostoc* strains have been screened for the production of chl-a, soluble proteins, carbohydrates, ammonia excretion, carotenoids, phycobiliproteins and ARA activities. One hundred and ten (110) *Nostoc* strains have been subjected for lipid profiling and fatty acid composition by using GC-

FID methods. *Nostoc muscorum* BTA087 was found to content the highest phycocyanin (273.10 µg ml^{-1}) and carotenoids (80.30 µg ml^{-1}) which can be used as food pigments replacing current synthetic pigments. Highest ammonia excretion and nitrogenase activity was observed in *Nostoc hatei* BTA037 (169.30 µg ml^{-1}) and (90.90 nmole C_2H_4 μg^{-1} Chl-a h^{-1}) which can be useful for biofertilizer applications. Pentadecanoic acid (C15:0) of pharmaceutically importance was high in *Nostoc muscorum* BTA950 (69.17%). Twenty four (24) *Nostoc* strains have been partially sequenced, submitted to NCBI and obtained their accession number.

Key words: Biofertilizers, Cyanobacteria, Characterization, North-Eastern region, *Nostoc*, Repository

SVII/O-2

Preliminary Assessment of Biodiversity in the Vicinity of Larsemann Hills, East Antarctica

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Antarctica is the most precious asset on the earth and is the last heritage of human kind. Antarctica is the only area on earth planet, which is strictly devoted to scientific research and the continents of extremes come to be known as the "Continent of Science". It is the nature biggest laboratory on earth where no outside anthropogenic (human activities) interference has taken place over the centuries till recent times. Being at a unique geographic location, it offers unique opportunities for Scientists to conduct number scientific research experiments. Antarctica is attracting world attention because of the tremendous biological species in surrounding seas and likelihood of vast hydrocarbons. Even though it is difficult to survive at Antarctica, still Scientists all around the worlds have been engaged in pursing the exciting scientific research investigations. The investigations are essential not for the exploitation of natural resources buried under the region but for the preservation of environment and ecology on earth; especially in the light of climate change. Antarctica provides a unique, unpolluted and stable pure environment for carrying out scientific observation. It is far away from all sources of environmental contamination and thus remains an unpolluted datum point from which global changes due to pollution could be monitored and is suitable for a wide range of scientific research. India has conducted scientific studies, both at Dakshin Gangotri and Maitri stations in Antarctica in various disciplines. It now intends to broaden the scope of its scientific research by complementing the existing studies from an additional location. The new location for the new research base is at Larsemann Hills, Prydz Bay area, East Antarctica, which is about seven days away by ship from Maitri. The Larsemann Hills (69°202 - 69°302 S lat: 75°552 -76°302 E long.), named after Larsemann Christensen, is an ice-free coastal oasis with exposed rock and low rolling hills. However, it is mandatory to have some background ecological information prior to the initiation of station activity in the proposed area. Hence, the lichens, one of the major biological elements of Antarctica and highly privileged environmental indicators in addition to Moss communities, are studied to generate baseline information for future biomonitoring studies in the area to assess anthropogenic activities in the area after the construction of the third Indian research station in Larsemann Hills. Rock is the major substratum in the island accommodating many lichen species followed by moss species. True soil is virtually absent in the studied area, but a thin soil may be accumulated in rocks crevices, base of the rocks or in moss beds. The closely packed soil grains form a hard crust, a suitable habitat for lichens, as different species have been collected from such habitats. Organic matter comprising dead birds was frequent in the island and *Caloplaca citrina* was found growing luxuriantly in such habitats. Most of the lichens are substrate-specific, while some were found growing on all available substrate. *Buellia frigida, Candeleriella flava* and *Rhizoplaca melanophthalma* were found the most abundant and dominant lichen species in various islands/peninsulas of Larsemann Hills especially at Bharti Promontory and Fisher Island.

Key words: Antarctica, Biodiversity, Antarctic environment, South Pole, Pollution assessment

SVII/O-3

Species Diversity of Marine Centric Diatoms from North Arabian Sea Bordering Pakistan with Special Reference to Tasman Spirit Oil Spill

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A total of 21 phytoplankton samples were analyzed after Tasman Spirit oil spill from North Arabian Sea bordering Pakistan. Marine centric diatoms were the targeted species. Genus *Rhizosolenia* was found as the most diverse genus with 9 species which was followed by genus *Chaetoceros* with 7 species. Some genera were very rare represented by only one species. Light as well as Scanning Electron Microscopy has been used for identification of specimens. Moreover it has also been observed that species diversity was high in the samples collected after the spill. Data was compared with the other reports from this area.

Key words: Phytoplankton, Northern Arabian Sea, Centric diatom, Oil Spill accident, Karachi Harbor.

SVII/O-4

Assessing the Morphological Characters for Taxonomic Significance of *Rauwolfia serpentina* and *Rauwolfia tetraphylla*

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The *Rauwolfia* plant was named after Leonard Rauwolf, a German physician and botanist, who in 1582 published an account of his collections of medicinal plants from Asia and Africa. This plant belongs to a genus of the family Apocynaceae, which is indigenous to India and neighboring countries. The ancient Sanskrit name of *Rauwolfia serpentina* is "Sarpagandha", mention of which is found in an old Hindu manuscript of 1000 B. C. and also in the monumental work of Charak of the second century A. D. (Trease and Evans, 1954; Mukerji, 1955). The genus *Rauwolfia* L. (Apocynaceae) comprises of 80 species distributed in tropics of the world. India is the largest producer of medicinal herbs and is appropriately called the botanical garden of the world. Two species of *Rauwolfia,* viz., *R. serpentina* (L.) Benth. Ex Kurz and *R. tetraphylla* L. occur in India. *Rauwolfia serpentina* is the source of indole alkaloids, including the therapeutically useful compound 'reserpine' to treat cardiovascular hypertension, breast cancer etc. Pharmacological activity of *Rauwolfia tetraphylla* is due to the presence of alkaloids that expresses the central nervous system and lowers blood pressure. The root is also used to stimulate uterine contraction and is recommended for use in difficult child birth cases. Though considerable variations can be observed in gardens around the world, attempts have not been made so far to study the morphological relations among *Rauwolfia serpentina* and *Rauwolfia tetraphylla*. In view of these facts the study was conducted for the identification of plant by doing assessment of morphological relationship between two selected species of *Rauwolfia* using leaf - length, breath, seed- color, texture, stem- color, texture, bark, etc., may be useful to legitimatize conservancy of commercially important species. Thus a complementary method based on plant morphology for the identification of *Rauvolfia* species of the region is essential and is provided.

In this context, this work can lead to development of an efficient protocol to study the morphological relationship between two selected species of *Rauwolfia* using morphological characters.

Key words: Assessing, Morphological relationship, *Rauwolfia serpentina, Rauwolfia tetraphylla,* Morphological characters

SVII/O-5

Effects of Biomass Extraction on Bird Communities in Katerniaghat Wildlife Sanctuary, Uttar Pradesh, India

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Protected areas are created to protect and conserve biodiversity but dependency of people living at the periphery on forest resources for their livelihood and survival causes hindrance to this. Increase in

human and livestock population exerts pressure directly or indirectly on forest ecosystem. Very little information is available on the impacts of anthropogenic disturbance caused by biomass extraction on bird communities. An ecological study was carried out in Katerniaghat Wildlife Sanctuary, Uttar Pradesh, India to assess the effects of anthropogenic disturbance on the bird communities. The study area was stratified into high, medium and undisturbed categories on the basis of presence of sign indicating human induced disturbances. Within each category, point count method was used to assess the impact of anthropogenic disturbance on bird communities. PAST software was used to calculate diversity, richness and evenness of bird species. One-way ANOVA and Pearson's Product moment correlation was performed on Statistical Package for Social Sciences (SPSS) *ver*17.0. Results show density of birds found to be highest in medium disturbed areas and diversity, richness and evenness calculated maximum in undisturbed areas. The density and diversity indices of birds in both summer and winter seasons were found to be significantly different in all the categorized areas. On individually mentioning human induced disturbance gradients, bird density had a negative correlation with human trail, lopping and fire. Therefore, the present study indicates that anthropogenic disturbance caused by continuous extraction of ecologically important biomass effects bird communities. The sanctuary is rich in bird diversity but if large scale extraction of biomass continues then incidence of birds will be adversely affected due to habitat degradation. Therefore for future and long term management, urgent conservation initiatives are needed for the sanctuary.

Key words: Katerniaghat Wildlife Sanctuary, Anthropogenic disturbance, Biomass extraction, Bird community and Diversity indices

SVII/O-6

Biodiversity of Medicinal Plants of Satpuda Forest Region of East Khandesh, M.S., India

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Study covers the area falls in Jalgaon district situated between 20^0-17' and 21^0-26' north latitude and 74^o-47' and 76^o-28' east longitude. Topographically it can be distinguished as 1) The Tapi rich valley in the centre,2) The high mountainous ranges on the north and 3) Barren ridges of Satmala and Ajanta ranges on the south. The study is confined to first two regions only and more specific to Satpuda mountainous ranges from 2006-2009. Present study reveals about total no. of medicinal plant families '82 'composed of pteridophytes (3), Dicots (66), and monocots (13). The genera are 234, spread over pteridophytes (3), dicots (209) and monocots (22).Similarly Species are 270 out of which pteridophytes are (3), dicots (244) and monocots (23). The most Prominent and common method of administration of medicinal plants is oral 252(56.00%) followed by external 109(24.22%), internal applications are 49 (10.08%), poultice 31 (6.88%), smoking 3 (0.66%) and inhalation 4 (0.88%) and steam bath 2 (0.44%). The most striking feature of the study is evaluation and assessment of threat status of some important medicinal plants of the area to find out conservation priority. On the basis of number of medicinal plants, Habitwise breakup of plant species used as medicine, Dominant diseases with number of plants used, Mode of administration, Frequency of plant parts used The present paper highlights biodiversity of ethnomedicinal plants with reference to botanical name, family, part(s) used, distribution, threat Status, and mode of administration.

Key words: East Khandesh, Satpuda, Scorpion sting, Mountainous ranges

SVII/O-7

Algal Diversity and New Records of Algae from Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah

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Algae occurs even in wide range of habitats and have been distributed all over land, water, bark, etc. often in such as environments where there is no other vegetation possibly due to their adaptive capability to extreme adverse environmental conditions with respect to different environmental factors, availability of nutrients, etc. Botanical gardens are having unique resources that allow them to host important climate change research. These resources include controlled growing conditions, living collections with broad

taxonomic representation of not only the higher plants but also the Algae, Bryophytes, etc. Every Botanic Garden has great impact on surrounding climatic conditions and vies-versa. Acharya Jagadish Chandra Bose Indian Botanic Garden (AJCBIBG), Howrah is one of the very old and famous garden of India established by Col. Robert Kyd in 1787 and spread in an area of about 273 acres. The garden is the real repository of more than 12,000 trees, shrubs and climbers representing over 1,400 species together with a large number of wild and cultivated herbs. Among them this garden is well known for its native and exotic palms collection collected from South - East Asia and planted in an octagonal metalled enclosure i.e. Large Palm House. At the centre of the enclosure a very interesting rare giant palm listed in RED DATA Book i.e. Lodoicea maldivica (J.E.Gmel.) Pres. was planted in 1894 and thus now it attains its age 120 years. This plant is endemic only to two small islands, namely Praslin and Curieus among the chain of 115 islands in Seychelles. In general, the microclimatic conditions on and around trees provide congenial environment for the growth of diverse plant forms among which different algal forms also come into existence on different parts of the tree trunk and showed so much algal diversity. During study, altogether 47 algae were recorded from Lodoicea maldivica (J.E.Gmel.) Pres. Out of which 4 species (including one variety) new to India belongs to class Xanthophyceae(1), Euglenophyceae(1), and Chrysophyceae(2).

Key words: AJCBIBG, Climate, Algae, New records, Biodiversity

SVII/O-8

Use and Conservation of Traditional Medicinal Plants by Indigenous People in Village Kapsi, Balod District, Chhattisgarh (India)

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The present study documented 15 medicinal plant species belonging to 14 families used by the Halba tribes residing at villages of Rajnandgaon District. Among these 3 species are used for treatment of diabetes, 2 each for Joining bones, cold and cough, hairfall, digestion, wounds, jaundice and blood purification. 1 species each is used to cure piles, joint pains, cardiac problem. Single species is used to cure both malaria and thyphoid. The present study reports that various parts of different plants are used for different diseases. The data obtained from our results showed that plants have external use as well as internally applied. In this study, different parts of the plants were reported to be used for medicines. The leaves and the barks are the most commonly used plant parts in the preparation of remedies accounting for 47 % and 27% (15 species) of the total medicinal plants, respectively. Analysis of the data showed that leaf is the most sought plant part in the preparation of remedies. Herbal preparation that involves roots, rhizomes, bulbs, barks, stems or whole parts, have effects on the survival of the mother plants. In the study, the fear of destruction of medicinal plants due to plant parts collected for the purpose of medicine is minimal as leaves were the leading plant parts sought in the area. Moreover, the harvest of whole plants is not often practiced in the area.

The main threat for medicinal plants emanate from industrial expansion. Traditional medicine preparation mostly involves single plant; the mode of administration is mainly internal in which oral administration is the common route. Modernization, modification of culture and increased business work in the area have played a major role in changing the attitude of younger generation to ignore the use of traditional knowledge The existence of diverse cultural traditions and belief system were found to have both useful and harmful impacts on medicinal plants. For instance, some of these beliefs contribute to medicinal plant conservation as they reduce the rate of harvesting of the plants, while others contribute to deterioration of the knowledge on traditional medicine and medicinal plants.

Key words: Traditional, Medicinal, Halba, Tribes, Conservation

SVII/O-9

Composition, Structure and Diversity of Forest Communities of the Achanakmar-Amarkantak Biosphere Reserve: A Comparison and Conservation Implications

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The core region of Achanakmar- Amarkantak Biosphere Reserve falls in Chhattisgarh State (India) and lies between lat.22°15' to 20°58' N and long. 81°25'N to 82°5'E. *Shorea robusta* Gaertn F. (sal) is the dominant species occurring in this region. The present study deals with the comparative account of composition and diversity of pure *Shorea robusta* forest and degraded mixed moist forest of Achanakmar-Amarkantak Biosphere Reserve . Based on the repeated reconnaissance of the area, three representative sites of size 1 hac. in pure Sal forest was selected for two growth strata stages *e.g*. upper story(trees)under story(,saplings and seedlings). The forest vegetation was analyzed using 10 randomly placed quadrate(each 10 *10 m) within the representative sites. The vegetation data were quantitavely analyzed for frequency, density, abundance and Importance value index and various indices of alpha and beta diversity.

The pure *Shorea robusta* forest showed high density and basal cover of trees (1233 stem ha^{-1}, basal cover 36.36 m^2 ha^{-1}) and under story vegetation (density 1575 stem ha^{-1}, basal cover 1.85 m^2 ha^{-1}). The degraded mixed moist deciduous forest sites represents the degraded stage having low density of trees and basal cover (633 stem ha^{-1},basal cover 32.82 m^2 ha^{-1}) and under story vegetation (density 918 stem ha^{-1}, basal cover 0.37 m^2 ha^{-1}). The total number of species was high in pure *Shorea robusta* forest as compared to degraded mixed moist deciduous forest.

Similarly plant diversity was also high in pure *Shorea robusta* forest for trees and understory (2.82; 2.92 Shanon index; 4.76; 2.32 richness index, 0.99; 1.01 equitability, 0.21; 0.22 concentration of dominance, 5.78; 8.82 beta diversity) respectively than on degraded mixed moist deciduous forests for trees and understory (1.99; 2.44 Shanon index; 3.48; 1.43 richness index, 0.78; 1.04 equitability index, 0.39; 0.26 concentration of dominance, 8.20; 11.93; beta diversity), respectively. The climatic condition of the region supported the regeneration of *Shorea robusta* (sal) and its associates in the climax formation over a long succession process. The study focus the comparison and conservation implication of this biosphere reserve.

Key words: Bioshere Reseve, Composition, Floral diversity, Structure, Succession

SVII/O-10

Phylogenetic Assesment of Goan Mangroves along West Coast India using DNA Barcode Markers

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Mangroves are unique ecosystem exist along the sheltered inter-tidal coastline, in the margin between the land and sea in tropical and subtropical areas. They are among most productive, diverse, biologically important ecosystem and inclined toward threatened system. Identification of mangrove species is of critical importance in conserving and utilizing biodiversity, which apparently hindered by a lack of taxonomic expertise. DNA barcoding using plastid markers *rbcL* and *matK* is an effective method for species identification and for documenting biodiversity. In the present study, we performed molecular phylogenetic assessment of available 15 mangrove species of Goa, west coast India based on DNA barcode markers, *rbcL* and *matK*. We examined these markers singly and in combination to evaluate their discriminatory power among mangrove species. Intra and interspecific distance were analyzed in the available mangrove species for *matK* gene and exhibited highest distance in *Ceriops tagal* and *Kandelia candel*, and lowest distance observed in *Rhizophora mucronata* and *Sonneratia alba*. The interspecific highest pairwise distance was observed in *Avicennia officinalis*, while least pairwise distance was observed in *Rhizophora apiculata*. However, highest intraspecific rbcL distance recorded for *Kandelia candel* and *Aegiceras corniculatum*, and interspecific distance for *Avicennia alba*. Similarly, lowest *rbcL* intraspecific distance observed in *Excoecaria agallocha* and interspecific distance in Rhizophoraceae members such as *Bruguiera gymnorrhiza*, *Bruguiera cylindrical*, *Rhizophora apiculata* and *Rhizophora mucronata*. Our results clearly demonstrate that combined assessment using both *rbcL* and *matK* genes were able to adequately discriminate mangrove species except *Rhizophora*, *Sonneratia*, *Bruguiera* and *Lumnitzera*. Our study provides the first endorsement of the two locus barcode (*rbcL+matK*) in species resolution among mangroves with few exceptions. Future work

is focused on evaluation of other barcode markers to delineate complete resolution of mangrove species.

Key words: DNA barcode, Mangroves, *matK*, *rbcL*, West coast India

SVII/O-11

Eco-Physiology of Germination in Selected Plant Species of Sundarbans Mangrove Forest and Diversity

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Germination behavior of *Heritiera fomes* and *Xylocarpus granatum* in relation to salinity were investigated to explain the nature of adaptation. Seedlings of *Sonneratia apetala* planted (monoculture) in the Oligohaline zone in the experimental plot showed vigorous growth within three years. Plant community types of different ecological zones from Sundarban mangrove forests were identified and the changes were discussed. Dominant plant species of the ecological zones and the nature of adaptation showed formation of consociation in the Polyhaline zone and also to a lesser extent in Mesohaline zone In contrast, the Oligohaline zone exhibited mixed plant community.Seasonal variations of soil chemical conditions particularly salinity and water chemistry were highly variable. It was noted that exchangeable calcium is the dominant cation followed by magnesium. Salinity (conductivity) in the river water from selected locations showed strong seasonal variation and was several times higher in the Ologohaline zone at the end of the winter season (March) than in the monsoon season. which is due to the unavailability of fresh water supply from upstream through the river Ganges. Plant species from the quadrats of circular plots of 2m radius were recorded and Diversity was measured by *H´*, the Shannon-Wiener Index. Ecological diversity was measured based on rarefaction of the actual samples,

$$E(S)=\sum\{\ 1-[(N-{}_{n}Ni)/(\ N\ _{n}\ )]\ \}$$

The diversity values showed correlation with the ecological conditions. The rarefaction methodology was compared with a number of diversity indices using identical data and was found to be influenced by sample size. The abundance of species ranked from most to least abundant (in geometric series) was also calculated as

$$ni = NC_{K}K\ (1 - K)^{i-1}$$

Analyses of data with the log series and the Q statistic were done to bring plant diversity of the mangrove plant species to a sharper focus. The result indicated a strong diversity of the plant species of Sundarbans mangrove forest. Plant succession pattern and the plant composition in Oligohaline and Mesohaline zones were evaluated.

Key words: Species Diversity, Sunderban Mangrove Forest, Statics

SVII/O-12

Role of Mangrove Ecosystem in Protecting Environment

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Mangrove swamps are found in tropical and subtropical tidal areas. The specific regions where these plants occur are termed as mangrove ecosystem". Mangrove forests are regarded as the most productive wetlands in the world on account of the large quantities of organic and inorganic nutrients released in the coastal waters by these ecosystems. They are unique because they occupy both land and water and referred to as floating forests. They float due to their aerial roots that develop in fine mud or sandy sediments .These roots form a dense tangled network below water surface providing a home and shelter for diverse number of species. They act as buffer zone between the land and sea protect the land from erosion, play an important role as nature's shield against cyclones, ecological disasters. They protect the shore line during storm events by absorbing wave energy and reducing the velocity of water passing through the root barrier .The Sundarbans recognized as a World Heritage Site is the largest mangrove forest in the world, located in the Ganges River delta Bangladesh and West Bengal, India account as the largest single mangrove unit globally..The Pichavaram mangroves in TamilNadu is India's largest mangrove forest and second largest in the world. Climatic factors like temperature

fluctuation, humidity, precipitation number of rainy days, regular wind flow, radiation and fresh water flow in the region act as the most significant factors for development and succession of mangroves. The current assessment on mangrove cover by Forest Survey Of India in 2013 the country is 4,682 sq km, which is 0.14 percent of the countries' total geographical area. When compared with 2011 assessment, there has been a net decrease of 34 sq km in the mangrove cover of the country. Threats to mangrove ecosystem are either natural or anthropogenic. The natural threats include climatic changes, cyclones and physical process. Pollution, grazing, agriculture, aquaculture and human encroachment etc., are considered as anthropogenic threats to the ecosystem. Global warming is causing sea level rise and low lying mangroves forests are highly susceptible to it. As mangrove ecosystems are the protectors of environment in so many ways there is an urgent need to conserve these incredible habitats by educating the people about its importance.

Key words: Mangroves, Sundarbans, Disasters, Forest Survey of India, Threats, Conservation

SVII/O-13

Determinants of Lichen Family *Graphidaceae* in Eastern Palaeotropical Countries

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Tropical countries have the highest ecosystem diversity, and among lichens, *Graphidaceae* by far the most dominating family of Palaeotropics. The members of the family indicate undisturbed surroundings, optimum CO_2 content, and light intensity. Being placed in tropical belt, India, Sri Lanka, China in part, and Vietnam have dense, old forests continuity, supported by high and constant temperature regime, and the prolonged humid climatic conditions, which supports luxuriant growth of graphidaceous members. Though, the family mostly prefers trees growing in (semi-) exposed conditions in tropical or evergreen forests of lowland, but also able to colonize trees in montane and dry forests. India exhibits highest diversity of graphidoid taxa in Western Ghats and Eastern Himalaya and shows affinity with Sri Lankan, Vietnamese and Chinese *Graphidaceae*. The tropical rain forests of Sri Lanka recently explored well for the elements of *Graphidaceae*, while China has a huge land enjoying tropical to temperate climate, and together with Hong-Kong studied well for the family. The north-east India and Vietnam (Indo-Burma) in conjunction with southern part of China form a phytogeographical position experiencing a migration stream from China, India-Himalaya, Malaysia-Indonesia and other neighboring temperate regions, and assemble conditions for rapid speciation, which creates tremendous opportunity for emerging new elements due to intraspecific variations and interspecific diversity within the family. The Republic of Korea being small with sub-temperate to temperate climate establish conditions comparatively less favourable to graphidoid taxa. The scarcity of this group also attributed to destruction of old forests in the nearer past, and managed primary forests and national parks open for tourism. It has been observed that the chemical diversity in *Graphidaceae* of Eastern Palaeotropics, particularly the taxa from the Indian subcontinent, is higher if compared with species of the new world. Being densely populated, Asian countries likely to be influenced significantly by the environmental pressure. Despite having deteriorating climatic conditions, the high success of members of *Graphidaceae* in the region to some extent derived from their chemotaxonomy. Lichen substances are known to protect lichens against increasing environmental stress. The high concentration of lichen compounds having antioxidant and light screening properties in *Graphidaceae* of eastern palaeotropics well justify prevailing environmental complications in the region. A lichen compound, perlene quinone is wide spread in graphidaceous taxa, while norstictic, stictic, protocetraric, psoromic and salazinic acids are major determinants of *Graphidaceae* from eastern palaeotropical countries. Disjunct species distribution within the family advocates the existence of graphidoid taxa before continental drift or the formation of

Gondwana land. Widespread distribution and survival during millions of years suggest the adaptation of species of *Graphidaceae* during development and changing geographical condition. Owing to the high diversity and a constant process of speciation since millions of years, *Graphidaceae* in eastern palaeotropical countries presents the ideal family to understand the changing environmental conditions and related adaptation since evolution.

Key words: Chemotaxonomy, Continental drift, Diversity, Evolution, Graphidoid, Indicator

SVII/O-14

Status of Invasive Alien Plant Species in Protected Areas of Nepal

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Nepal occupies the central part of the Himalayas between the Palearctic and Indomalayan ecozones. Due to steep elevation gradient from 60 m above sea level (m asl) in the south-eastern Tarai to 8,848 m asl at Mt. Everest within a short horizontal span of about 200 km, and high ecosystem diversity, the country favours establishment of several alien species from around the world. A total of 218 alien plant species have been naturalized in Nepal, which share about 4% of the total angiosperm flora of the country. The alien species in Nepal are mostly neo-tropical origin, except few species introduced from Europe and North America. Many of these alien species have not shown invasive characters, and are not threatening the environment and native biodiversity of Nepal, although all naturalized alien species are considered as a potential invasive species. About two dozen alien plant species are considered as highly invasive species in different ecosystems of the country. Important ecosystems distributed in Tarai, Siwalik and Midhills of Nepal including the protected areas and World Natural Heritages sites are seriously threatened by several invasive alien plant species. The major problematic invasive species in Nepal including protected are *Ageratina adenophora, Chromolaena odorata, Lantana camara, Mikania micrantha, Eichhornia crassipes, Ipomoea carnea* ssp. *fistulosa , Alternanthera philoxeroides, Myriophyllum aquaticum, Parthenium hysterophorus , Ageratum conyzoides, A. haustonianum, Amaranthus spinosus, Argemone mexicana,Cassia tora, Hyptis suaveolens, Pistia stratiotes, Leersia hexandra, Bidens pilosa, Xanthium strumarium,* and *Cassia occidentalis*. The country has a network of protected areas that include 10 national parks, 3 wildlife reserves, 6 conservation areas, 1 hunting reserve, and 12 buffer zones which cover 34,185.62 sq. km (23.23%) of the total geographical area. The protected areas located in Tarai, Siwalik and Midhills are more seriously threatened by IAS than the protected areas of high elevation. The paper attempts to highlight the origin and status of invasive alien plant species occur in the protected areas located in Tarai, Siwalik and midhills of Nepal.

Key words: Naturalized plant species, Protected areas, Nepal

SVII/O-15

Forest Fragmentation in Meghalaya and its Ecological Implications

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Forest fragmentation is the process through which large forest areas turn into forest patches of varying sizes, isolated from each other by tracts of non- forested land. The increasing anthropogenic activities in recent years have caused destruction and degradation of the natural forests and as a result, they are getting fragmented into small patches. Fragmentation of forests has brought about adverse ecological impacts on forest ecosystem structure and function, physical, chemical and biological properties of soil, hydrology and biodiversity. Our study on forest fragmentation in Meghalaya using Remote Sensing and GIS tools utilizing and analyzing satellite data has yielded very interesting results. Based on the extensive ground truthing and also from visual interpretation, forest cover for the different forest fragments across different forest types of Meghalaya was worked out. Plant species present in the fragments of different sizes,

phyto-sociological parameters of the component species, soil properties and other ecological parameters were recorded. However, only a small part of that study will be presented in this lecture. It was found that large continuous natural forest patches are rare in Meghalaya. Due to increased human pressure, ecosystems are being modified and natural habitats are getting fragmented creating a mosaic of natural and human-modified environments.

Altogether six major forest types have been recognised in the state of Meghalaya covering 42.2% of the geographical area. Primary tropical and subtropical forests of the state have been destroyed to a great extent by various anthropogenic activities including age-old tradition of shifting agriculture and pine forests have developed as a stable secondary community on the disturbed area which is seasonally dry and nutrient-poor. The forest patches of varying sizes ranging from <1 ha to a few sq. km are found on inaccessible hill slopes and in valleys along the rivers and streams in the state of Meghalaya. Impacts of forest fragmentation included depletion of plant diversity and decrease in population density of primary forest species and increase in density of secondary successional species, displacement of resident species by weedy species, changes in physical, chemical and biological properties of soil, changes in micro-environmental conditions, and adverse effects on species diversity and community structure. Tropical and subtropical forests are rich in plant diversity and harbour large number of rare and endemic species while secondary forests are poor in species richness. The soil profile in broad-leaved forest is well developed, acidic and rich in organic matter and nutrients. On the contrary, the soil in the pine forest is more acidic and poor in organic matter and nutrients. The large and small fragments showed a great deal of variation in their ecological impacts. The ecological implications of forest fragmentation in Meghalaya have been discussed in detail, and recommendations have been made to check further degradation and fragmentation of these forests.

Key words: Community characteristics, Ecosystem services, Fragmentation, Northeast India, Shifting cultivation, Species richness

SVII/O-16

Water Relations Study of Invasive *Lantana* and other Co-occurring Shrubs

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Plants adapt to water stress either by reducing cell dehydration i.e. avoidance (leaf shedding, leaf rolling and low stomatal conductance) or by tolerance i.e. making osmotic adjustments at cellular level (Turner, 1979). Osmotic adjustment is done by lowering of osmotic potential by accumulating solutes in response to drought (Munns, 1988). *Lantana camara* has emerged as a potential threat for ecosystem (Priyanka and Joshi, 2013). There is an urgent need to study the mechanism of action and control measures to stop this obnoxious weed.

Water relations study (pre-dawn and noon water potential measurements, leaf conductance and P-V curve) was done for 8 shrubs: *Lantana camara*, *Balanites aegyptiaca*, *Carissa spinarum*, *Capparis sepiaria*, *Flueggea leucopyrus*, *Grewia tenax*, *Rhus mysorensis and Ziziphus* sp. was done in a semi-arid protected forested region of Jawaharlal Nehru University, New Delhi, which is a part of Aravalli.

Water potential (Ø) was higher in winter and monsoon for *Lantana and Carissa* (-1.0 to - 0.5MPa) and was lowest in summer. During summers, very low mid-day water potentials were observed which increased in winters and was highest in monsoon. Except *Lantana*, all species had high differences between predawn and mid-day water potential values. High stomatal conductance was observed during winters and lower during summers. As suggested by P-V curve data, drought adaptations in *Lantana* attained through less osmotic adjustments but with more elasticity (å = 0-2MPa) and other species with better osmotic adjustments but with low elasticity (å = 4.5-12.5MPa) [lower values of elasticityH" high elastic property]. Soil moisture content decreased from monsoon to summer and accordingly variations were observed in water relations of shrubs. *Lantana camara* readily adapts to weather changes because of its property to maintain lower values of tissue elasticity

and is able to grow successfully and sometimes even outcompeting the native species growing along with it.

Key words: Invasive, native, weed, water potential, elasticity.

SVII/O-17

Biodiversity of Uredinales in Khyber Pakhtunkhwa, Pakistan

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Khyber Pakhtun Khwa (KP), the smallest province of Pakistan, housing 40% of country's forests is considered as store house of natural biodiversity of Pakistan. Rust fungi have been found as a great threat to flora of this green part of country. Extensive surveys have been made since 1947 to document rust fungi, their association and distribution in various forest ecosystems in this region. Studies revealed that about one hundred and seventy three (173) species belonging to nineteen (19) genera of rust fungi have been reported infecting various economically important host plants in this province. This manuscript is a compilation of available rusts reported from, or know to occur, in Khyber PakhtunKhwa. Species identification, distribution, illustrations and host index. This data will help in further studies related to diversity of this region and its usage as biocontrol agents against weeds.

Key words: Biodiversity, Biocontrol, *Puccinia* sp., Puccinales, Rust fungi

SVII/O-18

Role of Plant Tissue Culture in Conservation of Biodiversity of some Economic Plants Including RET Medicinal Plants

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Biodiversity, particularly phytodiversity is the fundamental basis of human survival and economic development as it provides food, clothing, shelter, medicine, biomass, energy and industrial raw materials. Deforestation, changing agroclimates, global warming and thinning of ozone layer are some of the major causes responsible for threatening the biodiversity resulting in a situation where species are vanishing at an alarming rate. It is estimated that about 100 species of plants and animals are vanishing everyday globally. Conservation of phytodiversity is a holistic approach and involves both *in situ* and *ex situ* methods. Amongst *ex situ* methods, Plant Tissue Culture, the foremost and extremely useful facet of Biotechnology, may play a pivotal role. Development of reproducible regeneration protocols not only forms the basis for successful micropropagation/cloning, but also for an equally important aspect of germplasm preservation through *in vitro* strategies, which will lead to achieve the ultimate goal of conservation of phytodiversity by establishing 'Germplasm Repositories' or 'Gene Banks'. The medicinal plants constitute a large group of plants providing raw materials to be used in drug formulation and related industries. Out of 17000 flowering plant species in the country, 2000 have been found medicinally important. Due to high demand, medicinal plants have been indiscriminately extracted for short-term gain without putting any effort towards their conservation. In addition, during recent years, revival of traditional/ herbal medicine has also led to over-exploitation of medicinal plants causing great depletion and even extinction of many medicinally important rare, endangered and threatened (RET) plant species worldwide. Under existing circumstances, it is warranted to explore conservation strategies in case of medicinal plants throughout the world to achieve the ultimate goal of their sustainable utilization for the welfare of mankind. In this context, efficient *in vitro* processes for rapid micropropagation/cloning and germplasm preservation in case of a number of important medicinal plants, like, *Azadirachta indica* A. Juss.,*Citrus indica* Tanaka (an endemic threatened wild relative of citrus) and four important slow-propagating RET plants of the Indo-Gangetic plains, namely, *Clerodendrum serratum* L. Moon (a rare and threatened shrub), *Uraria picta* Jacq. DC (a rare endemic leguminous herb), *Operculina petaloidea* (Choisy) Oost. (a rare perennial vine) and *Embelia tsjeriam* - cottam Roem. and Schult. DC. (a vulnerable shrub) were developed for conservation and sustainable utilization.

Key words: *In vitro*, Plant tissue culture, Micropropagation, Germplasm preservation, Biodiversity conservation, Gene banks

SVII/O-19

Aquatic Cyanobacterial Biodiversity of Kailashahar, Tripura, India

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Cyanobacteria (Blue-green Algae) are the unique organisms with potential to manage oxygen evolving photosynthesis and anaerobic nitrogen fixation in a single thallus. They grow in almost all types of known habitats including rice-fields, sub-aerial, thermal springs and many other specialized habitats. In organically polluted water reservoirs they usually form dense blooms. Bloom forming cyanobacteria have implications in fresh water bodies by their allelopathic behaviour as well as in forming toxic substances. In order to know the biodiversity of planktonic cyanobacteria growing in the different water bodies of Kailashahar and adjoining area of Unakoti district of Tripura, India, water samples were collected from different water reservoirs of Kailashahar and adjoining areas and were analysed for various parameters and examined microscopically during last five years (2009-2013). Microscopic observation of water samples revealed the occurrence of total 29 strains of cyanobacteria belonging to 19 genera *viz, Aphanothece* (01), *Aphanocapsa* (01), *Chroococcus* (02), *Merismpopedia* (01), *Synechococcus* (01), *Coelosphaerium* (01), *Microcystis* (01), *Arthrospira* (01), *Geitlerinema* (02), *Jaaginema* (01), *Limnothrix* (01), *Lyngbya* (02), *Oscillatoria* (03), *Planktothrix* (01), *Phormidium* (04), *Pseudanabaena* (01), *Spirulina* (02), *Anabaena* (02) *and Microchaete* (01). Results also revealed unique distribution pattern of cyanobacteria in aquatic habitat of North Eastern states and which is totally different from the rest part of India.

Key words: Aquatic, Biodiversity, Cyanobacteria

SVII/O-20

On the Status of *Aconitum heterophyllum* Wall. ex Royle: An Endangered Medicinal Plant from Himalaya

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Himalaya is well known for its diverse natural resources, some of which are unscientifically exploited for various purposes, particularly medicinal plants. Most of the medicinal plants are being extracted for drugs and pharmaceutical purposes from the wild. These activities adversely affect the existence of several plants of high commercial value. Further, developmental activities in the Himalayan region also taking a toll on the existence of these threatened medicinal plants. *Aconitum heterophyllum* Wall. ex Royle (Ranunculaceae), commonly known as Atees is among such medicinal plants, which is widely distributed in alpine and sub-alpine zones of North West Himalaya between 2800-4500 m asl. It is one of the most commercially exploited medicinal herb, which finds key position in Red List of IUCN and is on the verge of extinction in the wild. Although species extinction is a natural process but human induced species extinction is 100-1000 times faster than the natural. The roots/tubers of this plant have been destructively harvested by commercial enterprises for its anti-inflammatory, antipyretic, antibacterial properties. Therefore, organized cultivation *of Aconitum heterophyllum* is necessary to ensure the quality and continuous supply of crude drug. However, poor seed set is one of the important constraints for non availability of sufficient and superior germplasm for cultivation. Besides, conservation threats, *A. heterophyllum* is also facing taxonomical complexities as it is a polymorphic taxon that exhibits variations mainly in height of plant, size and shape of leaves, inflorescence type, number of flowers, colours of sepals, bract size, shape, position and hairs on carpels. After critical study, this species emerges out with clear cut distinction of two infra-specific taxa i.e. var. *heterophyllum* and var. *bracteatum*. *A. atees*, *A. cordatum*, *A. ovatum*, *A. kashmiricum* and *A. heterophyllum* var. *roylei* have been treated as synonyms to *A. heterophllum* var. *heterophyllum and A. heterophyllum* subsp. *parciflorum* as a synonym to *A. heterophllum* var. *bracteatum.* In the present study, we addressed the taxonomic confusion, further sustainable utilization and its conservation in the wild.

Key words: *Aconitum heterophyllum*, Endangered species, Himalayas, IUCN

SVII/O-21

Spatial Distribution of Pteridophytes in Nepal: A Conservation Approach

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Nepal is a country popularly known for its natural beauty and great cultural heritage. It is a small country and located in South East Asia between China and India. Its neighbouring country is Tibet in the north and states like West Bengal, Sikkim, Bihar, U.P, and Uttaranchal of India are also bordering it. Its geographical area situated between 26°, 22'-30°, 27'N latitude and 80°,04'-88°,12'E longitude.

The present day pteridophytes consist of more than 400 living genera and about approximately 13000 species. The pteridophytes of Nepal Himalaya are also well represented by nearly 70 genera and 400 species. However Author has collected 34 species of fern and 4 species of fern allies which are collected from the different localities of Kathmandu and Pokahara of Nepal. Altitude wise distributions of pteridophytes were also determined. All the collected species of different pteridophytes were thoroughly studied with the help of natural photography, diagrams formations, venation patterns, scales, epidermal details, stomata and reproductive structures like sori and spores. The material of diverse pteridophytes is collected from different localities of Nepal including Kathmandu and Pokhara district. In Pokhara collection were mainly made near Pheva Lake and all along way from Pheva lake to World peace Pagoda, way to Gupteswar Mahadev, Devis fall areas etc. In Kathmandu the collection has been made chiefly from Royal Botanical Garden situated at Godawari and Phoolchauki. Pteridophytes were also collected from other areas like Kathmandu to Sonauli and vice versa. The plants like *Adiantum capillus- veneris, A. caudatum, A. philippens, Woodwardia unigemmata, Nephrolepis cordifolia, Polpodium subbandinum* etc were collected from Pokhara while *Cyrtomium caryotideum, Christella parasitica, Equisetum diffusum* were collected from Royal Botanical Garden. *Ophioglossum reticulatum* and *Ceratopteris thalictroides* were collected from Kathmandu. Other plants were collected from the ups and downs way to Phulchoki area as- *Polystichum auriculatum, Pronephrium nudatum, Pteris quadriaurita, Pteris dactylina, Tectaria macrodonta, Drynaria mollis, Angiopteris evecta, Loxogramma involuta, Pyrrosia flocculosa* etc.

This overview of knowledge regarding pteridophytic distribution, in relation to altitude and climatic condition their changes etc. in Kathmandu and Pokhara will be of much help in formulating conservation strategies.

Key words: Venation, Nepal, Ferns, Sori, Spores

SVII/O-22

Nostoc papillae NDUPC003, sp. nov., a Filamentous Cyanobacterium with Feathery Spores Isolated from Agricultural Fields of Varanasi, India

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A filamentous, heterocystous cyanobacterium designated NDUPC003 was isolated from agricultural fields of Varanasi, India. Organism was deposited at NBAIM, Mau, U.P. (NAIMCC-C-00123). Morphological features and 16 rRNA gene similarity as revealed by BLASTn searches confirm strain as *Nostoc*. Morphological and molecular characterization of strain was done to elucidate taxonomic position. The strain shows the close morphological resemblance with *Nostoc ellipsosporum* NDUPC002 and *Nostoc musorum* NDUPC006 but presence of papilla around the spore is specific for the strain. It form separate clad with the cluster formed by *Nostoc ellipsosporum* NDUPC002 and *Nostoc musorum* NDUPC006 in the maximum - persimony tree of 16 rRNA and nif-H gene. Unique morphological feature of spore, low level of 16s rRNA gene sequence similarity and unstable tree topology suggest that the strain *Nostoc* sp NDUPC003 is genetically distant from the other species of *Nostoc* and represent a new species, for which the name *Nostoc papillae* sp. nov. is proposed with the type strain NDUPC003.

Key words: Nostoc, Cyanobacteria, Agricultural field

SVII/O-23

Climate Change on Faunal Biodiversity Resources: Threats and Challenges

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Climate change is one of the global environmental issues worldwide which lead to threaten ecosystems and its function. Global average temperatures have increased 0.2 °C per decade since the 1970s, and global average precipitation increased 2% in the last 100 years. The dramatic changes of temperature either hot or cold affects sea level rise, spreading of vector-borne diseases, heat or cold waves, melting of iceberg, and loss of biodiversity. India is one of the 17 megabiodiversity nation including three hot spots contains enormous endemic and keystone species which is maintaining the ecosystem function properly. Due to the industrialization and transportation, carbon-di-oxide (CO_2) is the major causative agent of global warming and its concentration is currently 401.30 ppm (July 2, 2014). In its most recent assessment, the IPCC re-iterates that 20-30% of species assessed so far are likely to be at increased risk of extinction if increases in global average warming exceed 1.5-2.5 °C (relative to 1980-1999) and as global average temperature increase exceeds about 3.5 °C, model projections suggest significant extinctions (40-70% of species assessed) around the globe. In addition to the several impacts on biodiversity resources such as shifting in migration, habitat loss, species extinction and forest fire, the loss of forest cover is a big challenge to mitigate the global warming in terms of carbon sequestration in developing countries especially in India. United Nations is considered in the year of 2010 as the "*International Year of Biodiversity*" and 2010-2020 as "*Decade on Biodiversity*" which includes a series of programme to protect the biodiversity. India is hosting the Eleventh Conference of Parties (CoP) to the Convention on Biodiversity (CBD) in Hyderabad on 1-9 October, 2012. India with a strong commitment is contributing towards achievement of three objectives of the CBD, the 2010 target and the strategic plan. The CBD will provide India an opportunity to consolidate, scale-up and demonstrate our initiatives and strengths on biodiversity. The objectives of the Invited talk is mainly focused on the significant faunal species which is currently facing to be endangered and extinct as well as the strategic action plans taken by various governmental and non-governmental agencies to conserve faunal biodiversity resources.

Key words: Global warming, Carbon sequestration, Species extinction, Faunal diversity

SVII/O-24

Flora in Morocco: Importance, Diversity, Threat and Conservation Strategies

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Located in the extreme northwest of Africa, between 21° and 36° north latitude and 1° and 17° west longitude, Morocco covers an area of 710850 km^2. Its special geographic position between two coastlines gives an exceptional range of bioclimates varied ranging from the humid and subhumid to Saharan desert and through the arid, semi-arid and high mountain climate in the Rif, Middle and High Atlas, where altitudes exceed 2500 respectively, 3000 and 4000 m.This diversity creates a climate diverse ecosystem with a large range of different natural environments: woody forest formations pre-Saharan and Saharan steppe formations, formations of degradation.The floristic richness of the country is related to the biotopes heterogeneity. From the desert to the high mountains and the littoral to the most continental borders, Morocco offers very varied ecological conditions which allowed installation of various stocks species with a significant plant biodiversity compared to other Mediterranean countries. This plant currently has about 4200 species (4500 with subspecies) distributed among 940 genera and 135 families. Rare, threatened and/or endemic flora represents a significant part: 951 are endemics, 463 rare, 1284 threatened and 36 vulnerable.However, this diversity is subjected to many natural pressures (climate change, parasitic attacks…) and antropic (clearing, overgrazing,…). This presentation will be focused on the Moroccan flora richness and biodiversity conservation strategies (creation of more than 154 protected areas) and the assessment of the climate change impacts on the degradation and the

dysfunction of ecosystems as well as the rarefaction and the disappearance of species.

Key words: Morocco, Flora, Importance, Diversity, Climate change, Protected areas, Conservation

SVII/O-25

Plant Diversity and Climate Change Interactions in tthe East Mediterranean

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During the last century, climate change, excessive-unsustainable exploitation of natural resources, and destruction of habitats have damaged plant diversity so severely that this situation now threatens human lives. The reason is mainly a result of our supermacy. Nearly 5,000 taxa of plants are said to have become extinct since 1700. There have been mass extinctions on earth, but, the current extinction rate is estimated to be up to a thousand times higher than prehistory rates. Global climate change will produce additional effects on these extinctions.

The Mediterranean basin and the Caucasus are two regions of extreme species richness in Europe. Turkey and its neighbouring countries line its East shore, known as the cradle of civilizations, and an area of megadiversity of important food crops. More than 15000 plant species are distributed here. It was once blanketed by the forests of towering cedars, firs, and beech together with fragrant maquis and phyraganic shrub cover, but most of this cover has been destroyed. According to the climatic figures and current level of plant cover depletion, clear implications to desertification are prominently displayed. Effects of regional climate on the speices living at different altitudes reveal that there is shift in the distributional range of plants. The warming temperatures will alter the altitudinal patterns of forests, plant diversity issue will thus become even more critical.

The strategies to reduce plant diversity loss should thus include efficient landscape-level planning, sustainable consumption, stopping over-exploitation of other wild resources, protection and restoration of critical ecosystems, stop deforestation, promote ecosystem conservation for adaptation to climate change.

We do not know what our successors value systems will be, perhaps they will need vast quantities of some species which we consider now as insignificant or even harmful. A widespread education is needed for the protection of plant diversity. The politicians and mayors need to follow strict rules for their sustainable use with scientific foundation never affliated to the short term political gains. There is an urgent need for experimental, biogeographical approach to examine linkages between climate and patterns in the structure and dynamics of plant diversity.

Key words: East mediterranean, Plant diversity, Climate change

SVII/O-26

Causes and Consequences of Invasive Plants on Ramsar Site Wetlands

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Lacuna on invasion biology research on wetlands has been crucial impediment in scientific and global policymaking on wetland management. About 6% of earth's land mass is covered under wetlands where 24% of the world's most invasive plants occur. Documentation of invasive flora of these wetlands is therefore fundamental for their sustainable utilization as these are regions of high plant productivity and particularly vulnerable to invasions. Although wetlands act as storm buffers, their highly productive soil provides suitable habitat to invaders, often monotypes, which alter the community structure resulting in diminished native flora, reduced diversity and even alter nutrient cycling causing drastic collapse of overall productivity while also altering the food web and in turn, the ecosystem balance. Wetlands act as landscape sinks as they accumulate debris, sediments, water and nutrients, all of which facilitate invasions by creating canopy gaps, thereby accelerate the growth of opportunist invasive species. Coupled with these the other disturbances such as propagule, salt and heavy metal influx, as well as hydro-period alteration create environments and opportunity for invaders. Invasion by invasive species is therefore an outcome of cumulative impact associated with habitat alteration

of terrestrial as well as hydrophytic flora and biodiversity in general. Invasion by alien species is of serious concern as these have resulted in deterioration of wetlands by suppressing native flora, interfering in wetland management, contaminating ecosystem, increasing fire hazards, preventing recruitment of native species, reducing their aesthetic value and hampering socio-economic development. Invasion therefore plays key role in reducing biodiversity by creating single species dominance. An integrated approach is perhaps the only possible way for salvage of wetlands from such destruction by alien invasive species.

Key words: Ecosystem, Invasive Ramsar site, Sustainable management, Wetland

SVII/P-1

Study of some Rice Field Cyanobacterial Isolates from Karimganj District Assam, North East, India

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A preliminary investigation for the distributional pattern of some cyanobacterial isolates from the rice fields around Son beel area of Karimganj district, Assam, North East India was carried out. Thirty two number of soil samples were collected during the study period from the rice fields of Anandapur, Deodhar and Son beel both in summer as well as winter. The distributional pattern shows that a total of thirty four isolates were obtained belonging to nine genera. Among them the genera *Nostoc, Anabaena, Calothrix* and *Cylindrospermum* were the dominant rice field cyanobacteria in the district. Chl *a* content was estimated and used as an indirect biomass measurement and the highest was found in *Cylindrospermum* sp. (10.55 µg/ml) and the lowest was recorded in the strain *Nostoc sp.* (1.27 µg/ml). The present study deals and concludes that extensive work is necessary to characterize the highly potential indigenous cyanobacteria which are widely distributed in the rice field of this district and can be applied for the high yield of rice cultivation of the district.

Key words: Cyanobacteria, Distribution, Karimganj district, Rice fields

SVII/P-2

Conservation of Plant Biodiversity using Biotechnology

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Biodiversity refers to variation with in the living world, while genetic diversity represents the heritable variation within and between populations of organisms. The over grazing deforestation and overexploitation of native resources under range situation have eroded the biodiversity from the unique ecosystem. Plants are universally recognized as vital components of the world's biological diversity and an essential source for the planet. In addition to the cultivated plants, many wild plants have greater economic and cultural importance and potential as future crops and commodities more so as humanity grapples with emerging challenges of environmental and climatic change. Until now, most activities on *ex situ* conservation of plant biodiversity have focused on crop species. Botanic gardens play a very important role in *ex situ* conservation of plant biodiversity. During the last 2-3 decades, major advances have been made in conserving the plant genetic resources under in vitro conditions using tissue culture techniques. This is of particular importance for the effective maintence of wild relatives and cultivated crops. The development of biotechnology leads to the production new categories of germplam including clones obtained from elite genotypes, cell lines with special reference to genetically transformed materials. Tissue culture techniques are of great interest for the collection, multiplication and storage of plant germplasm. Various applications of biotechnology for conservation biodiversity using meristem culture, embryo culture, *in vitro* shoot multiplication, clonal propagation, conservation of somatic embryos, production of synthetic seeds and cryopreservation. The experimental investigations have been carried out for conservation of germplasm of wild and cultivated varieties of certain grain Legumes using *in vitro* techniques on solidified MS medium with special reference to Viability, seed germination, seedling vigor and filed seedling survival percentage etc.

Key words: Biodiversity, Germplasm conservation, Synthetic seeds, Tissue culture techniques

SVII/P-3

Biodiversity of Medicinal Flora with a Note on Conservation

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Plants are benefactors of mankind. 75% of the 120 Pharmaceutical products used by the industry are discovered from the clues obtained from Traditional Medicine. Wonder Drugs like Reserpine, Guglipid, Ergotamine, Ergomatrine, Vincristine, Vinblastine, Diosgenin and Hecogenin have been discovered in the recent past In nature plants are able to synthesize complex molecule of Secondary Metabolites like Alkaloids, Terpenoids, Tannins, Saponins etc.

Varied climatic conditions arising from myriad of geographical regions. India conceivably provides favorable locale to rich genetic and cultural biodiversity with about 9500 medicinal Flora and 400 Ethinicgrops. India is one of the 12 Mega Diverse countries. Medicinal plants are distributed across diverse habitats and land scapes. World Average of Medicinal plants is 12.5%, whereas of India is 20%. Vedetal (2001) Estimated the Number of Medicinal Plant species found in Different Bio geographic regions of India as Transhimalayas 700, Gangeticplains 1000, Himalayas 2500, N. Estindia 3000, Deccanpeninsula 3000, Islands 1000, Westernghats 2000, Coasts 500.

About 10 species are becoming extinct every day. Current status of Medicinal Plants is also quite disturbing. Eleven species were listed under cites. About 150 species fall under IUCN categories of Threatened, rare or endangered species. Ninety percent of the botanicals used by industry are collected from wild, Government of India had to publish a negative list of hundred and fourteen species regulating wild harvest and trade. Demand for herbal products is quite encouraging. Global market of Pharmaceuticals Nutraceuticals and Cosmaceuticals would be of order of U.S.$ 5 Trillion, by 2050. The estimated global trade at present is of the order of U.S.$ 60 Billion.

Now it is appropriate to promote large scale cultivation of medicinal species, in addition to the establishment of natural reserves like Parks, gene banks and ASBRC and FGB concepts.

Key word: Biodiversity, Conservation, Medicinal plant

SVII/P-4

Beautiful Insectivorous Medicinal Plant Drosera and its Meaningful Conservation through Tissue Culture and Sustainable Biotechnology

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Biotechnology contributes to sustainable development in several ways such as biofertilizer production, biopesticide production and management of environmental pollution, tissue culture and biodiversity conservation in vitro, in vivo and in situ, Insectivorous medicinal plant Drosera burmannii Vahl belongs to the Family-Droseraceae under Order-Caryophyllales, Dicotyledoneae, Angiospermeae which has 31 (thirty one) living genera and 194 species besides 7 (seven) extinct (fossil) genera. Locally it is known as "Patkanduri" in Odia. Its Hindi name is "Mukhajali" and its English name is "Sundew". The earliest species of Drosera was first reported in 1753 by Carolous Linnaeus called Drosera indica L (Indian Sundew). The latest species of Drosera reported by Fleisch A, Robinson, AS, McPherson S, Heinrich V, Gironella E and Madulida D.A. (2011) is Drosera ultramafica from Malaysia. More than 50 % species of Drosera have been reported from Australia and next to Australia is South Africa. India harbours only 3 species such as D. indica L, Drosera burmannii Vahl and D. peltata L. From our Odisha only D. burmannii Vahl is being reported for the first time from the district of Subarnapur near Sonepur (Arjunpur Reserve Forest Area). Drosera plant is autotrophic but to supplement its Nitrogen (N_2) requirement it adopts heterotrophic mode of nutrition (insectivorous/carnivorous) as well. The colour of plant in mostly red and about 20-30cm in height with beautiful pink or white pentamerous flowers. Plants grow luxuriantly during November to February in shady and moist places near small water bodies of running water stream. Medicinally it is a popular herb in the locality for the treatment of cold and cough in children in rainy season by the local Doctors (Kabiraj and Baidya). In the present field investigation an attempt has been made to understand the unique reproductive phase and life cycle of the plant thereby planning for its conservation and propagation through various techniques of tissue

culture and biotechnology. More importantly besides morphological and anatomical studies, cytological investigation is being carried out to find out the number of chromosomes in the cell and its genomics as there is no such report as yet for Drosera burmannii Vahl.

Key words: Insectivorous, Medicinal, Drosera, Biotechnology, Chromosome, Genome

SVII/P-5

Tree Species Diversity and its Population and Regeneration Status in Homegardens of Upper Assam, North-East India

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Study was conducted to investigate tree diversity and its population and regeneration status in homegardens of upper Assam, Northeast India through field study by quadrat method. A total of 154 tree species have been recorded from 135 studied homegardens under 109 genera 53 families. Most of these species (79%) are indigenous to our country, while the rest (21%) are aliens (naturalized and cultivated exotics) by origin. Out of the total 53 families, 52 families are angiosperm of which 49 are dicot (92%), and 3 are monocot (6%) and only one (2%) is gymnosperm. Tree species richness per homegarden varies greatly in different homegardens and is ranged from 5 to 52 tree species with a mean of 22 (SE±0.58). *A. malaccensis* is the most dominant tree species in the studied homegardens contributed 34% of the total tree density of the documented trees. The tree density is much higher with 4,259 individuals ha^{-1} but, basal area (5.97 m^2ha^{-1}) is very less. Based on the number of individuals present, very rare species is accounted for 10%, rare species 39%, common species 19%, dominants 14% and predominant species 18% in the present study. The population density of 154 tree species is 4,259 (individuals ha^{-1}) for adults (>10cm GBH), 5,902 (individuals ha^{-1}) for saplings and 38,164 (individuals ha^{-1}) for seedlings. The population densities in three different life forms (adults, saplings and seedlings) represent their possible future species composition. The density of seedlings> saplings> adults represents good regeneration status of tree species in studied homegardens. The population structure study showed that about 8% tree species have good regeneration status, 9% have fair regeneration status, 48% have poor regeneration status and 34% tree species have no regeneration. Study suggests that research and development action is needed to stimulate regeneration of those tree species which having high importance value indices but showing poor or no regeneration. Based on present observation, it can be conclude that homegarden can emerge as an effective means for both economic well-being and biodiversity conservation in upper Assam, Northeast India.

Key words: Tree species diversity, Density, Abundance, Dominance, Population status, Regeneration status

SVII/P-6

Status of Forest in Dudhwa National Park, Uttar Pradesh, India

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In the present study the status of forests of Dudhwa National Park (DNP) has been explored. It is situated between 28º22' to 28º41' N and 80º30' to 80º57' E with an elevation ranges from 150 to 180 m in Lakhimpur Kheri, Uttar Pradesh. It is a good representative of tropical moist deciduous forest of Terai region and comprises approximate 490 km^2 area. To know the current status of the forest, phytosociological assessment of tree species has been done in the national park. The cluster and PCA analyses grouped the forests of DNP into five major forest types: Sal miscellaneous forest, Sal-Asna miscellaneous forest, Low land miscellaneous forest, Teak plantation and Eucalyptus plantation. Each forest type has its specific species association and dominance. On the basis of importance value index (IVI) the Sal miscellaneous forest is dominated by *Shorea robusta* (183.94 ± 16.60) with *Mallotus philippensis* (29.13 ± 8.04) as first co-dominant and *Lagerstroemia parviflora* (12.35 ± 7.87) as second co-dominant species. Sal-Asna miscellaneous forest is again dominated by *Shorea robusta* (118.67 ± 9.33) with *Terminalia elliptica* (79.50 ± 9.48) as first co-dominant, *Mallotus philippensis* (34.19 ± 6.84) as second co-dominant and *Bridelia retusa* (16.32 ± 3.76), *Ficus semicordata* (11.23 ± 2.36) and *Lannea coromandelica* (11.12 ± 2.75) as other major

associated species. The low land miscellaneous forest is dominated by *Shorea robusta* (81.42 ± 8.08) and *Mallotus nudiflorus* (66.87 ± 3.60) collectively with *Barringtonia acutangula* (40.00 ± 4.39) and *Mallotus philippensis* (37.14 ± 3.62) as first co-dominant and *Syzygium cumini* (25.07 ± 4.13) as second co-dominant species. Teak plantation is dominated by *Tectona grandis* (208.01 ± 44.81) with *Mallotus philippensis* (31.35 ± 9.15) as first co-dominant and *Shorea robusta* (13.62 ± 12.20) as second co-dominant species. Eucalyptus plantation is dominated by *Eucalyptus citriodora* (260.14 ± 17.80) with *Shorea robusta* (15.63 ± 11.07) as first co-dominant and *Syzygium cumini* (12.50 ± 3.54) as second co-dominant species. Highest Simpson index (0.834) and Shannon index (2.154) indicates the highest heterogeneity and species diversity in Low land miscellaneous forest, while lowest Simpson index (0.2434) and Shannon index (0.561) indicates the lowest heterogeneity and species diversity in Eucalyptus plantation.

Key words: Forest status, Trees, Phytosociology, Dudhwa National Park

SVII/P-7

Morphological Trait Variations in the West Himalayan Populations of *Arabidopsis thaliana* along Altitudinal Gradient

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A large number of studies have been carried out worldwide on morphological and genetic analyses of model plant *A. thaliana*. In spite of having huge genomic resources, little is known about the variation in a particular trait across ecological and environmental scales limiting our potential to assess environment dependent trait variation. Identifying the most relevant trait variations may help us to better understand the plant response to changing environment. Though, being one of the biodiversity hot spot in the world, there is no report on detailed studies of *A. thaliana* from the west Himalayas. Here, we report the variations in morphological traits in the four populations of *A. thaliana* that grow along altitudinal gradients. Climatic conditions of the four sites varied significantly. A total of 39 traits were analyzed from each of the four populations from altitude of ~700 m above msl to ~3500 m above msl. Most of the quantitative traits were significantly correlated with each other among the four populations. There were marked differences in coloration of sepals as well as densities of stomata and trichomes (showing increase with altitude) among these populations. Regression analysis suggests most of the biomass related traits were negatively correlated with altitudes. Further, there was significant correlation between geographical distance and mean pair-wise distance among the populations. Overall our data suggests there is adaptive advantage in variations among traits of the populations along altitudinal gradients.

Key words: West Himalayas, Altitude, Morphological traits, *A. thaliana* populations

SVII/P-8

Diversity and Distribution of Lichens in Western Uttar Pradesh, India

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The study was carried out in western districts of Uttar Pradesh along with Hastinapur Wildlife Sanctuary. A total of 170 specimens are collected from Bijnor, Meerut, Moradabad, Mujaffarnagar, Pilibhit, Rampur, Saharanpur and Shahjahanpur districts. The study revealed the occurrence of 27 species of which 5 species namely *Arthothelium chiodectoides* (Nyl.) Zahlbr., *Diorygma soozanum* (Zahlbr.) M. Nakan and Kashiw., *Graphis pyrrhocheiloides* Zahlbr., *Opegrapha microspora* Müll. Arg. and *Pyxine cocoes* (Sw.) Nyl. were new addition to lichen mycota of Uttar Pradesh . The lichen mycota of western Uttar Pradesh is dominated by crustose form, out of them *Bacidia* species was maximum in number growing luxuriantly on *Mangifera indica* and *Syzigium cuminii* tree bark. *Hyperphyscia adglutinata* (Flörke) H. Mayrhofer and Poelt, *H. syncolla* (Tuck. ex Nyl.) Kalb, *Physcia dimidiata* (Arn.) Nyl., *Pyxine cocoes* (Sw.) Nyl., *P. reticulata* (Vain.) Vain. were the only foliose lichen. All the districts have poor natural vegetation, only Pilibhit has maximum forest cover chiefly dominated by *Shorea robusta* trees, rest of the areas were

dominated by *Mangifera indica* and *Syzigium cuminii* trees. It can be noted that earlier there was a record of only two lichen species from Pilibhit district and at present study represents 15 species with *Arthothelium abnorme* (Ach.) Müll. Arg., *A. chiodectoides* (Nyl.) Zahlbr., *Bacidia incongruens* (Stirt.) Zahlbr., *B. millegrana* (Taylor) Zahlbr., *Buellia disciformes* (Fr.) Mudd, *Caloplaca bassiae* (Ach.) Zahlbr., *Diorygma soozanum (Zahlbr.)* M. Nakan and Kashiw., *Dirinaria aegialita* (Afzel.) Moore, *D. consimilis* (Stirt.) D.D. Awasthi, *Graphis pyrrhocheiloides* Zahlbr., *Hyperphyscia syncolla* (Tuck. ex Nyl.) Kalb, *Lecanora achroa* Nyl., *L. helva* Stizenb., *Opegrapha astraea* Tuck., and *Pyxine cocoes* (Sw.) Nyl. Hastinapur Wildlife Sanctuary is restricted to forest areas on the either side of Madhya Ganga canal crossing Muzaffarnagar, Bijnor, J.P. Nagar and Meerut districts. It has scrub and deciduous type of vegetation. The specimens collected from 11 study sites resulted in 10 species. The sanctuary is dominated by crustose forms and *Pyxine cocoes* (Sw.) Nyl. was the only foliose lichen growing luxuriantly on *Syzigium cuminii* tree bark.

Key words: Biodiversity, Lichenized fungi, Flora, Mycota

SVII/P-9

Altitudinal Variation in Pharmacologically Active Constituents of *Epimedium elatum*, an Endemic Plant of Western Himalayas

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Epimedium is a well known genus of Chinese pharmacopoeia, possessing various medicinal properties such as aphrodisiac, antioxidant, immunomodulatory, vasodilatory, hepatoprotective, cardioprotective, antidepressant, anticancerous and antiosteoporosis activities. The active principle has been found to be its flavonoid glycosides, especially Icariin and Icariside-II. In the present study, *Epimedium elatum*, the only species of this genus growing in Indian subcontinent and endemic to Kashmir Himalayas, has been studied for its active principle content at different habitats. The plants were collected from wild populations (W.I, W.II and W.III) growing at three different sites of different altitudes and cultivated at low altitudes of Central Kashmir. After two years, the plants from wild populations as well as cultivated populations were collected, shade dried, grinded and prepared for HPLC analysis. The results showed that the content of active principles in leaves vary significantly between plants growing at different habitats. The Icariin and Icariside-II yield (per plant) of wild populations significantly increased with a decrease in altitude of habitat. Cultivated population growing at higher altitude had significantly more yield than all other populations, except the W.III. The content of active principles as a percentage of leaf dry mass increased with increase in altitude. However, the harvest index of wild populations showed a decreasing trend with increasing altitude. The content of active principles as a percentage of dry mass of whole plant was comparable in all the habitats, including the cultivated populations. The present study suggests that *Epimedium* plants cultivated at lower altitudes are equally or more productive in terms of Icariin and Icariside-II content than that of wild plants growing at higher altitudes.

Key words: *Epimedium elatum*, Icariin, Icariside-II, Altitude, Cultivation, Harvest index, Yield

SVII/P-10

Floral Diversity In Abu Dhabi; United Arab Emirates (UAE)

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Covering an area of ca.70000 km^2, Abu Dhabi is the largest of the seven Emirates that make up the United Arab Emirates (UAE). The climate of the region is hot and dry throughout most of the year, with temperature ranging from 50^{o}C to 5^{o}C across the year. Sand sheets and sand dunes cover large area of the Emirate with extensive gravelly plains found in the north-west and north-east. Mountains are covered with gravels and rocky substrate, while coastal sands are rich in calcium carbonate. Systematic surveys of vascular plants were conducted in different habitats using circular plots and quadrants based on stratified random sampling. The floristic evaluation has resulted in enumeration of 401 species. They constitute 254 genera of 62 families. The most dominant families of the region on the basis of species number were Poaceae

(74), Leguminosae (41), Compositae (36) and Amaranthaceae (35). 24 families were represented by a single genus and species. Families with fewer species such as the Cyperaceae (e.g. C*yperus conglomeratus*), Acanthaceae (e.g. *Avicennia marina*) and Zygophyllaceae (e.g. *Tetraena qatarensis*) are of ecological significance due to the dominance of individual representatives in the vegetation. The gymnosperm is represented by a single species, *Ephedra foliata*.

Applying IUCN categories, preliminary assessment were done to determine the status of the flora. A single species *Schweinfurthia imbricata* is placed in the endangered category, six species listed as vulnerable and 13 species listed as near threatened. Threat analysis suggests that habitat degradation, desertification, overgrazing, climate change and introduction of exotic species as the main reasons which play a significant role in the deterioration of plant diversity. The present work provides an important baseline data for further quantitative studies on the characteristics of plant communities in this region and will help in the identification of priority conservation areas.

Key words: Abu Dhabi, United Arab Emirates, Flora, Vegetation, Plant families

SVII/P-11

Diversity of Genus *Oscillatoria* (Vaucher) in River Ganga at Kanpur

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The River Ganga is known as the life-line of the Indo-Gangetic plains and is the perennial resource of freshwater from time immemorial. There are many large cities and towns are situated on the bank of river Ganga and it is the major source of drinking water for these cities. Kanpur is situated at 26.46°N latitude and 80.34°E longitudes at an elevation of 126 meters (416 feet) from sea level on the bank of river Ganga. Due to excess growth in human population and industrialization the river Ganga at Kanpur receive large amount of domestic and industrial effluents through various small channels and become polluted. This condition of water supports the luxuriant growth of algae especially bloom forming cyanobacteria (BGA). The cyanobacteria (BGA) are oxygenic photosynthetic prokaryotes and are among the most diverse, primitive and ubiquitous forms of life on the Earth. The genus *Oscillatoria* (Vaucher) is most commonly occurring cyanobacteria and plays an important role in bloom formation. The species of *Oscillatoria* (Vaucher) known to produce toxins which may be harmful to human and other domestic animals and also cause skin rashes or eye irritation due to showering or bathing in water containing blooms or scums. *Oscillatoria* (Vaucher) also produces several bioactive secondary metabolites which may be useful in various diseases. The study of Genus *Oscillatoria* (Vaucher) diversity in River Ganga at Kanpur was carried out seasonally [summer season (February to May), rainy season (June to September), winter season (October to January)] during the period of February, 2013 to January, 2014. During the present study 31 species of *Oscillatoria* (Vaucher) have been identified from different sampling stations of river Ganga at Kanpur between Bithoor to Jajmau. The minimum species diversity of *Oscillatoria* (Vaucher) has been recorded at Bithoorghat which gradually increased and reached maximum at Jajmaughat.

Key words: Ganga, Cyanobacteria, Blooms, Pollution, Diversity

SVII/P-12

Non-Food Uses of Plants: An Ethno-botanical Study in a Part of Garhwal Himalaya

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Every patch on the earth has a distinct diversity of plants that profoundly influence the culture and civilization of man. It supports not merely the existence of mankind but also an intimate relationship that the man has developed through ages. It is very fascinating to learn this relationship in ethno-botanical perspective. Garhwal is one of the most bewitching segments of the Himalaya. It is enriched with a great range of phtytodiversity with a strong bearing on its unique cultural heritage. The present study was undertaken to learn the relationship of humans with plants resources in a part of Garhwal Himalaya with the objectives to identify and make an inventory of

non-food plants and to learn the traditional knowledge about uses of these plants.

The study was carried out in twelve villages, located in three Blocks in District Pauri Garhwal. The villages lie in the mountainous region of the Shivalic tract that consists of chain of narrow and low mountain ranges of about 750-1200m running almost parallel to the main Himalalayas. The study is based on data from primary as well as secondary sources. During field surveys data was collected in a structured questionnaire using tools like observation, interviews, discussions and field visits with the elderly villagers. The plants indicated and identified by the villagers were identified botanically with the help of standard literature. In Garhwali tradition a large number of plant species are used. A partial list has been prepared by the common name, local names, scientific names and family together with the methods of how they are traditionally used.

Key words: Phytodiversity, Ethnobotany, Non-food plants, Garhwal, Traditional knowledge

SVII/P-13

Eco-Morphological Studies of Some Indian Pteridophytes

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In the present study, pteridophytes of different areas of India have been studied in great details. Numerous morphological features like stomata, hairs, scales, venation patterns, sporangia and spores have been subjected into great details for the first time.

Pteridophytes generally grow in moist places rich in humus and other organic substances or along the water streams. At the same time some are hardy surviving under the most adverse conditions for growth. Their first traces were recognized in the form of first land plants or early vascular plants in Silurian period of Paleozoic era. They flourished during Devonian, Mississipian and Pennsylvanion period of the late Paleozoic. These first legitimate and rightful owners of land,for a time, increased in number and spread over vast areas, though they could not meet well growing challenges. Therefore several species got perished for want of adaptability, some lingered on and some survived in more congenial and hospitable places. These are the living pteridophytes, remnants of once flourishing group of plants. Author has collected nearly 35 species of pteridophytes from different localities of India.

Osmunda regalis, Pteris quadriaurita , Pteris vittata, Pteris cretica, Pteris biaurita, Cheilanthes farrinosa, Cheilanthes tenuifolia, Adiantum venustum, Adiantum caudatum, Adiantum philippense, Adiantum capillus-veneris, Adiantum trapeziforme, Cyathea gigantea, Cyathea spinulosa, Pteridium aquilinum, Lindsaea cultrata, Athyrium macrocarpum, Hypodematium crenatum, Oleandra wallichii, Nephrolepis cordifolia, Asplenium alternans, Asplenium tenuifolium, Christella cyllindrothrix, Christella dentata, Christella malabarensis, Christella mollisculua, Christella subpubescens, Blechnum orientale, Woodwardia radicans, Dicranopteris linearis, Gleichenia longissima, Pyrrosia flocculosa, Arthromeris wallichiana, Marsilea minuta, Polypodium vulgare.

The various pteridophytes have been classified on the basis of habit and habitat,leaves, rhizomes, trichomes, sporangia, spores, epidermal and cuticular structures like stomata etc. stomata is also very important and characterstic feature often helpful in taxonomic determination. A detail study of venation pattern, epidermal features of pinnae and petiole, spore morphology, economic importance and ecology have been studied in great details.

Key words: Pteridophytes, Eco-morphologic

SVII/P-14

Bioprospection of Three North-Eastern Foliose Lichen

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Lichens are symbiotic association between a photobiont (algae) and a mycobiont (fungi) and the most significant indicators of environment. They are addresses as pollution indicator. About 900 secondary metabolites are present in lichens which have various industrial and medicinal values. North-Eastern part of

India exhibits enormous lichen diversity. Three different foliose lichen, *Sticta nylendriana Zahlbr*, *Acrosyphus sphaerophoides* Lev. and *Dirinaria* sp. were selected for their bioprospection such as antioxidant, antimicrobial properties. *In-vitro* antioxidant and reactive oxygen species (ROS) scavenging activities were estimated using 70% methanolic extract of the tree lichens. The percentage of scavenging DPPH radical by *Sticta nylendriana Zahlbr* was found 71.31% in respect to standard ascorbic acid (87.23 %) at 100 µg/ml concentration. Scavenging value of DPPH by *Acrosyphus sphaerophoides* Lev. was 76.51% where it was 65% for *Dirinaria* sp. Antimicrobial activity was performed with 70% methanolic extract of the lichens against a gram positive bacterial strain *Staphylococcus aureus*,. and a gram negative bacterial strain *Escherichia coli*. *Acrosyphus sphaerophoides* and *Dirinaria* sp. showed a good result with a clear inhibition zone of 1.2 cm and 1.3 cm in diameter respectively against the gram positive bacteria *Staphylococcus aureus*. In short results indicate that lichen species have significant ROS scavenging activity and can be natural sources of antioxidants in addition to as protective drugs against cancer.

Key words: Symbiotic assosiation, Pollution indicator, Bioprospection, Foliose lichen, North-East India

SVII/P-15

Evaluation of Diverse Plant Materials in Sodic Soil Environment

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Sustainability of agriculture is a major concern not only in India but also throughout the world. Sodic land is sporadically distributed throughout the Indo-Gangetic plains of the country. The cause of formation of these type of soils are both anthropogenic and natural. Sodic soils are recognized by no significant vegetation cover caused due to heavy and compact soil structure followed by seasonal water logging. These conditions generate some secondary constraints to plant growth by disturbing the ionic equilibrium of the soils through high pH and low EC. There is immense need to put these lands into use, otherwise continued declining soil quality or health can lead to permanent loss of prime agricultural land.

The research conducted at Banthara Research Station of CSIR-National Botanical Research Institute, Lucknow has vividly demonstrated reclamation of alkali soils through biological means. At the establishment, it was a landscape of completely barren sodic land bereft of any vegetation, except sparse growth of sodic tolerant grasses and some plants. Dedicated efforts were made to rehabilitate these inhospitable soils planted with tolerant trees/ crops. During the process of reclamation and sustainable use, several exotic and indigenous species were planted and evaluated. Species like *Prosopis juliflora, Acacia nilotica, Leucena leucocephala, Casuarina glauca* have shown good establishment and productivity. Other species such as *Terminalia arjuna, Acacia auriculiformis, Eucalyptus, Dalbergia sissoo, Pongamia pinnata* and *Albizzia procera* showed moderate performance. Non-traditional crops like Amaranths, several medicinal and aromatic crops like Chamomile, Vetiver, Lemongrass, *Asparagus*, *Mucuna*, *Desmodium*, Damask rose and floricultural crops like marigold and tuberose were successfully grown in partially reclaimed sodic soils. Recently, turmeric (*Curcuma longa*) was also introduced to such type of soil and evaluated for oil, yield and quality under various growing conditions. It was found that oil percentage in leaf and rhizomes are more in plants grown in sodic soil with high total phenolic and curcumonids content.

Key words: Sodic soil, Sustainability, Reclamation, *Curcuma longa* L.

SVII/P-16

Preliminary Studies on the Role of Microhabitats in Influencing Lichen Diversity: A Case Study from Semi-Arid Shrubby Forest of Rajasthan, North India

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In the present study, we aim to highlight the role of microhabitats in influencing the lichen diversity in

a semi-arid shrubby forest of Kota district, Rajasthan. The study area (25° 03' 32.78'' N 75° 43' 24.65'' E; elevation: 418m) comprises of two sites: open semi-arid shrubby forest and a deep gorge in the same area. *Prosopis julifera* and *Ziziphus mauritiana* form the major vegetation of open semi-arid shrubby forest. Only dark colored *Peltula euploca*, and *P. placodizans*, were the two lichen species showing dominance in this area. On the other hand, a fairly good diversity of lichens was observed in and around gorge. Gorge has small seasonal waterfall which allow rainy water to flow in a small pond downstream in monsoon. The availability of water round the year in the pond and shade from overhanging rocks and tree canopies have created relatively humid microclimatic conditions, which has supported rather good diversity of lichens. In addition to *Peltula* species, *Anema decipiens*, *Buellia alboatrior, Caloplaca cupulifera*, *C. pseudopoliotera*, *Lecanora indica*, *Pertusaria pertusa*, *Phylliscum indicum, Staurothele fissa* and *Verrucaria elaeomelaena* were the most common lichens growing abundantly in the gorge. The latter two lichen species were growing profusely on highly porous rock with numerous surface cavities containing water in them for a long period of time. Overall, the study area has a very dry climate with low humidity usually not suitable for lichen communities. But the gorge, with a seasonal waterfall, small water body and a semi-exposed environment has created a different microhabitat with in a dry region, which supports shade and moisture loving lichen taxa unable to colonize anywhere else in the region.

Key words: Microhabitat, Semi-Arid, Gorge, Microclimate, Canopy

SVII/P-17

A Recent Survey of Lichens in Nilgiris

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Nilgiris are the range of mountains placed in north-west of Tamil Nadu and constitute a small part of Nilgiri Biosphere Reserve (NBR). Owing to its placement in Western Ghats, the tropical rain forests of Nilgiri Hills maintain high diversity of plant groups and cover extremities of habitat. The luxuriant lichen diversity and species richness of Nilgiri forest can be assumed by more than fifty type localities of different lichen taxa described as new to science from the hills.

In a recent revisit to the type localities, many lichen species that were available for study in the past collections were not traced due to deforestation of exclusive tree species. The selective removal of phorophytes resulted in scanty appearance of species that were commonly observed in the past. A continuous trend of species repetition was also observed due to unavailability of tree diversity. Indeed, in the present time natural biota seems to be restricted to protected forests, and many lichen species that were previously easily available have now been shifted to managed forests. Nevertheless, home gardens of local people still conserve many of the crustose species of lichen genera *Graphis*, *Caloplaca*, *Arthonia*, *Opegrapha*, *Bacidia*, *Lecanora* and *Diorygma* on cultivated tree trunks of *Areca catechu* and *Artocarpus heterophyllus*. The *Eucalyptus* trees at the base of trunk and exfoliated bark in wet and moist places exhibit luxuriant growth of lichen species belonging to the genera such as *Heterodermia*, *Coccocarpia*, *Everniastrum*, *Ramalina*, and *Parmotrema*. Lichen genera *Chrysothrix*, *Hypotrachyna* and *Physcia* were readily available on *Pinus* trunk, whereas, *Cladonia* and *Diploschistes* were distributed on ground or on soil covering base of trees. The high altitude, dense and protected forests provided habitat for large patches of *Sticta* and *Pseudocyphellaria* growing in association with *Leptogium*, *Collema*, *Usnea* and members of *Pannariaceae*.

In randomly selected localities for lichen survey, only Reserve Forests and *Eucalyptus* tree patches showed significant lichen diversity, while other localities were found more or less under influence of natural or man-made disturbances. The most important emerging cause responsible for thinning out of forests is the expansion of existing tea gardens for commercial purposes. To protect the natural biota of the hills many government schemes and conservational strategies are planned and implemented. NBR itself is classified into different zones to limit human interferences with sustainable exploitation of resources. Due to continuous use of land for grazing, timber fuel wood and forest product, the Nilgiris are in a process of gradual degradation, and subsequent change in lichen diversity of the area indicates variation in micro-

climatic conditions, which consequently can create an alarming situation in the nearer future.

Key words: Conservational strategies, Diversity, *Eucalyptus*, Lichen, Nilgiri Biosphere Reserve, Western Ghats

SVII/P-18

DNA Barcode: A New Tool for Identifying Cetrarioid Cryptic Lichen Species in India

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DNA sequence data base generated from expertly identified specimens can provide an effective and correct species on the basis of barcoding studies. The correct identification of any lichen species is important for numerous reasons. However, it is not always simple or even possible based on morphology alone. Thus, use of DNA barcode is a more advanced molecular technique which supplements to the morphological data for authentication of taxa. The use of DNA barcode technique in the field of lichenology is recently employed in India for studies of cetrarioid lichens. Cetrarioid lichens are among the most common macrolichens in India and characterized by an erect foliose or subfruticose growth form of the thallus being loosely attached to the substrate and exhibit, presence of marginal apothecia and pycnidia. A total of 149 species and 25 genera of the group are reported from the world, out of which 45 species belongs to 11 genera are known from India. *Cetreliopsis hypotrachyna* (Müll. Arg.) Randlane and Saag, *Nephromopsis isidioidea* (Räsänen) Randlane and Saag, *Parmelaria subthomsonii* D.D. Awasthi and *Nephromopsis sikkimensis* (Divakar and Upreti) Randlane and Saag are endemic to India.

The DNA sequences of cetrarioid lichen genus *Cetrelia, Cetraria, Nephromopsis, Allocetraria Flavocetraria* and other genus of species are known from Germany, Canada, Finland, Italy, Russia, China, Sweden and Austria, however, such sequence for Indian cetrarioid lichens are not available and different species were segregate based on morphological and chemical characters. Thus there is a great need for DNA sequence of these taxa from India. The authentic species identification may have important implication on bio-monitioring, pharmaceutical researches and climate change. The identify accurate species with the help of barcoding provides a better system of classification of cetrarioid cryptic species that will consequently expose new and attractive discoveries in Indian lichen flora.

Key words: DNA barcoding, Biodiversity, Cetrarioid lichens, India

SVII/P-19

Altitudinal Variation in the Vegetative and Reproductive Behaviour of *Caltha palustris* L.: A Plant with Anti-Cancerous Property

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Caltha palustris L., commonly known as Marsh Marigold, belongs to the family Ranunculaceae. It is distributed in temperate and alpine regions but restricted to the sunny sides of aquatic, semi-aquatic, marshy and damp places. Present study was carried out on the vegetative and reproductive performances of *Caltha palustris* growing in varying altitudes i.e. at 3490 m. on the flat ground in the shallow stream, at 3434 m. in the mountain slope on the edge of stream and at 3398 m. in the valley on the edge of stream of Har Ki Doon Valley (Govind Wildlife sanctuary Uttarakhand, India). *Caltha palustris* revealed a very short flowering, fruiting and seed set life cycle, which started after snow melt i.e. May onward and ends up to September. The plant preformed flower primordia over long winter inside the snow (October-May), which shoots up early after snow melt. The average plant height at different stages of life cycle i.e. vegetative to flowering was decreased with increase of elevation along with delayed reproductive phenology. The population was good at mid and lower elevation but became scattered with few individuals at the higher elevation. Since, at higher elevation plant had to face severe constraints like shorter growing season, lower temperature and longer persistence of snow, its reproduction including establishment and colonization might be affected adversely. Though, average number of flowering units/branch (1.79±0.713) was lowest at higher altitudes, average number of stamen (77.90±13.127) and ovule (19.80±1.398)/flower were comparatively high. Total nectar production ranged 0.2 µl-6.9 µl /flower only up to first three days of total life span (5-7 days) of flower at higher elevation. Nectar was absent at lower

and mid elevations. However, average flower size and maximum visits of dominant pollen vectors identified as 'Syrphid flies', were not influenced by the altitudinal gradients. Though, plant morphology and population size were good in mid and lower elevations, reproductive success was equally hampered up to 86% by the post fertilization ovule abortion at all the elevations, might be due to environmental severity during seed development.

Key words: *Caltha palustris*, Vegetative and reproductive performance, Altitudinal variation, Ovule abortion, Syrphid flies

SVII/P-20

Fruit and Seed Analysis of *Mallotus Philippensis* Growing in Different Forest Types of Katerniaghat Wildlife Sanctuary

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Mallotus philippensis (Lam.) M. Arg. (Euphorbiaceae), commonly known as 'Kamala' or 'Rohini', is a dioecious perennial shrub or small tree of tropical and sub-tropical region. It is a dye yielding, oil yielding and medicinally important plant. Present study deals with the fruit and seed characteristics including seed quality and viability of *M. philippensis* growing in three different forest types i.e. Sal forest, Teak plantation and Miscellaneous dry forest of Katerniaghat Wildlife Sanctuary (Behraich, Uttar Pradesh). In Sal forest and Teak plantation, dominant plant species were Sal and Teak respectively along with small herbs, shrubs and climbers while in Miscellaneous dry forest, many plant species were associated to *M. philippensis* common to them were *Tectona grandis*, *Shorea robusta*, *Dalbergia sissoo*, *Ficus* spp., *Syzygium cumini*, *Murraya paniculata*, *Terminalia alata*.. The study revealed, though in the Miscellaneous dry forest *M. philippensis* was in its high density and vigorous growth, the average value of fruit and seed weight (0.349g/0.032g), fruit and seed size (7.78mm x 9.75mm/ 4.84mm x 3.99 mm) and fresh seed viability (92%) was comparatively high in Sal forest. Amongst the three forest communities, very thin population of sparsely distributed individuals of *M. philippensis* with poor reproductive output was recorded from Teak plantation. Seed viability from different forest communities was gradually decreased up to 28% within 60 days and completely lost (0%) within four months of storage period. A random analysis of seed quality revealed 44% to 48% seed sterility due to high empty seeds in fresh seed samples but increased up to 84% after four months of storage due to increased number of shriveled embryo and endosperm. Since, climate of the forest communities characterized by warm to hot summers, cool to frosty winters and normal rains to floods in rainy season, the reproductive behavior of *M. philippensis* relatively more prone to extremes and responsible for poor output accordingly.

Key words: *Mallotus philippensis*, Sal forest, Teak plantation, Miscellaneous dry forest, Seed viability, Seed sterility

SVII/P-21

Genus *Thalictrum* L. (Ranunculaceae) in India: Status and Complexes

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Genus *Thalictrum* L. belonging to the family Ranunculaceae, comprising of 190 species, distributed worldwide in sub-temperate to alpine slopes of the mountains in both the hemispheres. In India, the genus is represented by 21 species, scattered in all possible habitats from rocky to moist slopes of the Himalayan regions of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh to the dense forests of Maharashtra, Karnataka, Kerala and Tamil Nadu. *T. punduanum* var. *glandulosum* Hook. f. and Thomson is endemic to Meghalaya while several other species such as *T. obovatum* Blatter is endemic to Maharashtra and *T. dalzellii* Hook. to Western Ghats. Commonly known as 'meadow rues', *Thalictrum* is a perennial woodland herb and has been extensively studied for its medicinal value. This genus is rather controversial in terms of its taxonomical status having many taxonomic disarrangements which lead to different inter and infra-specific complexes, like polymorphism in *T. minus* L., *T. punduanum* Wall., *T. javanicum* Blume and *T. alpinum* L. complexes. Numerous species and varieties are poorly defined owing to insufficient field studies and because highly

variable characters have been used as diagnostic features in the earlier literature. Due to the voluminous and complicated synonymy and lack of stability in nomenclature within the genus, there is a great challenge in understanding the inter-linkages among the taxa. Therefore, it is important to solve out the complexes at every level of taxonomy. Further, several species are rare, endemic and threatened which need to be conserved by using suitable modern techniques.

Key words: Ranunculaceae**,** Meadow rues, Endimic species

SVII/P-22

Biodiversity Status of Ants in an Ecosystem

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Ants are social insects of the family Formicidae and, along with the related wasps and bees, belong to the order Hymenoptera. Ants always live in colonies that may occupy large territories and consist of millions of individuals. Ant colonies, and more generally social insect societies, are distributed systems that, in spite of the simplicity of their individuals, present a highly structured social organization. As a result of this organization, ant colonies can accomplish complex tasks that in some cases far exceed the individual capabilities of a single ant. There are quite a number of different types of ants, but some of the more well-known ones that you might have heard of or come across are driver ants, army ants, honey pot ants, leafcutter ants, silver ants, fire ants, weaver ants, and bulldog ants. There are types of ants within each colony, meaning groups of ants that have a specific job to do in the hierarchy. Those are worker ants and soldier ants. All of them are led by one single ant that is the queen. Although many types of ants will seem to act the same, their behavior actually depends on their type. For example, army ants and driver ants do not have permanent nests like many other types of ants. The size of different types of ants can vary a great deal as well, ranging anywhere between 2 and 25 millimeters. Most of the time we associate ants as being brown, but there are also many red and black ants as well. The most common introduced ant is the white-footed house ant (*Technomyrmex albipes*). The Argentine ant (*Linepithema humile*) is one of the world's 100 most invasive species. Black carpenter ant (*Camponotus pennsylvanicus*), Thief ant (*Solenopsis molesta),* fire Ant (*Solenopsis invicta*), Harvester ant ***(****Pogonomyrmex badius*)**,** Slave making Ant (*Polyergus lucidus*), Leafcutter ant (*Atta colombica*), Black Garden Ant (*Lasius niger*) are diverse group of ant species present in an ecosystem.

Key words: Ants, Biodiversity, Ecosystem, Social insect, Ant society

SVII/P-23

Phytosociology and Quadrate Study of *Isoetes coromandelina* L. in India

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The plants of genus *Isoetes* have been collected from the twelve populations of *I.coromandelina*, e.g. Matkuli, Renikheda, Renikheda village, Sitadongari, Sitadongari road side, Aritoria, Parasia, Banjariguri, Banjarimata, Jhirpa from Pachmarhi, Madhya Pradesh and Mirzapur, Manikpur from Uttar Pradesh have been investigated to determine the frequency of plants per quadrate in natural habitats. The detail investigation of ecological parameters of environment like temperature, p4", light intensity atmospheric pressure altitude latitude, longitude and humidity are recorded at spots. The quadrate analysis and prolonged observation of plants in natural habitats have revealed considerable variation in size, length of plants and number of leaves etc. Relative frequency and important value index are dependent on environmental conditions.

The maximum numbers of plants were found at Delakhari Pachmarhi (180- 200 in number of plants per quadrate) and the minimum Sitadongari Road Side (6-15 in number of plants per quadrate) has been studied. Rest of these localities exhibits comparatively less frequency moderate in quadrates.

Thus, the study of habitats of *I.coromandelina* shows that plants of *I.coromandelina* having phyto-sociological behavior with family members of Cyperaceae, Poaceae and Fabaceae. It may be due to different environmental conditions, water, light intensity, temperature, humidity, soil profile, altitude, and latitude and depth of ditch.

Key words: *Isoetes coromandelina,* Phyto-sociology, Ecological parameters, Frequency, Quadrates

SVII/P-24

Ex-situ Conservation of *Commiphora wightii*: A Threatened Medicinal Plant Species

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Commiphora wightii (Arnott) Bhandari (Burseraceae) is a threatened, slow growing shrub (locally known as guggul) that grows in arid, rocky tracts of the Aravalli range of Rajasthan and Gugarat states of India. The oleo-gum resin of *C. wightii*, is used to treat bone fractures, arthritis, inflammation, obesity, cardiovascular disease, and lipid disorders. Overexploitation, slow-growth and associated poor seed germination rate has led to this plant becoming an endangered species. This plant is incorporated in Data Deficient category of IUCN's Red Data list. Therefore, in this present study, community based efforts, under the theme 'Save Guggul Movement' were carried out to mobilize and raise awareness amongst local rural and tribal people of the Aravali hills about the its importance and conservation. A number of activities have been identified and conducted through the close co-operation of the village level communities who lives around the Aravali Hills of Rajasthan state. Community-groups are also prepared of different age, to disseminate conservation massage.

Save Guggal Movement received encouraging response and strong support from the local communities. The local rural and tribal communities are now conscious about the importance and conservation of guggul plants. The results clear indicate that biodiversity conservation at grass-root level cannot be achieved without the participation of local communities.

Key words: *Commiphora wightii,* Burseraceae, Oleo-gum resin, Community-based conservation, Save Guggal Movement

SVII/P-25

Macrophytes in Wetland Area of Saharsa District

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A large number of macrophytes luxuriantly growing in wet land area of Saharsa district, Bihar are utilize by local people for food, fodder, medicine, fish food, duck feed, fuel, worship and other purposes some of them such a Euryale ferox is one of the most important cash crop of this area. Saharsa district is located at 25.880 N 86.60 E with an elevation of 41m. The district consists of two subdivision and 10 blocks. Most part of the district fall under embankment of Kosi River. Villages under Kosi embankment have several water reservoirs in which water of Kosi River remain logged throughout the year. These water reservoirs are locally as "Chours". A large number of macrophytes such as Eichornea, Pistia, Trapa Typha, Polygonum, lotus, Hydrilla, Ceratophyllum etc grow luxuriantly in these chours and surrounding wet land.Some chours and manmade ponds are utilized for the cultivation of Euryole frox which is the most important cash crop of this area. Other macrophytes are also potential sources due to their high productivity and easy availability for utilization as food, Fooder medicine, fish food, basketry and mat materials. There is no any documentary information regarding the utilization of macrophytes of this area. Hence an investigation has been made to explore their utility and economy in the life of people inhabiting in this area.

Survey was conducted in remote villages of the district within Kosi embankment at regular intervals. Macrophytes from different Chours and ponds were collected and brought to Laboratory. Plants were identified with the help of standard flora (Taxonomy of Bihar and Orissa-Hains H.H) Information regarding local name of plants and their uses were gathered from local people. 16 Microphysics growing profusely in different water reservoirs are utilized by poor local people particularly belonging to caste Gorhi (fisherman) these people flowers of lutus and coca and sell them near temples where devotees come to worship god. Trapa fruits collected from different chours are sealed in different markets and Hatias of local villages. In the villages Akadh and Bhakua-mat is prepared from Typha and sold in Hatias of different villages. Mohanpur, Chandrayan, Nauhatta, Muradpur are the most important villages where Euryle ferox is cultivated in large scale and supplied to Kolkata and other places.

Key words: Macrophyte, Wetland, Euryale

SVII/P-26

Bioprospection of *Tinospora cordifolia*: Evaluation using Pharmacognosy, Phytochemistry and Biomarker Approach

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Tinospora cordifolia (Thunb.) Miers, Menispermaceae, is a dioecious creeper, commonly known as "Giloe" or "Guduchi" with significant medicinal importance in the traditional systems of medicine. This plant has been known to possess immunomodulatory, hypoglycaemic, antioxidant, anti-hyperglycaemic, antiallergic, anti-inflammatory, hypogycemia and several other properties also. The plant mainly contains alkaloids, glycosides, steroids, diterpenoid lactones, sesquiterpenoid, aliphatic compound and other miscellaneous compound. The quality assessment of source material of herbal medicine may directly proportional to its efficacy. Different vegetative parts viz. leaf, stem, aerial root were collected and studied for pharmacognosy and phytochemical studies. Microscopically leaf of *T. cordifolia* showed presence of anomocytic stomata, unicellular trichomes. Stem showed wheel shaped appearance at the transverse cut surface, a peculiar characteristic feature of the family Menispermaceae. Stem and aerial root exhibit abundant mucilage canals, dense ceratenchyma and characteristics wedge shaped medullary rays. Phytochemical screening analysis of the extracts revealed presence of tannins, phenolics, flavonoids, alkaloids, terpenes and steroids in most parts. The whole plant is used medicinally however; the stem is approved for use in medicine. The study on stem samples collected in different seasons revealed that total phenolics and total sugar concentration obtained highest values in summer season while starch and tannin content were found maximum in winter season. However biomarkers tinosporaside and berberine, reached to their highest concentration in monsoon season. Further, antioxidant potential revealed the highest inhibition percentage in winter season as well as in late summer season. The qualitative and quantitative variations in the bioactive markers among different seasons of *T. cordifolia* suggest the particular season for harvesting source material for getting the desired pharmacological activities.

Key words: *T. cordifolia*, Microscopy, Pharmacognosy, Tinosporaside, Berberine, Seasonal variation

SVII/P-27

A Study on Interaction of Two Coexisting Invasive Species, *Mikania micrantha* H.B.K. and *Alternanthera philoxeroides* (Mart.) Griseb.

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Invasive plant species are considered a major threat to ecosystems because of their aggressiveness in their non-native range. In this context, interactions between native and invasive plants have been intensively studied, but interactions between co-occurring invasive species have received less attention. Because of the pervasiveness of invasive species, potential interaction among invasive species has become an important issue in many plant communities. An attempt has, therefore, been made to study the interaction between two invasive plants, *Mikania micrantha* (mile-a-minute) and *Alternanthera philoxeroides* (alligator-weed), which are commonly found to co-occur in this region. The two plant species were grown in the greenhouse as monocultures for each species as well as grown together as mixed-cultures, at constant density. The experiment was terminated at the end of one month when plant biomass was recorded. The results showed that mean above ground biomass (dry weight basis) was maximum in case of *A. philoxeroides* when grown in monocultures and dropped from 25% to 20% when grown together with *M. micrantha*. However, there was a slight increase in above ground biomass (dry weight basis) from 14.7% in *M. micrantha* monocultures compared to 17.6% in *M. micrantha* mixed cultures. It was interesting to note that the number of lateral branches (emergence of new shoots from the base) were significantly higher in *A. philoxeroides* monocultures compared to that observed in *A. philoxeroides* mixed

cultures. This higher regenerative ability of plants growing in the absence of any competition probably contributed to the greater above ground biomass reported earlier for *A. philoxeroides* monocultures. The regenerative capacity of *M. micrantha* were comparatively much lower, with no major difference between the plants growing under mixed and monocultures, thereby indicating that *M. micrantha* was probably unaffected by the presence of *A. philoxeroides* and was a better competitor among the two invasive plants. Further studies are needed to gain more insight into the fascinating world of plant interactions.

Key words: Invasive plants, Interaction, Lateral branches, Regenerative abilities

SVII/P-28

Genetic Diversity and Association of Fe and Zn Concentration in Chickpea (*Cicer arietinum* L.) Genotypes

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Chickpea (*Cicer arietinum* L.), is the second most important pulse crop after common bean. It is widely used staple diet of millions of people, especially in the developing countries. Chickpea seeds has an average of 3.0-14.3 mg of iron, 2.2-20 mg of zinc in addition to the other micronutrients (Marwan et al., 2014). Breeding programmes mainly focus on high yield, stress and disease resistant features. Major attention needs to be focused on screening of germplasm vis-à-vis micronutrient concentrations and reducing antinutritional contents. Elite germplasm selection and their enhancements are one of the ways to tag the genotype of agronomic importance for planning future breeding strategies.

PCR based molecular markers are the reliable methods to tap the polymorphisms in the species like *Cicer*. The banding pattern as generated by RAPD and ISSR markers are one of the established techniques and may provide practical information regarding genetic makeup of the germplasm. Genetic diversity and association mapping of Fe and Zn are underway at various research institutes. In the present investigation, a total of 60 genotypes collected from Indian Institute of Pulses Research (IIPR), Kanpur for contrasting pair of characteristics were evaluated for Zn and Fe using Atomic Absorption Spectroscopy (Perkin Elmer). The results indicate that there is substantial variability in these chickpea genotypes. Furthermore, higher variants of these stocks were assessed for genetic polymorphisms using RAPD and ISSR markers to study their association if any, for micronutrients.

Key words: Chickpea, RAPD, ISSR, Micronutrients, Genetic diversity

SVII/P-29

Exploration of Phytochemicals from Botanical Garden Plants for Sustainable Utilization and Conservation

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In the times of deforestation, urbanization, advent of synthetics and substandard/unstandardized produce and products, the role of having botanical gardens and revival of plant based products is important for human health and well being. Further, undertaking studies on the phytochemicals of the plants that is effected by and affecting the environment for climate change becomes the current time challenge. The present work highlights some leads on exploring the plants that are and can easily be grown in botanical gardens; that itself or their produce have immense potential as/ for ornamentals, medicinal and economic purposes and could be a potential for environmental and economic change. The physicochemical estimations, extraction and isolation of such useful phytochemicals viz. dyes/ colours, gums, oils; medicinal and economically important secondary metabolites was carried out along with their evaluations for formulation prospects. Their role to increase/ decrease the absorption or reflect the light, change in oxidative level, humidity and temperature becomes important. Studies are done through simple methods and high end techniques to establish standards. These phytochemicals are eco-friendly, biodegradable and safe that can not only be

used in foods, pharmaceuticals, cosmetics and other commodities of economic interest but it may also have a significant role in bioremediation, moisture retainment and reclamation of the soil through their specific chemistry and unique physicochemical, functional properties which can be enhanced to manifold properties on interactions and value additions. Studies further scopes for sustainable utilizations and plant/plant produce/product production, environmental protection, and conservation.

Key words: Botanical gardens, Conservation, Eco-friendly, Phytochemicals, Sustainable utilization

SVII/P-30

Biochemical Estimation of Glycogen Levels in the Haemocytes of Freshwater Crab *Barytelphusa cunicularis*

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The haemocytes found in the blood of crustaceans are the main mediators of host defense against infections in crustaceans . Glucose is the principal monosaccharides present in the haemolymph of crustaceans .Glucose is stored in the form of glycogen .The stored glycogen is utilized in moulting ,adaptation to hypoxia and /or anoxia, osmoregulation and during fasting periods .The variation in glucose in the haemolympatic glucose seem to be related to the reproductive period of the species ,food availability and degree of environmental exploration .these factors led to different metabolic adjustment in distinct species of crustaceans. In this study the biochemical glycogen analysis was estimated in the haemocytes of both male and female freshwater crabs *Barytelphusa cunicularis*. The results showed that the average carbohydrate per cells in females is significantly more than that of males (PÂ 0.5).

Key words: Fresh water crab, Glucose, Haemocytes

SVII/P-31

The Hidden Diversity of Medicinal Plants in Western Madhya Pradesh, India: Diagnosis and Prospects for conservation

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The Plant diversity of western Madhya Pradesh is reducing at the fast rate due to anthropogenic disturbances and environmental degradation. Disturbance is a major factor responsible for fragmentation of forest vegetation; as a result there is a preponderance of small patches, some of them are still preserved as sacred groves because of strong religious beliefs held by the indigenous people of Jhabua district of western Madhya Pradesh. Dungari mata sacred grove is situated near Katthiwada village in Jhabua district of western Madhya Pradesh that considered being residence of local deities. The *Bhil* and *Bhilala* are the most dominant tribe of the study area and depends upon the forest resources for their livelihood. About 339 species, 286 genera and 82 families were found in the grove. Fabaceae (38 species), Poaceae (33 species) and Asteraceae (20 species) were dominant families and the *Ipomoea* was the largest genus, with 5 species. About 69 tree species, 25 shrubs, 157 herbs, 40 grasses, 3 epiphytes and 45 climbers and lianas were found in the groves. Some threatened plant species are growing over here that are not found elsewhere and they comes under various threat categories. About threatened taxa, 81 species were recorded from the grove that comes under various threat categories. The present status of the grove is of concern, as it is gradually declining under constant anthropogenic pressure. Their better management and protection is important for the conservation of plant diversity in the region and also for the benefit of indigenous tribes of the state.

Key words: Biodiversity, conservation, Dungari Mata, Sacred grove, *Bhil*, *Bhilala*

SVII/P-32

VAM Fungal Biodiversity in Restoration of Natural Ecosystem

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The wide range of micro-organisms that live in soil play important roles in driving many of the key in terrestrial bio-geochemical cycles that underwrite

primary production., via the prerequisite of mineral nutrients to plants and their characteristics properties that they impact in nature. Arbuscular Mycorrhizal (AM) fungus demonstrate a symbiotic relationship with more than 150 species of all vascular plants occurring worldwide in almost all type soil, forming the dominant type of mycorrhiza. The fungi endorse efficient nutrient absorption and increase plant growth and yield. VAM interactions with the soil play an important role in controlling soil fertility, soil erosion and plant water stress. The universal distribution of plants with different types of mycorrhizal associations is used to establish correlations with the major climatic factors (water, temperature) which standardize the distribution of plants, as well as more localized edaphic conditions. The importance of VAM fungi to sustainable agriculture and the ecosystem has led to its commercial development.

Key words: Vesicular Arbuscular Mycorrhizal (VAM), Biodiversity, Ecosystem, Restoration, Symbiotic

SVII/P-33

An Ethnobotanical Survey of Surguja

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An ethno botanical survey was carried out in Surguja district, for documentation of the flora and identification of various plants used for food by rural and tribal communities. Surguja district lies on the northern part of Chhattisgarh, and a greater part of the population consists of tribal communities, most of whom fulfill food and other needs from natural/ forest produces. They have a rich knowledge of plants which they use for livelihood and medicinal purposes.

People gather these plants and plant parts from forests, uncultivated fields, and other natural habitats, whereby the biodiversity is always facing the threat of overexploitation. The paper presents some plants which have been identified to be of high nutritive value and are also medicinal and therefore can serve as alternate sources of nutrition for mankind. Promoting their cultivation can help to diversify our food productive capacity, and help to reduce genetic erosion by overexploitation.

Key words: Wild plants, Food, Overexploitation, Genetic erosion

SVII/P-34

Algal Diversity in Morinda Lake at Govind Wild Life Sanctuary, Uttarkashi District, Uttarakhand, India

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Govind wild life sanctuary is situated at a remote area in the district Uttarkashi, Uttarakhand, India, covering an area of 953 sq km. and the altitude varies from 1300 mts to 6323 mts. It is also known as Govind Pashu Vihar. It is located in the greater part of the Tons river. Temperature is ranges from 25°C to 50°C and it receives a maximum of 100-1500 mm of rainfall. Morinda lake is located at 4388m and the surrounding area covered with snow. High altitude lakes characterized by low temperature, generally low buffering capacity and low level of nutrients act as reference system for global climate change. (Psenner 2002; Catalan et al., 2006). Due to the extreme environmental conditions, the biodiversity of this lake is scanty.

A total of 10 algal samples were collected from the four different sites of Morinda lake. A total of 22 algal taxa were reported for the first time from the Morinda lake which belongs to three different classes Cyanophyceae, Chlorophyceae and Bacillariophyceae. Chlorophyceae with 5 genera namely *Ulothrix, Chlorella*, *Nannochloropsis*, *Mougeotia* and *Zygnema,* Cyanophyceae with 7 genera namely *Synechocystis*, *Stichococcus*, *Oscillatoria, Phormidium*, *Nostoc*, *Anabaena, Nodularia* and *Gloeocapsa* and 3 genera namely *Navicula, Nitzschia* and *Fragillaria* belonging to Bacillariophyceae were reported in this paper.

The more intriguing is the morphological variation in *Nostoc* spp. *Anabaena* spp. and *Cosmarium* spp. and the variation in pigmentation of algal species. High altitude lakes have received little attention so far in terms of their biodiversity, conservation but they are becoming increasingly important due to the possible consequences of the global climate change (Bhat et al. 2011). The wide morphological diversity of algal population and their pigmentation under some ecological and environmental conditions needs further investigation.

Key words: Algal diversity, Morinda Lake, Govind Wild Life Sanctuary

SVII/P-35

Algal Diversity in Different Habitats from Munnar, Idukki District, Kerala, India

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Munnar is a hill station located in the Idukki district of the South Western Indian state of Kerala located between 10°10'N latitude and 77°04'E longitude and situated around 1600 m sea level in the Kannan Devan hills village of Devikulam Taluk, Western Ghats range of mountains. Most of the native flora of Munnar has disappeared due to severe habitat fragmentation resultant from the creation of the plantations. However, some species continue to survive and thrive in several protected areas. Collection of 25 algal samples was made from 11 habitats in Munnar. A total of 39 algal taxa which were belonging to 33 genera were reported from the present survey. Out of these Chlorophyceae with 16 genera, Cyanophyceae with 9 genera, Bacillariophyceae with 5 and Euglenophyceae with 3 genera were reported.

Algal diversity in various habitats was reported as follows: In Pericanal(15 Genera), Chinna Canal(14 Genera), Kundra Dam(10 Genera), rocks and pebbles(9 Genera), on soil(6 Genera), tea stem(4 Genera), small ditches(3 Genera) followed by submerge plants, Callar Waterfall(1 Genera) followed by tree bark, tea leaves and on coconut shell.

Among the green algae order Chlorococcalean members like *Scenedesmus, Chlorella, Crucigenia, Botryococcus, Coelastrum, Asterococcus* were most common form in waterfall and dam. Some Cyanophyceae like *Anabaena, Nostoc, Scytonema, Oscillatoria, Hapalosiphone Trentepohlia, Phormidium, Scytonema, Anabaena, Calothrix,* were very common form present in leaves, stems, barks and tree trunks and rocks. Desmids like *Cosmarium, Arthrodesmus, Staurastrum* and *Cylindrocystis* were reported from dam, waterfalls and streams. The wide morphological diversity of algal population under some ecological and environmental conditions needs further investigation for conservation of algal species. Algal diversity in different habitats in Munnar is described in detail with photographs in the present communication.

Key words: Algal diversity, Habitats, Munnar, Ecology and Conservation

SVII/P-36

Bird Communities of Semi-Arid Grasslands in the Great Indian Bustard Sanctuary, Maharashtra, India

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Density, distribution, composition and temporal changes in composition of bird communities were investigated in the Great Indian Bustard Sanctuary, which falls in the Deccan biogeographic zone. The study also examined the significance of protected grassland patches in conservation of avifauna of the Deccan plateau with special reference to conservation of Great Indian Bustard. The sanctuary encompasses mainly grassland, grazing land and plantation habitat types. Line transect method was used for sampling bird communities fortnightly in each habitat type. Eight bird guilds namely, granivores, granivore-insectivores, insectivores, raptors (birds of prey), frugivore-insectivores, omnivores, frugivore-granivores and nectarivores were recorded from the major habitat types of the Sanctuary. In summer, the highest density of insectivorous birds (190 individuals/ sq. km) was found in plantations whereas lowest (9 individuals/sq. km) in grassland. Density of raptors was maximum in plantations (4 ind/sq. km) and grazing land (2 ind/sq. km) and grassland (2 ind/sq. km). The nectarivore birds were found only in plantations. The granivores were higher in plantations (120 ind/sq. km) and grazing land (113 ind/sq. km) than grassland (70 ind/sq. km). In monsoon, the granivore-insectivore birds were found maximum (575 ind/sq. km) in grassland and minimum (102 ind/sq. km) in in plantations. Density of raptors was maximum (10 ind/sq. km) in grassland and minimum in grazing land (7 ind/sq. km) and plantations (2 ind/sq. km). In winter, the maximum (7) number of guild were recorded in plantations whereas minimum (4) in

grassland. Nectarivorous birds were found only in plantations. Density of granivore-insectivores was higher (128 ind/sq. km) in grassland than plantations (80 ind/sq. km). The birds of prey were more abundant in grassland (9 ind/sq. km) and grazing land (5 ind/sq. km) than plantations (4 ind/sq. km). The Great Indian Indian Bustard population has shown drastic decline during the last 10 years and nearly extirpated from the Sanctuary. The main reason for decline in bird populations such as the Great Indian Bustard is habitat fragmentation, over-grazing by livestock and habitat decay due to intensive use of pesticides in vineyards, which are surrounding the Sanctuary.

Key words: Bird density, Bird guilds, Grassland, Conservation, Great Indian Bustard

SVII/P-37

The Study of Ethonobotanical Documentation and Phytochemical Analysis of Few Medicinal Plants in Rajnandgaon District, Chhattisgarh, India

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The tribals of Chhattisgarh have developed vast knowledge of plants which they have acquired through their traditional practices since time immemorial. Use of certain plants for some particular purposes is restricted to some people only and normally they are quite reluctant to share their knowledge with any outsider. There is an urgent need of documentation of this irreplaceable knowledge. It may be lost when traditional cultures collapse with advent of modernization. The present studies aimed at documenting all Ethnobotanical Products data covering most important eco-sensitive zones of the state. The photographic documentation is more useful in identification of plant species in the field and it may also useful for conservation strategies. Generally, it was noted some rare traditionally useful plants knowledge and values which accounts for 49 plant species with 27 families. Most of the claims are found to be interesting to the indigenous system of Indian medicine. The present enumerations about medicinal plants of the area studied is not last the only account of medicinal plants but a treasure of folk lore uses of plants can be explored from these tribal areas. Considering previous studies and the present exploration indicate that such kind of ethno-medicobotanical studies may be highly useful to human race in fighting disease with cheap and best non-side effect remedies. Results will be discussed during presentation.

Key words: Medicinal, Plants, Ethonobotanical, Traditional

SVII/P-38

Plant Diversity, Benefits and Management Strategies at Meja Thermal Power Plant (MTPP) in Allahabad, Uttar Pradesh

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The present study was conducted in Allahabad during 2011-2012. The proposed site is located in Meja tehsil of Allahabad district, Uttar Pradesh about 45 km in the south-east of Allahabad city in Vindhyan region. Meja TPP is envisaged as a coal based thermal power project based on super critical technology. The exact geographical locations of the project site is between latitude $25^0$07' to $25^0$10'N and longitude $81^0$54' to $81^0$58'E and its elevation above MSL is 340 to 364 feet.

From this region total number of 150 species (24 trees, 19 shrubs, 107 herbs) belonging to 52 families were recorded within 10 km of thermal power project site. Among families, Asteraceae (14 species) Poaceae (12 species), Euphorbiaceae and Cyperaceae (11 species) each, Fabaceae (10 species), Acanthaceae (9 species) were most species diverse.

Scrophulariaceae and Mimosaceae are represented by 5 species. Amaranthaceae, Caesalpiniaceae and Lythraceae by 4 species. Rhamnaceae, Solanaceae, Convolvulaceae, Tiliaeae, Polygonaceae, Moraceae, Malvaceae and Lamiaceae by 3 species each. Four families have 2 species and the remaining 29 families were monospecific.

The project would partially meet the power shortage of Uttar Pradesh and other willing states of Northern Region, which is vital for economic growth as well as improving the quality of life. In addition, construction and operation of the project would benefit local people with respect to employment opportunity, Conservation of land resources, improvement in infrastructural facilities and improving the aesthetics

of the area. The Management Strategies were also recommended to reduce the likely potential impacts of the proposal on the terrestrial environment.

Key words : Project, Power shortage, Benefit, Management, Environment

SVII/P-39

Study of an Invasive Plant *Mikania micrantha* H.B.K. in an Urban Context: Its Spread Potential and Effect on Floral Diversity

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In context of plant invasion, the present study is concerned with one of the top 10 worst weeds of the world *Mikania micrantha* H.B.K. of the family Asteraceae. The presence of this plant in India has mainly been reported from forest or plantation areas where its invasion leads to considerable economic loss. In view of the recent concern regarding the spread of invasives into urban areas, this study was initiated in one of the rapidly expanding cities of India namely, Kolkata with two primary objectives: to assess the impacts of this plant on floral diversity as well as its potential for spread into new areas.

A field survey and quadrat based sampling method was initiated in 85 well distributed points in Kolkata to estimate *M. micrantha* cover percentage and number of associated native as well as non-native species. *M. micrantha* infestation was graded into four severity categories based on its cover percentage. More than half of the sampling points revealed *M. micrantha* presence and found significant negative impacts on floral biodiversity of this invasive plant in terms of species richness, Simpson's Diversity Index and Evenness Index. Soil samples were analyzed for physical and textural parameters to find the preferred soil type for this plant growth. Analysis of soil texture revealed sandy loam was the soil type where the plant would like to grow. Co-occurrence of multiple invasive species in a community was evident from this study and GLM analysis with a modified Poisson regression model highlighted the exclusive negative effect of *M. micrantha* on native plants after adjusting the facilitative effects of other invasives on native floral community.

For management options, one desirable and one undesirable hypothesis were formulated based on chance of finding at least 3 natives and no native species. The probability of finding of at least 3 native species was found to increase in presence of multiple invaders while the chance of complete native biodiversity loss was found to be maximum in presence of *M. micrantha* as single invader species. This study highlights the management options which can be devised based on the resident community structure.

Key words: Invasion, *Mikania micrantha*, Urban, Diversity, Soil, GLM

SVII/P-40

A Study on Cyanobacterial Isolates from Karimganj District Assam, North East, India

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A preliminary investigation for the distributional pattern of some cyanobacterial isolates from the rice fields around Son beel area of Karimganj district, Assam, North East India was carried out. The distributional pattern shows that a total of thirty four isolates belonging to nine genera were obtained. The genera *Nostoc, Calothrix, Anabaena* and *Cylindrospermum* were the most dominant rice field cyanobacteria in the district. The pigment profile was estimated and the highest was found in *Cylindrospermum* sp. and the least was recorded in the strain *Nostoc sp.* The present study highlights the promising cyanobacteria which are widely distributed in the rice field and significantly use for the high yield of rice cultivation in the district.

Key words: Cyanobacteria, Distribution, Karimganj District, Rice fields

SVII/P-41

Distribution, Diversity and Molecular Characterization of Indian Soap-Nut

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Soap-nuts (*Sapindus* L.) is an economically and taxonomically important genus belonging to the family Sapindaceae. Soap-nuts have long been used in indigenous systems of medicine and are commercially much valued for fruits. Soap nut is one of the oldest medicinal and industrial plants in the world. People have been using soapnut as natural laundry detergents from ancient times for washing fabrics, bathing and traditional medicines. In fact, some botanists trace it to the period of the Vedas, about 5000 years ago. The generic name of *Sapindus* is derived from the Latin words *saponis*, meaning "soap" and *indicus*, meaning "of India". The plants of soap nut are trees. Occasionally the trees of soap nut come up from the self-sown seeds and can also be raised artificially by direct sowings or transplanting the nursery raised seedlings. Cuttings and grafting are also a traditional method for its propagation. *Sapindus* is widely distributed in tropical and subtropical regions of the world; especially it is well represented in warm regions of Asia, Australia, North America and South America. Three species of the genus *Sapindus* (*S. emarginatus, S. mukorossi* and *S. trifoliatus*) are found in India. They are sparsely distributed in the tropical regions of different geographical provinces (Gangatic Plains, Western Ghats, Deccan Plateau, North-West and Eastern Himalaya) in deciduous and dry evergreen forests, occasionally along roadsides and near habitations. The species of the genus *Sapindus* also extend its distribution to neighboring countries like Pakistan, Myanmar and Sri Lanka. In the present investigation, we carried out the diversity and systematic analyses of the Indian species of the genus *Sapindus* using molecular markers. The study on genetic variability in different species of *Sapindus* provided important information on the available diversity and distribution of *Sapindus* in nature, and contributed to an overall understanding of the biology of *Sapindus* species found in India.

Key words: Genetic diversity, India, Population structure, Phylogeny, *Sapindus*

SVII/P-42

Indigenous Knowledge and Biodiversity of the Chitrakoot Forest Area (Uttar Pradesh) and its Conservation

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Plants with medicinal properties enjoyed the highest position in the indigenous system of medicines all over the world. All cultures from ancient times to the present day have used plants as a source of medicine. Today according to world health organization (WHO) as many as 80% fo the world population depend on traditional medicine for the treatment of various diseases.

Chitrakoot is a well known place for historical and religious importance of lord rama Chitrakoot lies along the northern part of vindhyan range is situated between 80°50'-80°52' longitude and 25°10'-25°12' latitude on the border of Madhya Pradesh and Uttar Pradesh. This region is inhabited by various original tribes like kols, Gonds and lodhies. Who more often use many local plants for the treatment of different diseases.

Some environmental conservation practices followed by tribal communities like kole gonds and lodhies tribes lived in the remote area of chitrakoot forest division are interesting and unique. These practices have been helpful in conserving some important species some interesting species have been observed in these sacred groves are *Aegal marmelos* (Bel), *Calotropis procera* (Aak), *Cynodon dactylon* (Doob ghas). *Ficus religiosa* (Peepal), *Ficus benghalensis* (Bargad), *Ocimum sanctum* (Tulsi) etc.

The present communication deals with the utilization of plants in relation to medicinal properties by local inhabitants of the remote localities of chitrakoot forest area, accumulated some interesting as well as little information on 21 plant species used as medicinal value and conserved the environment.

Key words: Indeginous, Conservation, Tribal area, Medicinal, Biodiversity

SVII/P-43

Bioactivity of Bryophytes Against *Fusarium oxysporum* f. sp. *lycopersici* Causing Fusarium Wilt of Tomato

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The continuing development of conventional fungicide and their resistance in plant pathogens necessitates the discovery and development of natural fungicides. Since fungicides are designed specifically to fight harmful fungi and therefore are toxic to them, they may present hazards to the environment by their potential effect upon non-target organisms. There is a growing interest in the use of plants for fungal infection related diseases control program as an alternate to conventional fungicides. Bryophytes belong to the group of the oldest known land plants, which includes liverworts, hornworts and mosses. Fusarium wilt is considered one of the most important diseases of tomato worldwide. To overcome this prominent problem of wilt common in field and green house grown tomatoes, an eco friendly study has been observed. The antifungal potential of two bryophytes (*Conocephalum conicum* L. and *Anaectangium thomsonii* Mitt.) collected from mid hills of Kumaon Himalayas was studied by extracting them in two organic (ethanol and acetone) solvents. The antifungal activity was investigated against *Fusarium oxysporum* f. sp. *lycopersici* by disc diffusion, food poisoned and broth microdilution methods. Both the extracts showed varied degree of potent antifungal activities in dose dependent manner but the highest degree of antifungal activity was shown by ethanolic extract of *C. conicum* followed by acetone extract with (MIC/ MFC = 31.25/ 125µg/ml) and (MIC/ MFC = 125/500 µg/ml) respectively. The similar trend of antifungal activity was found when the *in vitro* study was followed by *in vivo* study. High content of phenolics and flavonoids was observed in ethanolic extract of *C. conicum* at100 µg/ml. The chemical composition of potent plant was determined by gas chromatography- mass spectrometry (GC-MS) for further study. The results clearly indicate the *in vitro* potential of tested extracts of bryophytes as antifungal agent against one of the most important tomato plant pathogen. In future it can provide a substitute for the conventional synthetic fungicides giving an ecofriendly approach to plant health management.

Key words: Bryophytes, antifungal activity, *Fusarium oxysporum* f. sp. *lycopersici*, Phenolics and GC-MS

SVII/P-44

Genetic Diversity and Multivariate Analysis

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Genetic diversity has been defined as the variety of alleles and genotypes present in a population and this is reflected in morphological, physiological and behavioural differences between individuals and populations. Genetic diversity is the basis of evolutionary potential of species to respond to environmental changes and serves as a way to adapt to changing environments. Study of genetic diversity is the process by which variation among individuals or groups of individuals or populations is analyzed by a specific method or a combination of methods. A thorough assessment of genetic diversity can be invaluable in crop improvement programs for analysis of genetic variability in cultivars, identification of diverse parental combinations for creating segregating progenies with maximum genetic variation and for introgression of desirable genes from diverse germplasm into the available genetic base. Multivariate data analysis refers to any statistical technique used to analyze data that arises from more than one variable. Multivariate statistical algorithms that simultaneously analyze multiple measurements on each individual under investigation have been widely used in analysis of genetic diversity. These analytical techniques include principal component analysis (PCA), principal coordinate analysis (PCoA), cluster analysis, and multidimensional scaling (MDS).

Key words: Genetic diversity, Multivariate analysis, Quantitative traits, Principal Component Analysis (PCA), Principal Coordinate Analysis (PCoA)

SVII/P-45

An Assessment of Floristic Diversity of Sitamata Wild Life Sanctuay, Rajasthan, India

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The Sitamata wildlife sanctuary, Chittorgarh, Pratapgarh and Udaipur, South Rajasthan is one of the pride owner of most unique ecosystem with first

richest biodiversity in Flora and fauna in Rajasthan. It is one and only of the important natural habitats for flying squirrel in India. The sanctuary is situated in between 74º25'-74º40' E longitudes and 24^{0}04'-24^{0}23' N latitude covering an area about 422.95 Sq. km in which the total reserved forest area is 345. 37 sq. km and proteted forest area is 77.57 sq. km. The plant resources of Sitamata Wildlife Sanctuary were studied and analysed. A total of 646 Angiospermic species belonging to 426 genera under 116 families were recorded. Herbs dominate the flora followed by trees, climbers and shrubs. Dominance of phanerophytes indicates the tropical moist and humid climate. Six, two and 53 angiospermic taxa have been recorded as the threatened, endemic and rare taxa respectively. Proper conservation and management plans are needed to save the natural resources, especially medicinal plants, of this sanctuary.

Key words: Floristic diversity, Sitamata Wildlife Sancyuary, Rajasthan, India

SVII/P-46

Action Plan to Enhance and Conserve Biodiversity for an Open Cast Mine

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Biodiversity is considered as an important factor in maintaining the natural balance of the environment. The developmental activities like industrialization cause habitat conversions which are one of the major drivers of biodiversity loss. Biodiversity and development activities can exist and flourish side by side. If necessary measures are taken sufficiently healthy biodiversity can exist within the confines of an industrial area, without one harming the other. Assessment of existing biodiversity of an area and preparation of a document pertaining to the conservation of existing biodiversity is a first step for integrating biodiversity into businesses. A biodiversity action plan containing suggestions and strategies for conservation was formulated by studying ecological data of operational and buffer zone of an open cast mine of zinc. The study included multiple components like ecological data assessment, ecosystem service benchmarking, assessment of risk to biodiversity due to various operational activities etc. Aim of baseline analysis of the study area was to generate a primary database about existing flora and fauna along with the type and health of habitat. While threat analysis was done to identify the potential threats to biodiversity from operations or any other surrounding activities, benchmarking of ecosystem services involved detailed interaction with the management and culminated into a score. Along with these major components the study also involved various minor components like preparation of biodiversity sensitivity map, socio ecological survey, preparation of intensity map etc. All these components were merged together to give a comprehensive view of biodiversity and ecosystem services. The outcome of this study was a set of recommendations on conserving and enhancing biodiversity of the study area. Implementation of suggested activities like plantation of native species, management of invasive species and eco restoration strategy for overburden will aid in enriching biodiversity and maintaining ecological balance of the area.

Key words: Biodiversity, Ecosystem services, Sensitivity map, Open cast mine

SVII/P-47

Environmentally Threatened Biodiversity and Conservation Management in Bangladesh

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Investigation for assessment of the threatened categories of plants has been carried out throughout the flora of Bangladesh and a complete inventory of 13 angiosperm families have been made, recognizing a total of 211 taxa which are environmentally threatened in the flora at various degrees and need immediate conservation management for environmental sustainability. The threatened categories have been determined through survey of relevant floristic literature, repeated field trips since 1993, examination of collected herbarium specimens preserved in national and international herbaria, *viz.*, CAL, E, K, DACB, DUSH, BFRIH, BCSIRH and HCU. These 13 plant families are Anacardiaceae, Annonaceae, Apocynaceae, Asclepiadaceae,

Begoniaceae, Boraginaceae, Cucurbitaceae, Magnoliaceae, Menispermaceae, Myrsinaceae, Periplocaceae, Rubiaceae and Vitaceae, representing in the flora of Bangladesh by a total of 497 species of which 211 (about 42.5%) are recognized as threatened and classified in to IUCN Red List Categories, and included in the Red Data Book of Bangladesh (RDB) for taking national conservation strategies. Of these threatened taxa, 52 species are extinct, 128 endagered, 20 vulnerable and 11 other categories. The 52 species are presumed extinct since these have no report of collection after 19th century. In this communication, an enumeration of some extremely rare, endangered and extinct species is presented. Each species in the enumeration is cited with current nomenclature, local names, habit, ecology, potential values, field/ herbarium photograph, distribution and conservation status in the wild as per format of the Red Data Book of Bangladesh.

Key words: Threatened biodiversity, Conservation management, Environmental sustainablility, Bangladesh

SVII/P-48

Effect of Environmental Conditions on Genus *Bryum* Hedw. In Western Himalaya, India

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Bryophytes are the most simple and primitive group of embryophyta with about 25,000 species distributed all over the world. They are among the pioneers of the land vegetation on earth and are important key components of the ecosystem biodiversity. These plants are greatly influenced by climatic as well as geographical factors thus used as indicator species for climate change due to their sensitivity to environmental condition. Various consequences of climate change on the species component of biodiversity include; change in geographical distribution, increased extinction rates, changes in reproduction timings and changes in length of growing seasons for every species, therefore research on bryophyte diversity, richness and distribution is also increasing in recent years. These plants have wider distribution and longer altitudinal gradient than vascular plants; therefore have been considered as ideal group for altitudinal studies. Altitudinal variation forms an important parameter for the biodiversity that determines the distribution of bryophytes.

Genus *Bryum* is unique group of taxa, not only for its species diversity, but also for the species to colonize a diverse variety of environments, wide range of growth forms, habitats and distribution pattern. Their distribution in a particular site or locality depends on various macroclimatic factors such as temperature, air current, light, wind velocity, atmospheric gases, rainfall etc. as well as the microclimatic factors *viz.*, habitat including chemical and physical properties of substrate that are governed by the altitude and this shows a direct relationship between altitude and species distribution. The western Himalayan region is characterized by a variety of climate types and accordingly the flora is also varied markedly, thus the prevailing weather conditions in different parts of western Himalaya seem to be favourable for the growth of *Bryum* spp.

The present study is to describe the distributional pattern of *Bryum* taxa along an altitudinal gradient upto 6500 m a.s.l. in western Himalaya and the analysis indicates that diversity and richness of *Bryum* taxa increases up to 2800 m and beyond this it decreases. Maximum occurrence of taxa is observed between 1801-2800 m, represented by 17 species and 1 variety due to moderate humidity and temperature, while above 4500 m the temperature increases and humidity seems to be very low therefore minimum occurrence of the genus is observed, represented by only 1 species: *B. thomsonii*. During the assessment 6 species: *B. apiculatum, B. argenteum, B. capillare, B. cellulare, B. coronatum* and *B. dichotomum* are found at lower altitudinal range below 800 m exhibits low temperature and high humidity.

Keywords: Altitude, Bryophytes, Climate change, Ecosystem, Western Himalaya

SVII/P-49

Ecology and Diversity of *Ficus* L. (Moraceae) of the Gangetic Plain in India with Special Reference to Uttar Pradesh

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Due to varied climatic conditions India has been divided into 12 biogeographic regions which have resulted enormous amount of plant diversity among different plant groups. *Ficus* commonly known as 'Fig, is also considered one of the major constituents of Indian diversity with about 115 species. The present study examines the genus *Ficus* from one of the important biogeoraphic regions 'The Gangetic Plain' by highlighting its diversity and ecological aspects. The Gangetic plain stretches from the eastern Rajasthan through Uttar Pradesh to Bihar and West Bengal. The entire region is a flat alluvial region and consists of tropical environment. Majority of *Ficus* species are found in low land and moist areas in mixed forest, waste lands and besides nallahs and water bodies. In addition, they also occur on abandoned buildings, walls of houses, in orchards, gardens, along roadsides in villages and cities etc. Many species grow epiphytically either on the other species of *Ficus* or on different tree species. Some of the species also found growing as lithophytes (*F. mollis*). Species like *F. benghalensis* and *F. reliogiosa* can play an important role in colonization in coal mining affected areas. *Ficus* is considered as a keystone species in tropical rain forests as it plays very fundamental role in ecosystem, due to its fruits which are eaten by insects, birds and animals throughout the year. The fallen figs are used by decomposers and improved the soil organic component and its fertility. Various insects and wasps species are dependent on figs for their food and to complete their life cycle. The study reveals that the Gangetic Plain comprises about 50 species of *Ficus* (including 7 cultivated species) from its entire range, 3-4 from Estern Rajasthan, 17 from Bihar and Jharkhand, 14 from Uttar Pradesh and 15 from West Bengal. Out of 14 species occurring in Uttar Pradesh, the maximum species belong to trees except *F. assamica, F. heterophylla, F. pumilla . Some of the species such as F. benghalensis , F. racemosa, F. religiosa* and *F. virens* are found in both wild as well as in cultivated forms while *F. benjamina, F. drupacea var pubescens, F. drupacea var. surepanda, F. elastica, F. krishnae, F. maclellandii, F. pumila,* are chiefly cultivated as ornamental, avenue tree etc. In overall gross morphology *F. krishnae, F. hispida, F. mollis, F. palmata ssp. virgata, F. semicordata* and *F. viren,* exhibit considerable amount of variations.

Keywords: Diversity, Ecology, *Ficus*, Moraceae, Uttar Prdesh, Gangetic Plain

SVII/P-50

Phenological Behaviour of three Woody Species in Vindhyan Region of Uttar Pradesh, India

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The study deals with the phenological behaviour of three dominant woody species such as *Hardwickia binata* Roxb., *Butea monosperma* (Lam.) Taub. and *Acacia catechu* (L.f.) Willd. Growing in the Vindhyan region of Uttar Pradesh, India. The area around the Vindhyachal Mountains is known as Vindhyan region. The region is spread from Gujarat to Uttar Pradesh covering north-eastern Madhya Pradesh. It represents tropical dry deciduous type of vegetation. Sonbhadra district of Uttar Pradesh falls within the range of Vindhyan is selected as study site. In the present study different phenophases like leaf bud initiation, young leaf emergence, leaf maturation, floral bud initiation, flowering, fruiting and leaf fall initiation were observed on monthly basis for the candidate species. In *Butea monosperma* flower buds initiated just before summer (*i.e.* March), flowers blooms on the tree in summer (*i.e.* April) and produced fruits before rains in the month of May which sustained on up to July. At the time of fruiting the leaf bud busting also started. After a month from the leaf bud busting the young leaves appeared on the twigs in June and got matured in August. In *Acacia catechu* leaf buds initiated in the month of February, young leaves appeared on the twigs in March and got matured in August. Flower buds initiated in June, flowers persisted on the tree only for one month and produced fruits during rains in the month of July which continued on the tree up to next year (*i.e.* January-February). In *Hardwickia binata* leaf buds initiated in the month of February and young leaves appeared on the twigs in March and got matured in May. Flower buds initiated in July with rains. The flowers persisted on up to August and produced fruits

just after rains in the last week of September which continued on the trees up to December. This kind of study will help to assess the response of these plants against the changing climate if done periodically for longer period.

Keywords: Trees, Phenology, Vindhyan region, *Hardwickia binata, Butea monosperma, Acacia catechu,* Sonbhadra District

SVII/P-51

Genetic Diversity among some Exotic Species of *Pinus* using RAPD

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The present study investigated the genetic diversity among 12 exotic species habituated in Western Himalayan regions of Uttarakhand. The species under study were diverse and displayed a range of variability (0-100%) for RAPD. The exotic species of *Pinus* were collected from different localities of Western Himalayas in Uttarakhand, viz. Kausani, Ranikhet, Almora and Nainital of Kumaon using RAPD (Random Amplified Polymorphic DNA). Twelve species of *Pinus* considered for the following study included *P. canariensis* (PC), *P. densiflora* (PD), *P. echinata* (PE_1), *P. ellottii* (PE_2), *P. engelmanii* (PE_3), *P. greggii* (PG), *P. insularis* (PI), *P. oocarpa* (PO), *P. pinaster* (PP_1), *P. pinea* (PP_2), *P. taeda* (PT_1) and *P. thunbergii* (PT_2). Present RAPD profile analysis, involved six primers of which two primers (OPB-01 and PIN-08) did not give any satisfactory amplification, while remaining four random primers (OPC-01, OPA-10, PIN-02 & PIN-07) were more informative, produced maximum PCR amplification products with all *Pinus* species under study. A total of 81 RAPD polymorphic markers were used to generate a genetic similarity matrix followed by the cluster analysis. Specific groups were revealed by each cluster analysis. A total of 81 bands of genomic DNA were generated. Maximum number of 17 and 18 amplification products were obtained with OPC-01 and OPA-10 primers respectively. Minimum numbers of 6 amplification products were generated with PIN-08. The total numbers of unique bands detected were 16, out of which 5 bands were contributed by OPA-10 primer, 1 band by OPC-01 and PIN-08, 2 bands by OPB-01, 3 bands by PIN-02 and 4 bands by PIN-07 primers.

The primers exhibited hundred percent polymorphism, probably because of wide distribution of the *Pinus* species in different geographical regions. The dendrogram generated using RAPD profile, revealed the distinctness of each species of *Pinus*. It was also seen that *P. taeda* (PT_1) had highest similarity with *P. echinata* (PE_1), and *P. ellottii* (PE_2) was near similar to *P. greggii* (PG). These species probably had the highest similarity with each other since they inhabited same geographical range of distribution. *P. oocarpa* (PO) forms separate cluster since its DNA was not amplified by the primers. This technique has also been successfully used earlier to study the genetic diversity in several other species of *Pinus* (Kaya et al., 1993; Gomez et al., 2001; Nkongolo et al., 2002; Monteleone et al., 2006).

The study revealed extreme diversity at molecular level in *Pinus* species and has opened vistas for further research in this area where molecular diversity can be correlated to their morphological diversity.

Key words: Genetic Diversity, *Pinus*, Random Amplified Polymorphic DNA (RAPD), Polymerase Chain Reaction (PCR), Polymorphism

SVII/P-52

Bryophyte Diversity at Govind Wild Life Sanctuary (Uttarakhand), Western Himalaya, India: A Preliminary Overview

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Western Himalaya boasts a rich and remarkable floral diversity due to vast range of Climatic and altitudinal zones providing variety of niches and microclimatic conditions. In Uttarakhand State, Govind Wild Life Sanctuary (GWLS) in Uttarkashi district of Garhwal hills is an area which is less explored for its floristic resources in general and for bryophytes in particular. The sanctuary covers an area of about 953 Km^2 with the altitude ranging from 1300-6230 m above mean sea level. The area comprises of valleys of Rupin and Supin, the tributaries of river

Tons. The vegetation of the region includes subtropical coniferous forests through mixed temperate forests, dry temperate forests to alpine scrubs and meadows. The area is very rich in medicinal plants and home for a large number of endangered animals and plants. A recent investigation on the bryoflora of GWLS has revealed the occurrence of 262 taxa of bryophytes belonging to 124 genera of 55 families. Mosses are represented by 168 taxa of 84 genera and 27 families, liverworts are represented by 87 taxa of 37 genera and 25 families, and hornworts consist of 7 species of 3 genera and 3 families. Among the mosses, family Pottiaceae seems to be more dominant in the region with 25 taxa, followed by Bryaceae and Thuidiaceae, while genus *Brachythecium* has maximum number (8) of species. As far as the leafy liverworts are concerned, family Plagiochilaceae exhibits maximum number (14) of species, while Frullaniaceae is represented by 9 species. Liverwort *Frullania handel-mazzettii* S. Hatt. and moss *Bryhnia nepalensis* Takaki have been recorded as new to India.

Key words: Bryophytes, GWLS, Uttarakhand, India.

SVII/P-53

Ecological Implications of Bryophyte Diversity at Pachmarhi Biosphere Reserve (M.P.) India

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Considering the world wide initiative towards the biodiversity management and conservation, the study of floral and faunal attributes of protected areas holds utmost importance. Pachmarhi Biosphere Reserve (PBR) encompassing an area of 4987.38 square kilometers is a prominent protected unit of central India. Its inclusion in UNESCO'S Man and Biosphere (MAB) Programme and under project Tiger since 1999 and 2000 respectively has made it a prime region of concern. Rich in floral and faunal heritage, PBR is celebrated for its cryptogamic diversity, specifically pteridophytic and bryophytic flora.

Bryophytes harbour varied localities of the area but mostly these are inhabitants of shady, moist and undisturbed places. The bryophytes play imperative role in formation and maintenance of different ecosystems. Considering their presence on variety of habitats ranging from soil, soil covered rocks, bare rocks (both moist and dry), walls to tree barks and leaf surfaces, within an altitudinal range of 400-1350 meters (approx) at PBR, their role and importance in ecosystem dynamics remains indispensable.

The present study elucidates the species composition of 132 bryophytes of the chosen sites at three altitudinal gradients, viz. lower altitude (400m-800m), middle altitude (801m-1000m) and higher altitude (above 1000m) across six selected habitats namely soil, dry rocks, wet rocks, soil covered rocks, epiphytic and stony walls. In order to study the habitat diversity and compare the species composition across the altitudinal gradients, ? diversity and similarity indices were calculated. In the present study, across the various habitats, ? diversity ranged between 6.26 and 6.00. Further rocks and soil covered rocks emerged as the most pertinent habitat for bryophytes at PBR.

Species composition of bryophytes at different sites situated at the three altitudinal gradients were compared in order to find out the similarity and dissimilarities using Sorensen's Similarity Index. In general, the similarity in species composition between the sites was less than 50%. The lesser percent similarity present among the overall species distribution indicated towards the less species similarity and higher diversity of the bryoflora at PBR.

The direct and indirect participation of bryophytes in ecosystem relationships illustrate their essentiality and highlight the need for their documentation and conservation in protected areas. Considering the eminence of PBR among Indian protected areas, efficient utilization of bryophyte populations promises to aid and add to sustainable development of this Biosphere Reserve.

Key words: Pachmarhi Biosphere Reserve, Bryophytes, species composition.

SVIII/O-1

Utilization of Microwave Assisted Chemical Pretreated Rice Straw Hydrolysate for Hydrogen Production via Dark Fermentation

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In present scenario, most of the energy demand is fulfilled by fossil fuels which in turn lead to the green house gas emissions and climate change. This instigated the search for new fuel which is sustainable, renewable and pollution free. Hydrogen production from lignocellulosic biomass is one of the most promising alternative energy options to fossil fuel as it is an eco-friendly, clean, sustainable and high energy fuel (122 MJ/Kg). In the current study, rice straw is utilized for hydrogen production because they are abundant, cheap and easily available. Firstly, rice straw is pretreated with microwave assisted chemicals (NaOH, H_2SO_4 and H_2O_2) and sugar is released through enzymatic hydrolysis which is converted to hydrogen gas by bacteria via dark fermentation. The response surface methodology (RSM) is employed for optimization of microwave-chemical pretreatment process. Under optimum conditions, maximum reducing sugar is obtained through H_2O_2 pretreatment (2143µg/ml) and maximum hydrogen gas yield is attained 46.99% through bacterial strain *Bacillus coagulans* 2323.

Keywords: Hydrogen, Enzymatic hydrolysis, Microwave, Dark fermentation

SVIII/O-2

Development and Effectiveness of Low Cost Cationic Polymer for the Harvesting of Microalgae

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One of the major challenges being faced by algal industry is the efficient and cost effective harvesting due to very small size (3–25 µm) charge of microalgae and negative prevents aggregation. The microalgal harvesting by conventional methods such as centrifugation or filtration are highly energy extensive and therefore very expensive. The aim of the study was to develop an economically viable and environmentally sustainable cationic polymeric composite microalgal harvesting. We designed a new quaternary ammonium salt of polyamine based high molecular weight and highly cationic polymeric composite by polycondensation of Epichlorohydrin, N,N-Diisopropylamine and Ethylinediamine. The chemical, structural and thermal properties of this newly developed composite was studied by UV, FTIR, TGA-DSC analysis. The thermogravimetric analysis revealed thermal stability of the composite up to 2000C and FTIR authenticated the presence of amine, carboxyl and hydroxyl functional groups. High molecular weight was comfirmed by it's high viscosity (1040 cps). In coagulation and flocculation studies, high biomass recovery efficiency (>95%) was achieved for Scenedesmus spp at very low doses (10ppm) of the polymeric composite. Most importantly, this polymeric composite has not shown any deleterious effects on the lipid profile of microalgae. The polymeric composite proved to be highly effective for microalgal flocculation. Charge neutralization between the negative charges of algal surfaces and positive charges of the polymeric composites played a significant role in the higher flocculation effectiveness of the polymeric composite. Based on biomass recovery efficiency and material used, the estimated cost of this flocculant is approximately less than 0.5 USD for harvesting of 1 kg of algal biomass. These findings suggest that this type of polymeric composite is highly cost effective and could be used for the harvesting of microalgae for biofuel purposes.

Key words: Microalgae, Cationic polymer, Flocculantion, Harvesting, Charge

SVIII/O-3

Induction of Lipid Production in *Desertifilum tharense* Msak01 and *Leptolyngbya* sp. under Nitrogen and/or Phosphorus Limitation Conditions

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The enormous usage of petroleum based energy sources depleted non-renewable sources of energy and generate a shift towards renewable source of energy. The oil-accumulating algae provide the suitable solution though biofuel production. However high lipid producing algae are slow growers while fast growers producers small quantity of algal biomass. Thus as a practical approach, the present work studied nutrient limiting condition by nitrogen and phosphorus deficiency. The current study is a unique approach for the enhancement of lipid content in novel algal strains, *Desertifilum tharense* MSAK01 and *Leptolyngbya* sp. under nutrient limiting conditions. In *D. tharense*, the lipid production has been enhanced to 198% under nitrogen limiting conditions and 110% under phosphorus limiting conditions, compared to the control. Similarly, in *Leptolynbgya* sp., the lipid production has been enhanced to 210% under nitrogen limiting conditions and 165% under phosphorus limiting conditions, compared to the control. Also, nitrogen and phosphorous deficiency are found to be the most appropriate, economical, and feasible stimulants for the accumulation of lipids for algal biofuel production. Therefore, induction of lipid production among fast grower algal strain generates lipid rich biomass thus deciphers the energy crisis.

Key words: *Desertilum tharense*, *Leptolyngbya* sp., Nitrogen limitation, Phosphorus limitation, Lipid, Biomass

SVIII/O-4

Evaluation of Performance and Emission Characteristics of Biodiesel Blends with Diesel in a Single Cylinder DI Diesel Engine

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Biofuel is an alternative fuels have been effectively applied world-wide in the transport, mainly due to running down the resources of crude oil, its increasing price, and also anticipated global climate changes. The wide variety of Vegetable Oils (edible and non edible) and animal oils are applicable as fuels in standard diesel engines. In this article the experiment was conducted on a single cylinder direct injection diesel engine is tested using animal oil blends B20 (20% animal oil and 80% diesel fuel) and B40 (40% animal oil and 60% diesel fuel) as fuels under variable load operating conditions at a constant speed of 1500rpm and their performance and emission characteristics were compared with diesel fuel. Here the engine was run successfully on a blend of B20 and B40 without any modification in engine parts. The results which are obtained for performance from B20 and B40 could not find slight progress than diesel fuel characteristics. The emissions result shows that increasing biodiesel concentration in the diesel fuel blend the carbon monoxide (CO) and hydrocarbons (HC) emissions are reduced. The smoke density was also reduced at some operating load conditions for biodiesel blends. In general, animal oil blends with diesel shows a considerable reduction in emissions.

Key words: Diesel, Biodiesel, CI engine, Engine performance, Exhaust emission

SVIII/O-5

Diesel Engine Performance Enhancement and Emission Diminution with Low Heat Rejection Diesel Engine by using NME As Fuel

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Economic and social status of any country depends upon utilization and requirement of alternative energy. Fuels derived from renewable biological resources are environmentally friendly. Vegetable oil like Neem oil is non edible in nature, and a favorable alternative between the different diesel fuel substitutes. Inferior volatility, cold flow

characteristics, and high viscosity of edible and inedible oils, causing the engine complications like severe engine deposits, injector coking, and filter gumming, etc. To avoid the mentioned complications, vegetable oils to form mono esters with the suitable transesterification method. The dual step transesterification process was adopted for production of biodiesel from Neem oil. The maximum yield of biodiesel from Neem oil was 75-85%. Literature shows that Low Heat Rejection (LHR) engine concept was more efficient than another.

The main aim to compare naturally aspirated LHR Compression Ignition (CI) engine with Basic naturally aspirated CI engine. To improve engine performance and reduce the smoke density by using diesel and Neem Oil Methyl Ester (NME) as fuels. Thermal barrier coatings are Nickel (Ni), Chromium (Cr), and Aluminium (Al) are composed like bond coat to use as an oxidation resistant layer. Top layer coated with partially stabilized Zirconia to provide thermal insulation against the metallic substrate. Exhaust gas temperature, Brake thermal efficiency (B_{Teff}), and Brake specific fuel consumption (BSFC) of NME used LHR engine were improved, but the smoke density of the NME used LHR engine is decreased.

Key words: LHR Engine, Neem oil methyl ester, Performance, Smoke density

SVIII/O-6

Harvesting of Microalgae for Biofuel: Use of Polypropylene Non-woven Fabric Membrane and Self-flocculation Property

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Microalgae has emerged as a potential source of biomass for food, feed, bulk chemicals and biofuels besides their role in wastewater treatment, greenhouse gas (GHG) reduction, and air pollution abatement. However, their production is challenged with cost-effectiveness and efficiency in harvesting, which demands up to 20–30% of the total biomass production cost. Out of the various methods of harvesting, filtration is a simple and low-cost technology, which ensures a non-contaminated biomass and facilitates continuous operation, media recycling, removal of protozoa and viruses, and reuse of residual nutrients. We evaluated the applicability of polypropylene non-woven fabric membrane (PNM) for harvesting of self-flocculating microalgae by filtration due to its reasonable price, hydrophobic nature, excellent hydrolysis resistance, anti-acid, anti-alkali, and anti-abrasion properties. Pre-concentration of algae by flocculation before the final concentration step minimizes the cost, energy and complexity of harvesting. Therefore, self-flocculation property of *Scenedesmus obliquus* as a pre-concentration tool was explored.

The objectives of the study reported here were: (1) to evaluate the effectiveness of PNM in the dewatering of self-flocculating and non-self-flocculating microalgae, and (2) to establish the role of self-flocculation property as a harvesting aid.

Filtration experiment through PNM was done under gravity, no additional vacuum or pressure was used. The membrane showed high filtration efficiency for *Scenedesmus obliquus* whereas its performance for *Chlorella sorokiniana* was not attractive. At around 3 g/L algal density, although the filtration efficiency for *Scenedesmus* was >99% efficiency, it was <10% for *Chlorella*. Filtration through fresh membrane was slow. On reuse, the filtration rate increased with a slight compromise in efficiency. Filtration efficiency of the membrane was also affected by the culture density. The better filtration performance by *Scenedesmus* can be attributed to the formation of 'algal bio-filter layer' facilitated by its self-flocculation property. *Scenedesmus* culture as well as filtrate were able to flocculate *Chlorella*, the former being more efficient. Thus, self-flocculating property of relevant microalgae as a flocculation aid in harvesting of microalgae and use of PNM can be exploited to reduce the the cost of algal biofuel production.

Key words: Bio-filter, *Chlorella sorokiniana*, *Scenedesmus obliquus*, Algal density, Filtration

SVIII/O-7

Biofuels: Impact on Ecosystem Services, Biodiversity and Human Well-being

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Leaps and bounds hike in the international prices of crude oil and a greater need for energy security has led to a sharp growth in the demand for biofuels globally. This is now a general consensus that our climate is changing on account of increased Green House Gas (GHG) emissions and this could have serious consequences. Of all causes anthropogenic emissions have shown significant increments. It is evident from IPCC 2007 reports that the carbon emissions from transport may be as high as 80% more than the current levels by 2030. Biofuels can be considered as a promising alternative to withstand this ever increasing demand for energy supply. It has the potential to be developed as an element of sustainable approach towards climate change. As such biofuels present both benefits and risks; benefits include energy security, GHG reductions while risks include intensive exploitation of resources, suspected biodiversity loss, land use change. Taking biofuels on 'Cost-Benefit' analysis requires socio-economic and more importantly environmental sustainability in order to maximize pros and minimize cons. Significant improvements in efficiency are required to be made before biofuels are integrated as realistic substitutes to the conventional fuels. Since currently available literature on biofuels is rapidly expanding in multidisciplinary fields therefore it becomes a challenging task to obtain a comprehensive picture of biofuels tradeoffs.

Key words: Climate, Anthropogenic, Greenhouse gas, Biofuels, Sustainability, Environmental

SVIII/P-1

Bioethanol Production from Green Seaweed *Ulva fasciata* using Solid State Fermentation (SSF) Derived Cellulase

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Depletion of fossil fuels, environmental concerns arising from burning of fossil fuels and volatile energy costs have propelled the biofuel research worldwide. Given the global energy scenario, the biofuels are considered as promising alternatives to liquid fuels. Recently, seaweeds have gained considerable global attention as a potential source of feedstock for biofuels mainly bioethanol. In this study, cellulase produced from marine fungus *Cladosporium sphaerospermum* through solid state fermentation (SSF) was investigated for its saccharification potentials using common green seaweed *Ulva fasciata*. The green seaweed substrate containing inoculated fungus with 60% moisture content cultured at 25°C and pH 4 for four days has showed optimum enzyme production. The enzyme assayed for CMCase and FPase showed an activity of 10.2±2.79 U/g and 9.6±1.88 U/g respectively on DW basis. Further, ionic liquid tolerance of enzyme was studied in the presence of [EMIM]Ac, [BMIM]Cl, [BMIM][OTF] and [BMPL][OTF]. At 10% v/v concentration, enzyme retained 72.17 to 85.04% activity in all the ILs. After 24 h of pre-incubation in all ILs (10% v/v), enzyme activity was recorded in the range of 73.77% to 93.67%. The hydrolysis of *U. fasciata* feedstock with enzyme (10 U/g) for 24 h at 40°C and pH 4 gave maximum reducing sugar yield of 112±10 mg/g DW which on fermentation gave an ethanol yield of 0.44±0.10 g/g reducing sugar corresponding to 93.81% conversion efficiency. It is evident from these findings that cellulase produced from marine fungus can be employed for saccharification of cellulosic feedstock for production of renewable biofuels from marine macroalgal feedstock.

Keywords: Cellulase, Saccharification, Solid state fermentation, Seaweed, Ulva

SVIII/P-2

Addressing Energy Inefficiency through Solar Water Pumps in Agriculture Sector in State of Punjab – An Assessment

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Agriculture in India is primarily dependent on rainfall. Tubewell, pumps, rivers, canals etc uses motors highly reliant on fuel and electricity to withdraw water. Supply of energy generation through conventional resources is not meeting the demand of

society and also leads to climate change. In India, electrical and diesel-powered water pumping systems are widely used for irrigation, community water supply, livestock watering, and in various industrial processes. To cope up with the issue of energy efficiency, Indian Government has initiated the installation of Solar Water Pump Scheme which is highly dependent on Renewable Energy (RE) resources to bring energy efficiency in Agriculture sector. Photovoltaic (PV) Solar Water Pump is the best alternative which is based on Solar Energy and is environmental friendly and cost effective.

This paper will concentrate on the use of PV Solar Water Pump in agricultural sector especially in irrigating the fields to increase their yield. The main objective of the study is to evaluate the implementation of Solar Water Pump scheme in Punjab State while considering the perception of beneficiaries towards their installation to meet their requirement of energy and its comparative benefits over other pumps. Paper will also discuss various gaps in implementation of Government policies or strategies in creating awareness of Solar Water Pumps among farmers and suggestive measures are given to improve the irrigation through Solar Water Pumps Primary data for this paper is collected by interviewing fifty beneficiaries from Gurdaspur district of Punjab state (maximum no. of Solar Water Pumps installed). Secondary data is collected from annual reports of Punjab Energy Development Agency, e- Journals and other Government documents.

This paper is beneficial for policy makers who are involved in framing plans and the implementation agencies who are involved in installation of Solar Water Pumps. It is also relevant for research scholars and civil society.

Key words: Solar pumps, Punjab, Energy efficiency, Punjab Energy Development Agency

SVIII/P-3

Variation in Soil Organic Matter Dynamics in Dry Tropics: Impact of Land use Change

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Land use change (LUC) has been considered to exert larger impact on soil organic matter (SOM) dynamics than projected climate change. Concerns have been raised for restoration of degraded ecosystems resulted from change in land use pattern of natural ecosystems. SOM, comprised of both the stable and the labile pools, plays a major role in C and nutrient cycling. Soil microbial biomass (SMB), represents the labile pool of SOM and has been considered as an important tool to predict changes in soil quality, whereas soil organic carbon (SOC), the stable pool, indicates the C storage status in soil. For designing long term restoration strategies, understanding of the impact of LUC on SOM dynamics through the soil profile is required especially in dry tropics. The broad objective of the present study was to evaluate the changes in SOM dynamics in terms of SMB and SOC dynamics in response to various land use patterns involving natural forest, degraded forest, agroecosystem and biofuel plantation in form of *Jatropha curcas* plantation in dry tropics. The experimental sites were situated at RGS Campus, Barakachha and forest of Marihan range, Mirzapur, India. Soil was sampled from three depths i.e. 0-10, 10-20 and 20-30 cm across all the land use patterns for analyzing SMB-C during rainy, winter and summer and SOC during summer only. Conversion of natural forest to agroecosystem resulted in highest loss of SOC, whereas it was lowest in biofuel plantation across the soil profile. SOC content was higher at upper layer and decreased with increasing soil depth across all the land use patterns. SMB levels were lowest during rainy season which increased through winter to the highest during summer across all the land use patterns. Levels of SMB were highest in natural forest through the annual cycle and across the soil profile, followed in decreasing order by biofuel plantation, degraded forest and lowest in agroecosystem. Since plantation of biofuel in degraded lands resulted in higher levels of SOC and SMB as compared to agroecosystem, it may be concluded that biofuel plantation in dry tropics holds promise in restoration of degraded lands.

Key words: Land use change, Soil organic matter, Soil microbial biomass, Soil organic C

SVIII/P-4

Clean Energy Investment – A Case of Indian Transport System

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This study suggests that how implementation of LNG into freight transportation in a country as vast as India could make a huge difference towards pollution control. According to 2011 census, road traffics carry nearly 65% of freight and 85% of passenger traffic. About 70% of the total diesel consumption is in the transport sector. The distribution of diesel in transportation sector is accounted as follows: Private cars & SUVs- 13.5%, Commercial &SUVs- 8.94%, 3-Wheelers-6.39%, Truck-28.25%, Bus-9.55%and Railway-3.24%.

According to The American Lung Association of California, diesel exhaust contains more than 40 toxic air contaminants. It is known to increase the risk of cancer and causes cough or aggravate asthma like diseases in human beings. Also, environmentally it is one of the major contributors of smog and fine particle pollution.

Thus, the need of the hour is to introduce cleaner energy fuel to replace diesel with LNG. Initially, India should promote freight transport to switch to LNG since their diesel consumption is most in the Indian market. This would not only be economically viable but also a much cleaner fuel. LNG is cleaner as it generates no residues, particulates or soot and releases less greenhouse gases compared to other fossil fuels on burning and has high calorific value. Also, transportation of LNG is easy as it can be liquefied. Although initial investment will be required in upgrading the current engines of the transportation vehicles, considering the sustainability factor, the cost of replacing vehicles will eventually be recovered. In the future, LNG can also be acquired from bio-mass plant, making it an even greener investment.

Key words: India, Freight transport, Diesel, LNG, Clean fuel, Clean energy investment

SVIII/P-5

Screening of Microalgae Species from the Effluent of Carpet Industry for the Production of Biodiesel

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Microalgae are the most promising organisms for biodiesel production, since they are widely distributed group of photosynthetic, oxygen evolving, fast growing organisms with oil rich biomass producing ability as compared to energy crops. Micro algal species such as *Chlorella* sp., *Nannochloropsis* sp., and *Scenedesmus* sp. was isolated by using routine micro algal techniques from the effluent of carpet industry (pH, 9.0) situated in Bhadohi district, U.P, India. The isolated micro algal species were cultured in standard $BG11^{+}$ growth media for twenty days and pH of medium was adjusted to 7.5 and cultures were incubated at 27±1 ºC temperatures and illuminated with white fluorescent lamps at an irradiance of 46.25 µmole m^{-2} s^{-1} photons under the regime of 14:10 light-dark photoperiod in 250 ml Erlenmeyer flasks. Exponential culture (100 ml) of micro algal species was harvested for the estimation of biomass and lipid content. Biomass was highest in the *Nannochloropsis* sp. (106 mg) followed by *Scenedesmus* sp. (102 mg) and *Chlorella* sp. (72 mg) respectively. While, lipid content was highest in the *Nannochloropsis* sp. (30%) followed by *Scenedesmus* sp. (28%) and *Chlorella* sp. (26%) respectively. Lipid of these algae can be converted into crude biodiesel by transesterification. In order to achieve this goal, present investigation was undertaken.

Key words: Microalgae, Biomass, Lipid, Transesterification, Biodiesel

SVIII/P-6

Molecular Cloning of Bifunctional Alcohol/ Acetaldehyde Dehydrogenase (Adh) Isolated from a Fresh Water Green Microalga *Scenedesmus* sp.

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The green alga has numerous genes encoding enzymes that function in anaerobic metabolism. Among these, the bifunctional alcohol/acetaldehyde dehydrogenase (Adh) is proposed to be a key component of anaerobic metabolism. In this study, molecular cloning of Adh from *Scenedesmus* sp. NBRI012 has been done. Based on the cDNA sequences for alcohol dehydrogenase of different hydrogen producing algae such as *Chlamydomonas reinhardtii* (AJ620190.1 and XM_001703533.1), *Volvox carteri* f. nagariensis (XM_002958307.1), *Chlorella variabilis* (XM_005845555.1 and XM_005850201.1) and *Polytomella* sp. (AJ495765.2) primers were designed. Sequences were aligned by CLUSTAL-W and MultAlin programme and compared for conserved sequence motifs. Out of all conserved sequences degenerate and specific primers were designed for alcohol dehydrogenase. A 2.3 Kb of PCR product was amplified by using the above-mentioned primers and cDNA of *Scenedesmus* sp. as template. PCR product was cloned in pBlueScript_II_SK(+) vector for the sequencing. Vector is transformed in *Escherichia coli* DH5á and screened by blue-white selection. Plasmid was extracted and confirm for the cloning by restriction digestion and colony PCR using the same primers.

Key words: Algae, Anaerobic metabolism, Biohydrogen, Molecular cloning, Bifunctional alcohol/acetaldehyde dehydrogenase

SVIII/P-7

Screening of Microorganisms for Production of Electrical Energy in a Laboratory Designed Microbial Fuel Cell (MFC)

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Continued use of petroleum and fossil fuels is widely being recognized as unsustainable because of their depleting supplies along with the contribution of these fuels to the accumulation of carbon dioxide in the environment, which is a major greenhouse gas. Therefore, renewable, carbon neutral, energy generation is necessary for environmental and economic sustainability, and is being considered the need of the hour. A microbial fuel cell (MFC) is a novel form of energy source that employs microbial metabolism and provides new opportunities for the sustainable production of energy from biodegradable compounds. In other words it is a bioreactor that converts chemical energy present in the organic compounds (in the form of chemical bonds) to electrical energy through catalytic reactions of microorganisms under anaerobic conditions. A simple microbial fuel cell was designed in laboratory to screen various microorganisms including bacteria (*Escherichia coli* and *Bacillus subtilis*) and yeast (*Saccharomyces cerevisiae*) for their capacity to generate energy in the form of electricity, employing different substrates as carbon sources. The substrates used in this study included glucose, sucrose and starch. Electron transport system started in the anode chamber due to microbial activity which was accelerated and availed by the use of an external mediator, methylene blue and the transport of protons started from anode to cathode through the membrane which was agar salt bridge in this study. The electricity generated by different microorganisms with different substrates was measured by multimeter device and recorded in milliamperes (mA), which was higher in case of *E. coli* than *B. subtilis* and *S. cereviseae.* Glucose as the substrate generated higher voltage and current in comparison to the other two organic substrates *viz.* sucrose and starch. One of the greatest advantages of MFCs over conventional fuel cells like hydrogen and methanol fuel cell is that a diverse range of organic materials as well as organic wastes from diverse industries can be used as substrates or fuels.

Key words: Microbial fuel cell, Agar salt bridge, Microbial metabolism, *Escherichia coli, Bacillus subtilis, Saccharomyces cerevisiae*

SVIII/P-8

Biorefining of Red Algal Biomass for Fuel and Biochemicals

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The utilization of low carbon technologies to convert biomass in to energy along with stream of products, while minimizing the waste is the most promising way to meet the energy sustainability goals for the future. Now a day's non-lignocellulosic resources such as marine macroalgae (seaweeds) are gaining attention as an alternate source of feedstock for biofuel production. However, only biofuel production from algal biomass is uneconomical and thereby emerged the need for biorefining of biomass for value added products along with fuel. Present study 8 different red seaweeds were characterized for their potential for biorefinery. The biochemical characterization includes the components such as pigments, lipid, minerals, protein, agar and cellulose. The results revealed *Gelidella acerosa* as a best candidate for which a bench-scale model for an integrated biorefinery was developed for the first time. Developed process enabled to produce renewable fuel bio-ethanol with integrated recovery of various commercial co-products like natural pigment, lipids, agar and minerals rich liquid without compromising the products yield and properties. The significant improvement was observed in quality of agar in term of gel strength (2.9 folds) without including alkali or acidic treatment. The developed process also minimized the chemical usage up to 75% in downstream processing for cellulose extraction without any solid waste leftover. Further the enzymatic hydrolysis efficiency towards the extracted celluloses was 83.63% with subsequent ethanol production efficiency of 89.08% for the investigated seaweeds. The developed process could be the key for settling up the small scale biorefineries which will fetch new opportunities for open sea cultivation of seaweeds leading to high rate of CO_2 sequestration besides gainful utilization of marine resources.

Key words: Agar, Bioethanol, Minerals, Lipid, Natural pigment

SVIII/P-9

In Silico Identification of Genes of Economic Alternative Sources Involved in the Production of Biodiesel

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Biodiesel is a form of fuel manufactured from vegetable oils, animal fats, or recycled restaurant greases. It is safe, biodegradable, and produces less air pollutants than petroleum-based diesel. Currently, biodiesel is commercially being produced from corn, soybean, sugarcane, Jatropha. The production cost of these sources is much higher as compared to existing ones, this is the reason why these alternatives are not much appreciated in practicality. Presently genomic approaches have opened the illustrative path towards the findings related to identification of genes and its expressions too. The current work is based on such findings in terms of identification of genes responsible for oil production along with their pathway analysis in alternate economic sources .Three genes are well established in the *Jatropha curcas* genome that are involved in biodiesel production, show high homologies with three of the genes present in the genome of the *Chlamydomonas reinhardtii*. These genes code for the enzymes lysophosphatidic acid acyl transferase, fatty acid desaturase and acyl carrier protein, all of which are crucial in the lipid synthesizing pathways responding as important in biodiesel production are showing their probability in *Chlamydomonas reinhardtii* too. Current findings may help out in the use of this green algae as cheaper and better alternative for the production of biofuels. Pathway analysis of identifying genes in *Chlamydomonas* involved in biodiesel production gives the idea about the pathway of oil production, and this can be much illustrative for the scientist in exploring out its mechanism for economic and commercial production.

Key words: Biodiesel, Pathway analysis, Biodegradable, Gene expression, Ecofriendly, *Jatropha*

SVIII/P-10

Optimization of Microalgal Cultivation for Enhanced Biomass Production for Sustainable Biofuel

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Due to increasing population and industrialization demand of energy is increasing rapidly. Fast dwindling of fossil fuels and environmental concerns have necessitated the exploration of environment friendly and cost effective sustainable energy sources. Currently, there is a global effort to develop alternative energy sources. Microalgae are sunlight-driven cell factories that utilize solar energy and convert carbon dioxide into potential biofuels, foods, feed, and high-value bioactives. In the present study a total of twelve micro-algal strains were screened for their biomass as well as lipid productivity. Three most promising algal strains *Neochloris* sp. (NBRI 081), *Nannochloropsis* sp. (NBRI 082) and *Chlorella* sp. (NBRI 070) were selected for mass culturing in indigenously made photobioreactor as well as in open pond. Two different culture media TAP and BBM were compared for algae cultivation in photobioreactor whereas open pond cultivation of algae was done using agricultural fertilizers Urea and Single super Phosphate (SSP) in tap water for economic point of view. Harvesting of cultures grown in photobioreactor was done by flocculation method using chitosan. Cultures grown in open pond required no flocculating agent and were autoflocculated in stationary phase. TAP media was found to yield higher biomass as well as lipid content of all the three microalgal strains compared to BBM media in photobioreactor. Biomass content of *Neochloris* sp., *Nannochloropsis* sp. and *Chlorella* sp. was found to be 1124 mg/L, 650 mg/L, and 704 mg/L having lipid content 14.60%, 15.74%, and 14.63% respectively using TAP media in photobioreactor. Whereas in open pond Biomass content of *Neochloris* sp., *Nannochloropsis* sp. and *Chlorella* sp. was 435 mg/L, 359 mg/L and 326 mg/L having lipid content 7.94%, 8.83% and 8.17% respectively.

Key words: Algae, Biofuel, Biomass content, Lipid, Photobioreactor

SVIII/P-11

Effect of pH, Light Intensity and Phosphate Concentrations on the Biomass and Lipid Production of Green Microalga *Scenedesmus abundans*

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The intense use of fossil fuel due to large scale demand has raised the threat of global energy crises and it has been estimated that, by the year 2050 most of the fossil fuel reserves will be completely exhausted. Besides this, the combustion of fossil fuel is posing serious threat to the environment as well as human health by the emission of green house gases. Therefore it has been realised that both exploration of new energy sources and safety of environment are equally important for sustainable development. Biofuel from microalgae are considered as one of the promising alternatives to fossil fuel, but there is a need to optimise different growth conditions so as to make this process more efficient and economical for large scale production. Therefore in the present work fresh water green microalga *Scenedesmus abundans* has been studied under autotrophic growth conditions using BG-11 culture medium. Various growth conditions such as pH (5-9), light intensities (3000, 4000, 5000 and 6000 lux) and phosphate concentration (20, 40, 60 and 80 mg/L) has been administered to see the effect on biomass and lipid content of the alga, all other media component were kept constant. As a result it was found that the highest biomass content of 770 mg/L, 769 mg/L and 742 mg/L was found on the cultures provided with 60 mg phosphate, pH-5 and 6000 lux respectively. On the other hand, the highest lipid content of 180.53 mg/L, 179.47 mg/L and 243.15 mg/L was recorded on the cultures provided with 20 mg phosphate, pH-6 and 6000 lux respectively. As our work was mainly focused on economical biofuel production, the overall result of the present study showed that, out of various culture

conditions provided, one set of experiment with 6000 lux showed highest (243.15 mg/L) lipid content.

Key words: Biomass, Lipid, Biofuel, Algae

SVIII/P-12

Effect of Various Carbon Sources on Biomass and Lipid Production in Mixotrophic Cultivated *Scenedesmus* sp.

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The major challenge of twenty first century i.e. global energy crisis arises due to enhance human activities, large scale industrialization and complete dependence over the fossil fuels. Combustion of fossil fuels is also a source of greenhouse gasses which are responsible for global warming. Biodiesel can be better source of energy to reduce the emission of greenhouse gasses and acts as an alternative for the fossil fuels. Microalgae can be use as a feedstock for biodiesel, as they are microscopic, photosynthesizing organisms that combine water and CO_2 in the presence of solar energy to produce biomass. Today the most common technique for the cultivation of microalgae is photoautotrophic, but in this mode of culturing very little amount biomass was obtained due to the self shading of microalgal cells. Mixotrophic culture condition can be a better culturing method for the production of biomass where CO_2 and organic carbon both are simultaneously assimilated by the photosynthesis and respiration respectively. In the present study *Scendesmus* sp. isolated from the water body of Unchahar, Raibareli, Uttar Pradesh and grown in mixotrophic culture condition with four different carbon sources Glucose, Sucrose, Glycerol and Acetic acid. After 21 day of inoculation the cultures were harvested by centrifugation and lypholised. The dried biomass is then subjected to lipid extraction by Folch's method. The results revealed that 1178 mg/l, 1150, 800 and 634 mg/l dried biomass and 253.27, 261.05, 150.4 and 101.44 mg/l lipid obtained from the cultures containing Glucose, Sucrose, Glycerol, and Acetic acid as carbon sources respectively, while the percentage of lipid was found to be 21.5%, 22.7%, 18.8%, and 16%. On the basis of the results it can be concluded as in mixotrophic culture condition sucrose can be used for higher lipid percentage and biomass.

Keywords: Microalgae, Biodiesel, Mixotrophic, Photoautotrophic

SVIII/P-13

Characterisation and Evaluation of Oleaferous Freshwater Algae of Dal Lake Ecosystem for Biodiesel Production

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In the present study investigations on the various oleaferous algae of Dal Lake were carried out to identify the promising microalgal isolate for biodiesel production which is very much relevant to the need of biofuel industry. To identify the most promising biodiesel microalgal strain for our future research programme thirteen microalgal isolates were successfully isolated and purified from the six different sites of the Dal Lake, Srinagar Kashmir and were subjected to lipid analysis using slight modified Folch method (1957). The peak lipid content in these isolates ranged from 4.63-30.99 per cent. Amongst all, green microalga *Scenedesmus dimorphus* was selected for further studies as the isolate possess appreciable amount of lipids 30.99 per cent respectively. The growth analysis pattern of this robust alga in the BBM media showed that the specie is fast growing and reached a stationary phase on 14th day of incubation and is suitable for high-density culture. Based upon its fast growth and maximum lipid content, the promising specie of microalga was selected for large scale biomass production in self made 25 liter lab scale photobioreactors having 15 liters BBM media. The specie thrived very efficiently and biomass was harvested after a period of five weeks of incubation using different harvesting techniques like flocculation, centrifugation, lypholisation and oven dry. The lypholized biomass was subjected to lipid extraction by Soxhlet (1875) using solvent chloroform: methanol

(2:1). The microalgal oil was subjected to fatty acid (FA) analysis and the fatty acid methyl ester profile showed that the specie possess appreciable amounts of major FA with carbon chain length of C16 to C18 viz oleic acid 21.1 per cent, palmitic acid 18.9 per cent and linoleic 13.1 per cent making it suitable feedstock for the production of good quality biodiesel. The quality parameters of the microalgal oil like degree of unsaturation, cetane number, iodine value, saponification value were within the limits of ASTM D6751 and EN 14214 standards respectively. The highly dense (0.980 g cc^{-1}) and viscous oil (0.539 Pa) of the microalga reveal that transesterification is an important step to minimize these physico-chemical characteristics of the oil and conversion of the algal oil into biodiesel. Over all our results suggest that *Scenedesmus dimorphus* is the promising isolate for producing high quality biodiesel.

Key words: Biodiesel, Dal Lake, Fatty acids, Lipids, Microalgae, *Scenedesmus dimorphus*

SVIII/P-14

A Preliminary Study on Hydrolysis of Carboxyl Methyl Cellulose (CMC) by Local Soil Microbes

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Enormous amounts of agricultural, industrial and municipal cellulosic wastes have been accumulated in fields/soils or used inefficiently due to the high cost of their utilization processes. Cellulose is a linear polysaccharide of glucose units with â-1, 4-glycosidic linkages. Abundant availability of cellulose makes it an attractive raw material for producing many industrially important products. Cellulases are enzymes produced chiefly by fungi, bacteria, actinomycete and protozoans during their growth on cellulosic material, and hydrolyses the â – 1, 4– glycosidic bonds to release glucose units. Due to the vast usefulness of cellulase, this study was aimed to isolate cellulase producing microorganisms from Selakui area of Uttarakhand, Dehradun, India (N30.33° E78.06°). Samples were taken from this area because of the presence of sal forests, where, there was continuous leaf fall and decomposition. These are the conducive conditions for the occurrence of cellulolytic microbes which degrade the cellulosic content of the leaves and use them as carbon source. In the present study a total of five bacterial, four actinomycetes and one fungal strain were isolated from soil samples of Selakui area of Dehradun, India. All strains were subjected to screening for their corboxy methyl cellulose (CMC) hydrolysis activity. Results revealed that, after fermentation at temperature 27°C, pH 7 and 1.5 % CMC concentration, bacterial strain MJSH-1205 showed the highest CMC hydrolysis activity of 0.01032 U/ml/min with 0.5% of urea as nitrogen source. Actinomycete strain MJSH-1207 showed highest activity of 0.00792 U/ml/min with 0.5 % of peptone as nitrogen source whereas fungal strain MJSH-1210 showed 0.00972U/ml/min activity with 0.5% ammonium sulphate as nitrogen source.

Key words: Cellulase, Bacteria, Actinomycete, Fungi, CMC

SIX/O-1

OJIP Test Analysis as a Tool to Predict Environmental Pollution

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Usually, plants are affected by pollution, but they can also play an important role to mitigate its effects. The Plants also can be used as bioindicators to predict the pollution effects. One of the most practical indictors is the physiological status of the photosynthetic machinery of the plants. Recently, a considerable development in plant physiology science is observed, resulting in an important advances of photosynthesis researches. It is due to the availability of modern, computerized, and portable instruments measuring chlorophyll *a* fluorescence and other signals from both Photosystem II (PSII) and Photosystem I (PSI) non-invasively. Since chlorophyll *a* fluorescence (ChlF) is present in all organisms capable of oxygenic photosynthesis (Embryophyta, algae, lichens and cyanobacteria) ChlF has potentially wide applications. Research techniques based on ChlF measurements are being successfully used in a range of research areas, including plant biology, biotechnology, ecology, plant physiology and plant protection, bioenergetics, agriculture, horticulture, forestry, seed science, plant breeding, storage of vegetables and fruits, and food technology and processing. ChlF measurements are also useful for determining the quality of fruits, vegetables and flowers and for choosing the best time to sell them. They can also be used to determine seed maturity, water quality, and to estimate the allopathic impact of secondary metabolites on plant growth and development. Moreover, ChlF measurements are among the most important methods currently used in the plant science and climate change studies, due to their ability to indicate physiological condition of plants invasively within short time (few seconds), providing insights into plant growth, development and yield under naturally occurring environmental stress conditions.

In this work, we introduce a relatively comprehensive information related to the possibility of the application of chlorophyll fluorescence measurements (mainly based on OJIP test) in ecosystems monitoring. We believe that, some of the measured parameters or/and analyzed signals can be used as indicator/s for the physiological status of any ecosystem affected by climate change and pollution.

Key words: Chlorophyll fluorescence, Bioindication, Physiological status

SIX/O-2

Variations in Groundwater Chemistry under Different Vegetation Types in Delhi, India

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Present work was undertaken to study the groundwater quality under different vegetated land covers in Delhi viz. protected forest area, trees outside forest and maintained park. Phytosociology, groundwater quality and depth for each land cover were studied. Protected forest area has best groundwater quality as per BIS drinking water standards. Trees outside forest reported worst water quality among all the land covers with Water Quality Index (WQI) value of 297. Groundwater under maintained parks was also found in the category of 'very poor' quality according to WQI value. Groundwater was available at minimum depth of 4.36 m below ground level under trees outside forest. While maximum water depth is reported from protected forest sites. Maximum number of tree species is reported from protected forest area with only seven species common to all the three land covers. Land cover with maximum groundwater depth i.e., protected forest has

maximum tree species while trees outside forest with groundwater available at least depth has reported minimum number of species.

Key words: Groundwater, Vegetation, WQI, Protected forest, Trees outside forest, Park

SIX/O-3

Air Quality Status of Moradabad City during Deepawali Festival

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Deepawali, the festival of lights, is an important festival and is celebrated all over the country with great fireworks display. During the display, smoke and toxic fumes are emitted which can pause acute short – term air pollution leaving an adverse impact on health. Thus a short – term survey was done i.e. one week before Deepawali, on Deepawali Day and after Deepawali Day to see the adverse change in air quality of city. Air sampling was done at four locations representing from different residential areas with various types of activities i.e. Buddh Bazar (SI), PTC (SII), Ram Ganga Vihar (SIII), Chandra Nagar (SIV). Concentration of major pollutants during Deepawali day i.e. $PM_{2.5}$ (521 μgm^{-3}), PM_{10} (657 μgm^{-3}) and SPM (766 μgm^{-3}) was reported about 3-5 times higher than the normal day. Gaseous concentration i.e. SO_2 (76 μgm^{-3}) and NO_2 (65 μgm^{-3}) was reported about five times higher than the normal day at almost all the sites. The 24 h mean concentration of metals associated with PM_{10} on Deepawali day was found to be in the order of Zn >Al > Fe > Cu > Pb > Mn > Cr > Cd > Ni in μgm^{-3} and all these values were found to be higher (except Fe) than the normal day and post Deepawali day. Correlation study shows a strong positive correlation between Cr with Cu and Cu with Zn. The results of the present study indicated that the burning of fire crackers during Deepawali festival might be the major source of emission and accumulation of fine particles and other toxic pollutants in the surrounding atmosphere and degrade the air quality.

Key words: Air quality, Fire crackers, $PM_{2.5}$, PM_{10}, SPM, SO_2, NO_2, Heavy metals

SIX/O-4

Assessment of Growing Ambient Noise Pollution in Ranchi Urban Environment using Geospatial Techniques

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The present study deals with the growing patterns of ambient noise levels in rapidly growing Ranchi urban environment in spatio-temporal framework during 2005-10 using geospatial techniques. The study demonstrated that commercial areas, residential areas (except Heavy Engineering Corporation) and silent zones in Ranchi City recorded high ambient noise than the prescribed limits of national standard during the study periods. Less noise was observed in the Tupudana Industrial Area, which although, exhibited a gradual increase in noise pollution during the study periods but remained within the prescribed limits. The average of ambient noise levels recorded at 19 locations during October (2005, 2006, 2008), November (2007), December (2009) and May (2010) were interpolated to map the spatial variability of ambient noise levels in Ranchi. The results revealed increasing ambient noise levels in all the zones viz., commercial, industrial, residential and silent in Ranchi city during the observation periods. The assessment of ambient noise levels with reference to increasing distance from the urban core areas using concentric buffer techniques exhibited high level of ambient noise in urban core areas in Ranchi compare to its fringe zones. The ambient noise levels at major traffic junctions in Ranchi were also evaluated within the proximity of 500 m to examine the relationship of built-up land/ vegetation cover with ambient noise levels. This revealed that the ambient noise level was inversely related with vegetation coverage (R^2=0.54) whereas, directly related with built-up land coverage (R^2=0.61) at the majority of localities in Ranchi. This signifies that vegetation cover contributes in noise reduction. It can be remarked that the critical and high ambient noise levels in the various parts of Ranchi urban environment could be attributed to the increasing number of vehicles (163% during 2005–2010). The partially developed road network, narrow width of roads, encroachment over roads, poor drainage systems

as well as violation of traffic rules by auto-rickshaws causing frequent traffic congestion within the urban core zones of Ranchi and resulted in high levels of ambient noise pollution. Study demonstrated requirement of effective imposition of traffics rules and proper town planning strategies like diversion of traffic flow, roadside plantation etc. may be opted to reduce the level of ambient noise pollution in the city.

Key words: Ambient noise, Land use/ land cover, Urban area, Remote sensing, GIS

SIX/O-5

Seasonal Study of Physiochemical and Biological Characteristics of Five Wetlands of District Mainpuri (U.P.)

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Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. Mainpuri contains a mosaic of wetlands which are important for the existence of wetland birds. The present study was carried out to estimate the Physiochemical parameters of five wetlands study sites viz. Site-I (Markandeshwar), Site-II (Bhamwat Canal), Site-III (Saman), Site IV (Sauj) and Site-V (Kirithua). Saman and Sauj (Site-III and IV) are **IBAs** (Important bird areas) under Important Bird Areas Programmes of BNHS and Bird Life International. Physiochemical studies of wetlands of Mainpuri was conducted six times in an year, during April 2011 to Feb 2012 to evaluate the pollution level of water of wetlands at Mainpuri.In this paper we discuss Colour, BOD, TDS, Chloride, Fluoride, heavy metals and coliform count. Changes in the hydrologic regime due to management or climate change can result in changes in the distribution and abundance of different wetland types. This can adversely affect many wetland bird populations that frequent freshwater habitats, particularly during the breeding season.

Key words: Landscape, Physico-chemical, Wetland, Environment, Study sites, etc.

SIX/O-6

Assessment of Noise Pollution in the City of Bathinda, Punjab

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Noise is commonly defined as an unwanted sound which produces undesirable physiological and psychological effects in an individual. The word '*noise*' owes its origin to the Latin word '*nauseas*', which implies seasickness. When compared with other forms of pollution, sound does not remain in the environment for extended periods of time; however, it is the extraordinary sensitivity of the ear that permits such a relatively small amount of energy to adversely affect any biological species.

The present study was undertaken with the objective to quantify spatial dynamics of noise pollution in the city of Bathinda in the backdrop of national and international noise level criteria. Measurement of noise levels such as L_{max}, L_{min} and LEQ (Equivalent Noise level) were carried out at various sampling sites in the city of Bathinda using Envirotech Sound Level Meter SLM-100. The sampling sites represented varied land use such as residential area, commercial area andtraffic junctions. A detailed analysis of the results revealed that in residential area, L_{max} noise levels were found to be in the range of 80.2-95.9, L_{min} was observed to be 42.9-61.6 and LEQ in the range of 64.2-76.2. In commercial areas, L_{max} was 75-91.1 dB, L_{min} was 59.2-63.1, while LEQ was observed to be in the range of 68.3-79.1. At traffic sites, L_{max} was 74.3-99.4 dB, L_{min} was 64.8-72.8 while LEQ was 78.3-86.3.

As per CPCB Guidelines, the permitted noise levels during day and night time for residential, commercial, industrial areas and silence zone during daytime are 55, 65, 75 and 50dB respectively and during night time are 55, 45, 70 and 40dB respectively. The measured noise levels exceeded the permitted noise levels at almost all the sampling sites. Hence, the present study attempts to quantify the levels of noise pollution in Bathinda city so as to suggest suitable measures for managing noise pollution and its incorporation in the policy formulation.

Key words: Noise, Pollution, L_{max}, L_{min}, Equivalent noise level (LEQ)

SIX/O-7

Artisanal and Small Scale Mining of Limestone in Meghalaya, India and its Effect on Quality of Water

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Limestone is the second most important mineral resource extracted after coal in Meghalaya, India. It accounts for about 9% of the country's total limestone reserve. It is being extracted both at large and small scale levels. In Sohra, extraction and processing of limestone is done manually by individuals using minimal machinery and thus can be categorized as Artisanal and Small Scale Mining (ASM). Limestone is processed locally to produce calcined lime (quicklime). In the process of extraction and processing waste materials such as overburden and unusable solid lime are disposed off openly in the vicinity of mining and processing units. In this paper we present our findings on the effect of limestone mining and processing on the water quality of the area.

Surface water samples from control (L1), upstream (L2), in the vicinity of mining and processing site (L3) and downstream (L4) were analysed for 12 parameters. The study revealed that water quality at L3 was reported to display a comparatively higher value of pH (10.1-10.8), EC (343.33-747.67 µS), TDS (183.33-260 mg/l), TH (126.67-261.33 mg/l) and SO_4 (304.17- 687.50 mg/l). Of which, pH, EC and SO_4 were reported to exceed the permissible limit. On contrary, the values of most parameters at L1and L2 were found below the permissible limit. Moreover, overall water quality at L4 was also found to be poor in quality but not as degraded as that of L3. This clearly indicates that the lime waste material when comes in contact with surface water deteriorate the water quality of the surrounding area. Water quality index (WQI) method was used to classify the quality status of the water analysed. Based on results of WQI calculation, the quality status of the water samples in the study area ranged from good (WQI = 34.62 at L1) to very poor quality categories (WQI = 80.62 at L3) in pre-monsoon and good quality (WQI = 52.62 at L1) to unfit for consumption categories (WQI = 103.32 at L3) in post-monsoon. However, even though the effect is found to be localised, there is need for proper disposal and management of lime waste material by the people involved so that further deterioration of water quality can be minimized, and limestone mining and processing can be done sustainably in the area.

Key words: Water Quality, WQI, Limestone, ASM, Meghalaya

SIX/O-8

Greenbelt Designing and Development for Industrial Pollution Abatement

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The cost effective method of greenbelt development have been used in various urban areas throughout the world. Industrialized areas often face air pollution problems due to anthropogenic activities. The ambient air quality of an industrialized area can be restored by creating an effective greenbelt design. Many times industries are located near urban settlements. In such scenario, restriction of pollutants near its source by creating vegetation buffer is most suitable practice. Creation of such buffer zone needs systematic plantation of trees and shrubs. Designing a greenbelt according to the industry type and location involves multidimensional approach. Greenbelt designing for a petroleum company spanning around 75 acres situated in the industrialized zone adjoining to the residential area was prepared and executed in the year 2013-2014.Creation of greenbelt was necessary as the petroleum company is surrounded by many manufacturing plant units such as steel, zinc, cement, fertilizers etc. that causes dust nuisance. The systematic planning of greenbelt development involved various steps such as initial site visit, preparation of tree inventory, calculation of carbon sequestered, health wise assessment of existing greenbelt, study of various soil and water parameters, proposing greenbelt in various zones according to the site requirements, planting trees using standard operating procedures, designing irrigation system that aid in optimum use of water, maintaining and monitoring newly planted vegetation etc. During

preparation of greenbelt design various recommendations were given in order to avoid fragility. Pollution mitigating trees suitable for the site according to its agro climatic zone were suggested. Various tree species with epidermal outgrowths on leaves such as *Morus alba* were preferred, as these trees act as a sink by accumulating dust. The upgradation of existing greenbelt resulted in ecologically effective and stable vegetation buffer zone that acted as a good pollution mitigation tool and provided a check on sprawl of built up area.

Key words: Green belt, Design, Petroleum industry, Air pollution, Dust

SIX/O-9

Fluoride an Overview: Boon or Bane

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Fluoride is known to have both beneficial and adverse effect on humans, depending on the total intake. Fluoride ion is wide spread in nature. It is estimated to be thirteenth in abundance among the elements of the earth. Fluoride is a component of most types of soil with the total fluoride concentration ranging from 20 to 1000 µg/g of soil (Chauhan et al. 2014). Bioaccumulation of fluoride in many plants creates secondary source of fluoride to human population resulting in food-borne fluorosis, primary source being water. Drinking water is usually the main source of fluoride and fluoride is sometimes added to public water supplies to help prevent dental caries (Ene Indermitte et al. 2009) long-term use of groundwater for drinking has resulted in the onset of widespread fluorosis symptoms, from mild forms of dental fluorosis to crippling skeletal fluorosis (Veena Chaudhary 2010). Fluoride toxicity may lead to dental fluorosis, and be associated with Alzheimer's disease and other types of dementia, formation of a crippling bone disease called skeletal fluorosis, disruption of thyroid gland activity, and reduction in melatonin level (Ghosh et al. 2010). Fluoride is rapidly distributed throughout the body via the blood. Fluoride is a well-known G protein activator. Which affects the enzymes production, are fundamentally important in cell signal transduction or energy metabolism (LiL 2003). Excess fluoride consumption may adversely affects on bone health and teeth, decreased bone mineral density (BMD) with endemic fluorosis, damages the immune system and induces the release of superoxide free radical in resting white blood cells (John Yiamouyiannis 1993). Fluoride also inhibits PSI, PSII activity thus affects as detrimental growth, necrotic leaves, ion uptake and bioaccumulation of associated minerals. This review focused on recent developments in the research on the exposure to fluoride in fauna as well as flora.

Key words: Ecqvivocal carcinogen, Superoxide free radical, Postmenopausal BMD, fv/fm.

SIX/O-10

Environmental Impact Assessment of Natural Resources using RS and GIS Approach in Kashmir Himalayan Valley

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Environmental impact assessment of the natural resources of district Budgam of Kashmir valley was carried out during 2013-14 using Indian Remote Sensing satellite data "IRS P6, Linear Imaging Self Scanning (LISS-IV) data of Nov-Dec 2012", with a spatial resolution of 5.8 M at 1:20,000 scale. The study reveals that among the available natural resources, agricultural land covers an area of 38985 hectares amounting to 32.7% of the total geographical area and is the dominant natural resource of the district followed by forest cover with 26809 hectares (21.94%), snow and glacial cover with 16532 hectares (13.5%), mixed plantation 10281 hectares (8.4), alpine meadows/ grasslands with 7755 hectares (6.3%), built up 6559 hectares (5.4%) orchards/Horticultural plantation 5860 hectares (4.8%) ,Wastelands 5205 hectares (4.3%), wetlands 1600 hectares (1.3%) and water-bodies 1594 hectares (1.3%) respectively. These statistics show considerable differences in various land use and land cover features pertaining to district. The change detection studies of the last few years shows a decreasing trend which can be attributed to the fact that agricultural land is being converted either into orchards or used for construction purposes and being subjected to industrialisation. Similarly, orchards and horticultural plantation shows an increasing trend during the years 2008-2012 (from 5407-5860 ha).

Similarly, built up and transportation also show an increasing trend during the years 2008-2012. As population of the district is increasing at a rapid pace, a need arises for extra space and mostly agricultural land, wasteland and orchards are being used for this purpose. The paper presents a holistic view of the changing pattern of natural resources in the district.

Key words: Landuse/landcover, LISS-IV data, Natural resources, Remote-sensing, Kashmir Himalayas

SIX/O-11

High Dissolved Aluminum in Water Resources of Ganga Alluvial Plain and its Implication to Waste Management Plans

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In northern India, the Ganga Alluvial Plain is one of the densely populated regions in the world and serves as a home to nearly 500 million people. Aluminium (Al), an environmentally abundant and immobile element, has been studied for its dissolved concentration in the Gomati River Basin draining in the central part of the Ganga Alluvial Plain. Total 36 water samples have been collected from the Gomati River and 109 groundwater samples (India Mark-II hand pump) collected from the Lucknow area. The concentration of Al in river water ranges from 273 to 77,861 µg/l with an average value of 5,289 µg/l and in the groundwater of Lucknow area ranges from 14 to 6596 µg/l with an average value of 247 µg/l. based on the sodium-normalized elemental mobility index, the Al in the Gomati River water is classified as a moderately mobile element. Nearly 19 % of Lucknow Groundwater samples and all the Gomati River water samples have Al values above the permissible limit (200 µg/l) recommended by World Health Organization.

It has been noted that high concentration of Al in drinking water may affect human health and has been linked to the Alzheimer's disease and other neurological disorder. The sweeping of Alzheimer's and other dementia diseases were reported in a rural community of northern India at the prevalence rate of 8.4 per 1000 persons. It is suggested that the mobilization of Al from the alluvial sediments is controlled by the chemical weathering processes of mica minerals (muscovite and biotite) and monsoon precipitation. The source of labile organic carbon is necessary to derive microbial reduction of iron present in mica minerals of the alluvium for the chemical weathering process. Regional Developmental Schemes such as National Drinking Water Mission and Central Rural Sanitation Programme are extensively using the shallow aquifers to provide safe drinking water and to introduce natural organic matters, respectively. Therefore, to prevent further devastation, there is a dire need of a comprehensive study of Al distribution in drinking water resources and its toxic effects over human population in the Ganga Alluvial Plain.

Key words: Dissolved aluminium, Groundwater, Gomati River, Development plans, Ganga alluvial plain

SIX/O-12

Effects of Physicochemical Properties on Heavy Metals in Soils of Yelagiri Hills, Tamilnadu, India using Multivariate Statistical Analysis

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The physicochemical properties and accumulation of heavy metals determines the quality of soil ecosystem. This ecosystem is altered by natural and anthropogenic activities. In this study concentration of 12 heavy metals (Mg, Al, K, Ca, Ti, Fe, V, Cr, Mn, Co, Ni and Zn) determined by energy dispersive X-ray fluorescence spectroscopy (EDXRF) and physicochemical properties such as, P^H, electrical conductivity, bulk density, porosity density, sickness, plasticity, moisture condition, soil texture and color are determined by conventional analytical methods in

soils of Yelagiri Hills, Tamil Nadu. The function of physico-chemical properties to accumulate heavy metal concentrations in soils are studied by multivariate statistical methods such as Pearson correlation analysis and cluster analysis. Spatial distribution of soil parameters such as P^H, soil texture (sand, silt, clay), electrical conductivity was studied by geo-statistical methods such as kirging identified areas.

Key words: Soil, Physicochemical properties, Heavy metals, Statistical methods

SIX/O-13

Environmental Impact Assessment of Paint Industry: A Case Study

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Environmental Impact Assessment is a methodology that is required to be done to assess the likely positive or negative impact that a proposed project may have on its surrounding environment. EIA studies include environmental, social and economic impacts of a project prior to decision-making and find appropriate measures to reduce them. This article specifically discusses the EIA studies on Paint Industry. The study aims to exhibit the various parameters that may be considered while preparing the impact on Environment due to proposed Paint Industry. The detailed study on the processes and by products revealed that it has a greater impact on the environment especially in areas of noise pollution, water pollution, soil pollution, occupational health etc. Volatile Organic Compounds (VOCs) in paint are considered harmful to the environment and for people who are in regular contact with them. Based on the findings, few recommendations were made for the elimination of the negative effects in some case. A detailed environment management plan was prepared during the construction, and operation and maintenance phase of project.

Key words: Environmental impact, Design, Management plan, Measures, Pollution, Sustainability

SIX/O-14

About Gases of Chimney Number 101 of Jam Petrochemical Company in the Years: January, February and April 2010

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The natural gas basically consists of carbon and hydrogen which combine with oxygen in the air and make carbon dioxide and carbon monoxide or water steam. Gases fuels burn in the flames or the fuels and the air are pre-combined in the furnaces leading to burning. As CO gas is dangerous to human beings, animals it is important decrease this gas emitting from chimney. On burning natural gas emits SO_X, CO, HC and they make a lot of Azotic oxide which are the reason of pollution as these are formed at the start of fuel burning. Recently the affects of Azotic oxides is realized. Human health is in danger when the concentration ranges between 0.063 to 0.08 PPM for 6 months. Also the combination of SO_2, NO_2 is dangerous for the earth. The most important affect of NOX is making photo chemicals in presence of sunlight and hydrocarbons. TESTO 350 –XL was used in this search. The study industry is Grade2 according to the Iran environment saving organization. The concentration of CO_2 was respectively 0.00, 0.00, 0.00 during December 2009, February 2010 and March 2010 where as gas emitted from the chimney is 150ppm. The concentration of NOx (ppm) was respectively: 101, 111, 109 during December 2009 and February 2010 and March 2010. The amount of this gas emitted from the chimney is 350ppm. The concentration of SO_2 (ppm) was respectively: 0.00, 0.00, 1.91 during December 2009 and February 2010 and March 2010 and the of this gas from chimney is 800 ppm.

Key words: Petrochemical, Azotic oxide, Chimney, Natural gas, Carbon monoxide

SIX/O-15

Measurement of Polycyclic Aromatic Hydrocarbons in Low Income Houses using Kerosene as Cooking Fuel

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Kerosene is a complex mixture of branched and straight-chain compounds; Kerosene has been an important household fuel since the mid-19th century. In India, a majority of low income household uses kerosene, as an energy source, to cook food and kerosene lamps are frequently used when electricity is unavailable. There are mainly two types of kerosene stove depending on how the fuel is burned—wick stoves, which rely on capillary transfer of fuel, and the more efficient and hotter burning pressure stoves with vapor-jet nozzles that aerosolize the fuel using manual pumping. In low-income households, wick stoves are more commonly used, because they are cheaper, they easily provide simmer heat for some staple foods. Kerosene, when burned in stoves or other appliances emits many potentially health-damaging pollutants like PM, CO, SO_2, NO_2, along with polycyclic aromatic hydrocarbons (PAHs) in an uncontrolled manner. Exposure to indoor air pollutants is recognized as one of the major human health concerns especially for women and children residing in slums and low income families. A number of health hazards associated with the use of kerosene as fuel. In the present study, the concentrations and profile of carcinogenic PAHs, PM, CO, SO_2 and NO_2 were measured in the selected low income houses using kerosene as the cooking fuel.

Key words: Indoor pollution, Low income houses, Kerosene, PAHs

SIX/O-16

Local Weeds: Evaluation of their Potential

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Weeds are defined in various ways but generally they are considered as plants which grow where they are not wanted. Out of 2,50,000 plant species, 800 have been described as weeds. Weeds have been ignored by policy makers, extension workers and economist. They are important components are biodiversity. Studies show that these are treasure of various economically important materials. They affect food chain / food web in eco-system, provide seeds for evolution of new species. They play important role in agriculture, pharmaceuticals and neutraceuticals. Role of weeds in pharmaceutical and neutraceutical has been generally overlooked. There are number of reports which suggest that weeds have relatively high accumulation of secondary metabolites. Present study was undertaken to enlist weeds from local habitat and fields. Their morphological features and measure events of life cycle have been described.

Key words: Weeds, Biodiversity, Phamaceutical

SIX/O-17

Change in Environment at Dehradun and its Impact

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Dehradun, is best described as "Valley in Shiwalik Hills", being surrounded by Shiwalik mountain range, fringed with the Ganga on the east and the Yamuna on the west. The jewels studded in DehraDun's crown are-Queen of hills-Mussoorie, Sahastradhara, Rishikesh, Haridwar, Lachiwala, Maaldevta ,Bhatta falls, Tiger Falls, Robber's cave, Buddha Monastry, Shiv Temple, Tapkeshwar Cave Temple, Shenshai Ashram, Ramkrishna Mission Ashram, Malsi Deer Park, British architecture,leychee farms,resplendent weather and pristine natural beauty.

Dehradun houses great institutions and schools like The Indian Military Academy, The Forest Research Institute, The Oil and Gas Corporation, The Survey Of India, Wadia Institute of Himalayan Geology, Wildlife Institute of India, National Institute of Remote Sensing, Rashtriya Indian Military College, the Lal Bahadur Shastri National Academy of

Administration at Mussoorie, The Doon School, The Welhams School within Dehradun and several of them uphill in Mussoorie.Today Doon has developed and expanded but at at the cost of its natural bounty.

After the formation of Uttarakhand State in November 2000, Dehradun was declared the "Capital" of Uttarakhand.This proved to be the biggest misfortune that befell on our beloved city. The city today faces huge difficulties in terms of waste management as around 300 tonnes of waste is generated everyday, of which only 100 tonnes is collected and recycled. The rest stays around us in the form of roadside litter and open dumpsites.

Mass migration of people from uphills to the city in search of quick bucks followed by rapid urbanization led to building of houses even on a small piece of land with roads becoming narrower for the traffic. Since 2000, over 2 lakh trees were cut officially, while unofficial estimates put the number five times. The leychee farms have been replaced by multistoreys, malls, hotels and resorts. Today the beauty of Dehra Dun is like of a wounded tiger at the Rajaji National Park.

Doonites are proud of the grown up DehraDun but due to modernization we are losing the most precious gift given to this land by god; Nature! Prakriti! The city has lost its lusture with polluted air, trees look lifeless, Himalayan birds disappearing and rivulets narrowing.

Key words: Valley in Shiwalik, Leychee farms, Capital of Uttarakhand, Mass migration, Waste management, Urbanization, Himalayan birds

SIX/O-18

A Study of the Impact of Cognizant Consumer Purchase Behavior and Food Preferences on Secondary Carbon Footprint

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2014 has been declared as globally the hottest year ever. CO_2 a major contributor to the climate change has finally crossed the 400 parts per million mark, thus necessitating immediate reduction in carbon footprint. The present study aims to encourage consumer in reducing secondary carbon footprint by intentional change in purchase pattern and food preferences. Carbon Footprint Calculator is used to collect data. The consumer's Food Preferences (Vegetarian, Non-Vegetarian), Purchase Intent for Packaged Food (No Packaging, Little Packaging, Nice Packaging) and Recycling Considerations for used products (Mostly, Sometimes, Never) form baseline for study. The secondary footprint (in metric tons of CO_2/year) of a consumer owing two cars; bank account; sometimes preferring purchase of organic, season food; mostly buying locally produced nicely packaged products with no consideration to recycle used product; restricting purchase of latest fashion and home products only when needed; and occasionally going for recreation to movies, restaurants etc. is 6.45 (for vegetarian) and 7.69 (for non-vegetarian). Only purchasing products with little packaging, reduces footprint to 4.85 and 5.82. Recycling most of used products restrains it to 4.14 and 4.90. A vegetarian can further slash it to 3.14 by decreasing number of owned cars from 2 to 1, but it is still more than the worldwide target of 2 metric tons of CO_2/year to combat climate change. Zero carbon activities for recreation are found to be exceptionally functional in reducing it to 2.28. So, consider the impact of purchase and recreation activities on environment before accomplishing them. The Indian government has earmarked **Rs.** 100 crore budget for climate adaptation fund. Climate change is expected to exacerbate health problems; slow down economic growth, increase displacement of people and indirectly raise risks of violent conflict. Increased risk of heat related mortality; water and food shortage causing malnutrition and flooding leading to damage of infrastructure and livelihoods are key risk factors due to climate change in Asia.

Key words: Climate change, Consumer purchase behavior, Packaged products, Recycling, Secondary carbon footprint

SIX/P-1

Cross-Domain Control of DOC Build-Up in Ganga River: Role of Atmospheric Deposition and Land Surface Runoff

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River Ganga, a trans-boundary river extending over India, Nepal, China and Bangladesh, together with Brahmputra-Meghana river system is second only to Amazon with respect to the amount of water discharge. From the last few decades, the Ganga River basin, supporting about 43% of India's population, receives massive input of carbon and nutrients along its 2525 km long course from human-driven sources including atmospheric deposition (AD). The present study was an effort to investigate atmospheric deposition of NO_3^-, NH_4^+, PO_4^{3-} and organic carbon (OC) and, nutrients and dissolved organic carbon (DOC) in runoff and nutrients, DOC, chlorophyll a biomass (Chl a) and gross primary productivity (GPP) along a 35 km stretch of Ganga River at Varanasi. Concentration of nutrients in river showed significant positive correlation with their AD inputs and runoff import. Chl a and GPP followed a trend similar to nutrients, increased downstream and highest during winter. Phytoplankton development in terms of Chl a biomass and GPP showed strong relationship with atmospheric input. Our study indicated that AD-coupled runoff flushing of C and nutrients can substantially enhance DOC build-up in Ganga River. The study provides important information and cues on which predictive climate models and Ganga River basin management strategies can be keyed.

Key words: Atmospheric deposition, Climate change drivers, Ganga River, DOC, Phytoplankton, Nutrients

SIX/P-2

Methane and Carbon Dioxide Emission and Leachate Chemistry at Two Landfill Sites along the Ganga River at Varanasi

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Carbon dioxide and methane are the most important green house gases being emitted from landfills. Methane is the only gas which directly affects the tropospheric chemistry, and through a series of chemical reactions, largely determines the concentration of hydroxyl-radicals, the most important oxidizing constituent of troposphere. In addition to contributing to climate change and free radical chemistry, the landfills contaminate surface and ground waters through leachate and have concern from a human health perspective. We studied the emission flux of CH_4 and CO_2 and the chemistry of leachate for two consecutive years at two landfill sites situated along the Ganga River at Varanasi. The emission flux of CH_4 ranged from 10.73 to 96.74 mg m^{-2} h^{-1} and that of CO_2 from 17.28 to 321.89 mg m^2 h^{-1} and increased with rising moisture and temperature. Emission rates were higher at young landfill site (Kzzakpura, KZP) and between-site differences in the emission rates of these gases were significant. Concentration of nutrient ions and heavy metals in leachate emerging from study landfills varied with season with values being highest in rainy season. Leachate at young landfill site (KZP) contained Fe (6.12 to 23.17 mgL^{-1}), Zn (0.615 to 3.06 mgL^{-1}), Cd (0.047 to 0.37 mgL^{-1}), Cu (0.639 to 3.83 mgL^{-1}), Ni (0.12 to 0.98 mgL^{-1}), Pb (0.49 to 1.89 mgL^{-1}) and Mn (0.69 to 9.87 mgL^{-1}). Concentrations of these metals were relatively lower at old landfill site (Bypass, BPS). The study has relevance reducing uncertainties in greenhouse gas emission estimates in India and to uncover landfill associated contamination to Ganga River.

Key words: Greenhouse gases, Climate change, Free radicals, Landfill, Leachate, Human health

SIX/P-3

Ion Analysis of Surface Water Samples from Ropar Wetland, Distt. Ropar, Punjab

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In the past few decades, there has been substantial increase in pollution in all parts of the environment. Water has been no exception to this. Water is the basic necessity of life. Surface water is used for household work, drinking and for irrigational purposes. It has direct impact on human health, therefore it is essential to keep a keen check on the quality of surface water. Considering this problem, present study was planned to analyse different ions in the surface water from Ropar wetland. Ropar wetland is a man made wetland situated on the banks of river Sutlej in District Ropar, Punjab. For this study, five surface water samples were collected from the river Sutlej in Ropar wetland for

ion analysis. Copper, iron, lead and manganese ions were analysed using flame atomic absorption spectrometer. Chloride, calcium and magnesium ions were analysed by titrimetric methods, sodium and potassium ions were analysed using flame photometer whereas, nitrate and phosphate ions were analysed using double beam UV-Vis spectrophotometer. All the parameters were compared with the permissible limits of Bureau of Indian standards. Concentration of lead and iron ions was found to be high whereas, concentration of copper, manganese, chloride, calcium, magnesium, sodium, potassium, nitrate and phosphate ions was found to be under the permissible limits in all the samples.

Key words: Chloride, Nitrate, Phosphate, Lead, Iron, Ions

SIX/P-4

Heavy Metal Status in Wastewater, Irrigated Soil and Plants of Different Drains Discharge into River Ganga at Allahabad, Uttar Pradesh

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The heavy metal concentrations in the environment are due to primarily natural availability and anthropogenic activities, and because the heavy metals are very persistent pollutants, they get accumulated in the water, soil and plants, finally entering in the food chain. This paper assess the quality of wastewater and contamination of heavy metals like Fe, Cd, Pb, Zn and Cu from these selected drains discharging effluent in the river Ganga at Allahabad, Uttar Pradesh during 2012-2013. The heavy metal concentration of Fe, Cd, Pb, Zn and Cu were estimated by using Atomic Absorption Spectrophotometer. The presence of heavy metals were observed in all sites throughout the year, summer season recorded maximum concentration of Fe (0.498 mg/l), Zn (0.095 mg/l), Cu (0.009 mg/l), Pb (0.007 mg/l) and Cd (0.006 mg/l) in Mori gate drain, Fe (0.257 mg/l), Zn (0.056 mg/l), Pb (0.042 mg/l), Cd (0.036 mg/l) and Cu (0.019 mg/l) in Mawaiya drain and Fe (0.494 mg/l), Zn (0.093 mg/l), Cd (0.006 mg/l), Cu (0.008 mg/l) and Pb (0.005 mg/l) in Bairagiya drain, respectively. Maximum level of heavy metal contamination was observed in Mori gate drain as compared to Mawaiya drain and Bairagiya drain. The presence of heavy metal in our environment shows the great concern because of their toxicity when their concentrations are more than possible level. Mobility and bioavailability of the contaminant depends on its nature and on the characteristics of the environment. The ecotoxocological results depend not only on the sensitivity of the organisms but also on their interaction with both of the contaminant and the matrix. Transport and availability of contaminants may be characterized by integration of chemical analytical and biological/ ecotoxicological data. Often, plant can accumulate high amount of metals in their tissue without any obvious sign. Food plants which tolerate relatively high concentration of these potential hazardous metals are likely to create a greater health risk than those which are more sensitive and show definite symptoms of toxicity.

Key words: Wastewater irrigation, Contamination, River Ganga, Heavy metal pollution

SIX/P-5

Role of Plants in Mitigation of Environmental Impact during Construction Phase of Building Projects: A Case Study of Curaj Campus

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Urbanisation trends to rapid increasing response in the construction projects especially in building, roads, metro rails, railways, airports. During the construction phase of such types of activities creates negative impacts on natural exiting environment. Therefore, there are needs of proper mitigation strategy consisting low cost efficiency, long term residence, and finally sustainability. Objective of the study is to find the role of semi-arid regional plants for mitigation of different impacts during the construction phase of newly established central university campus. The study area is under pioneer phase situated in central aravali and semi-arid region of Ajmer district Rajasthan. Pre-construction assessments of plants species show the *Acacia nilotica, Prosopis cineraria, Zyzipus nummularia, Cyperus rotundus, Corchorus depressus* are dominant species around the campus. The total

groundcover is 7.77% where as 45% as green belt of dominants species of plants. The comparatives analysis of pre, during operation, and post events of construction shows the decreasing concentration in SOx, NOx, HC,O_3, RSPM, TSPM level by 0.66 ìg/m^3, 1.02ìg/m^3, 0.19ìg/m^3, 0.23ìg/m^3, 5.2 ìg/m^3, 7.4 ìg/m^3 respectively. The area having 0.75 surface run-off coefficients having under control hydrological parameters. The water qualities affected by very small differences and final results as pH, EC, TDS .Salinity, Alkalinity is about 7.4, 584, 262 ppm, 26.3ìg/l, 530ìg/l respectively. The mitigation response of all five dominant plants is quite good during the investigation. The research conclude the dominants plants of area will mitigates all general and specific impact during such types of activates and will recommended for the EIA management plan.

Key words: EIA, Construction projects, Semi-arid region, Mitigation response, *Prosopis cineraria*

SIX/P-6

A Case Study for Environment Impacts Assessment using Non-Spatial Data Sets

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Anthropogenic activities in the form of urbanization, land use changes, infrastructure development and many more are major threat to biodiversity. The fragmentation and loss of natural habitats are great obstacles for the long term preservation of biodiversity, its component and nature protection measures alone may not be sufficient to tackle the problem. EIA (Environmental Impact Assessment) play a major, central and efficient role in identifying, predicting and managing the impact of human activities on environment and biodiversity. The review of current research suggests that the complexity of the task is underestimated and that new methodological approaches encompassing the entire landscape are needed. It is a known fact that any new project brings along number of unwanted and negative impact on any particular area. In short establishing new project means exploitation of all environmental components including flora, fauna, land area etc of that area. The current study is based on EIA study and its impacts over SIA (Social Impact Assessment) of a base area which is (CURAJ) campus. Data of environmental parameters is collected before its establishment and during its constructional phase and analyzed the probable impacts by comparing both data. It showed different impacts on different components.

Key words: Anthropogenic, EIA, SIA, Biodiversity, Environmental parameters

SIX/P-7

Comparison of Physico-Chemical Quality of Water Bodies of Chinhat Area and Gomti River

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Groundwater is one of the most important sources of drinking and irrigation, but its quality is under constant threat of contamination directly or indirectly. Compounds in surface water can eventually be transferred into ground water. Contaminants such as arsenic and nickel can leach from pond water into the ground water. Any alteration of physical, chemical or biological properties of water, injurious to animal, plant or aquatic organisms' health, is called water pollution. Despite the fact that the river Gomti is an important source of drinking water to a large number of people living in Lucknow, 51% requirement of drinking water is met from ground water through tube wells and hand pumps; whereas the remaining 49% is met from the river. Lucknow and its surrounding area had a number of water bodies or ponds, of which many have already disappeared due to illegal construction and encroachment. According to a government report, based on survey conducted in 2003-05, water from ponds like Butler Palace and *Motijheel* were contaminated with heavy metals, e.g. lead, chromium, cadmium, arsenic etc. Thus these water bodies can pose a serious environment and health hazard. There are two large water bodies or ponds in Chinhat area of Lucknow, one of which is called Chinhat jheel. Majority of population residing in surrounding localities is dependent in water from this jheel/pond. An attempt has been made here to analyze physico-chemical status of the water of these ponds in post monsoon season and then compared with Gomti river water.

Key words: Water pollution, Water bodies, Gomti river, Physico-chemical properties

SIX/P-8

Arsenic Level in Drinking Water of District Bareilly and Shahjahanpur of U.P.

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Since arsenic has been reported from bore water of the two sites of Bareilly and one site of Shajahanpur, therefore, studies was carried out to examine the effects of the arsenic on the teeth deformity. Twenty one patients having symptoms of the arsenic on their skin, being suffered by arsenic, were examined for the teeth deformity. Non of them were found to have had any teeth deformity. It could be that level of arsenic was not over dangerous levels in groundwater in Bareilly and Shahjahanpur. World Health Organization stipulates that 10 microgram per litre is the accepted level of arsenic in water, while its concentration was around 0.05 mg/litre to 0.09 mg/litre in several sites of the districts of Bareilly and Shajahanpur. However, prolonged consumption of this water is not safe and cannot rule out eruption of any symptoms. Further work is in progress in districts Rampur side too beside Shahjahanpur and Bareilly. Low level of the arsenic was probable the sole region that did not show any toxic effect on teeth. The arsenic level in analyzed drinking water was in the range of (arsenic presence from 0.03mg/litre to 0.07mg/litre) from and pumps of analyzed sites of Bareilly was unfit for consumption.

Key words: Arsenic, WHO, Drinking water

SIX/P-9

Detection of Heavy Metals in Total Suspended Particulate Matter (TSPM) Collected from Six Different Sites of Amritsar City (Punjab), India using Scanning Electron Microscope (SEM-EDX)

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Air, along with water and soil, is one of the essential components for survival of living organism. However, due to heavy traffic loads in the recent years, composition of air shows great extent of variations in its organic as well as inorganic fractions. It is essential to characterize the suspended particulate matter present in air exposed to traffic emissions due to increased risk of chronic obstructive pulmonary diseases (COPD), chronic kidney diseases (CKD), chronic respiratory diseases, infertility as well as chronic cardiovascular diseases. Considering all, PM10 samples were collected from the six different locations exposing to vehicular emissions viz., Jallianwala Bagh, The Golden temple, urban site, commercial complex, residential area, Guru Nanak Dev University campus and Guru Nanak Dev University campus hostel complex with particulate concentration 215, 168, 196, 215, 159, 164 μgm^{-3} respectively using High Volume Sampler (HVS). The samples were analyzed by SEM-EDX for morphological as well as to estimate individual elemental composition of SPM in different locations. The results of SEM-EDX has shown the presence of various elements *viz*., C, O, Na, Mg, K, Ca essential elements as well as heavy metals such as Fe, Cu, Ti, Zn etc.

Key words: COPD, Morphological, Air pollution, Elemental analysis

SIX/P-10

Assessment of Ground Water Contamination around the Municipal Solid Waste Sites of Vadodara

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Ground water is stored in ground in materials like gravel or sand. It's like the Earth is a big sponge holding all that water. Water can also move through rock formations like sandstone or through cracks in rocks. Water in a lake can soak down into the ground water and become ground water. Water is a good solvent which dissolves minerals from the rocks with which it comes in contact. Groundwater may contain dissolved minerals and gases that give it the tangy taste enjoyed by people. Without these minerals and gases, the water would taste flat. The most common dissolved mineral substances are Sodium, Potassium, Calcium, Magnesium, Chloride, Bicarbonate and Sulfates. Groundwater may be in many places contains

excessive amounts of iron. A test of the acidity of water is pH- measure of potential of Hydrogen ion concentration. The scale ranges from 0 to 14. A pH 7 indicates neutral water. Ground water is an important ecological resource. It helps keep our rivers and lakes full, and sustains a wealth of plants and animals. Some of our ecosystems are dependent on ground water for their survival.

Four composite water samples were collected from eight hand-pumps located near the landfill site and open dumping site in Vadodara. Physicochemical characteristics of these samples were analyzed using methodology as given in CPCB manuals and APHA guidelines. Significant amount of ground water contamination in area close to the dumping site was observed. Results are indicative of TDS 4-5 times higher and Chloride 2-5 times higher than normal level, etc. These increase in certain water quality parameters maybe due to leaching of chemicals due to rains from the dumped waste.

Key words: Contamination, Groundwater, Municipal solid waste, Vadodara

SIX/P-11

Demonstrating Urban Pollution using Heavy Metals of Road Dust in Lucknow City, Uttar Pradesh, India

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Heavy metal contamination in urban road dust and road side soils has become a growing concern in recent years. Road dusts in urban areas are indicators of heavy metal contamination. The road side dusts primarily consist of soil derived minerals but it also contains some potentially toxic pollutants like heavy metals, originating from a wide range of anthropogenic sources. The anthropogenic sources of heavy metals mainly include traffic emission (vehicle exhaust particles, tire wear particles, weathered street surface particles, brake lining wear particles), industrial emission (power plants, coal combustion, metallurgical industry, auto repair shop, chemical plant, etc.), domestic emission, weathering of building and pavement surface, atmospheric deposited and so on. Heavy metals can be deposited in road dust by dry or wet atmospheric deposition and can be transported into water, air and soil and can even enter plants, animals and human bodies. Therefore, many people who use sidewalks and those who live near roadways in urban areas may be exposed to toxic heavy metals in road dust. In present study a total of 25 road dust samples have been taken from eight representative locations categorized as residential (four) and commercial (four) areas in Lucknow city for assessing the concentration of six heavy metals (Iron, Manganese, Chromium, Zinc, Lead, Copper, Nickel). Metals were analyzed through acid digestion followed by atomic absorption spectrophotometric method. Results showed that road dust samples contained significantly high levels of the metals as compared to the values from the control site. The variation in concentration of most of the heavy metals determined decreased in an order represented as commercial > residential > control. It is due to more traffic density and crowd in commercial areas. In all the road dusts, iron is the most available and labile element followed by manganese. Road dusts concentration varied from 3.41-7.160 for Nickel , 6.150-33.720 for lead, 4.101-15.480 for copper, 9.00-90.50 for chromium, 40.25-92.250 for manganese , 9.250-79.500 for zinc and 2943.50-3874.50 for iron. All concentration is in mg/kg. The order of average heavy metal concentration in residential areas is Fe>Mn>Cr>Zn>Pb>Cu>Ni and for commercial areas Fe>Mn>Zn>Cr>Pb>Cu>Ni. Results indicate that the metal pollutants in road dusts could significantly contribute to deteriorate the environmental status of the city Lucknow.

Key words: Heavy metals, Road dust, Traffic emission, Acid digestion, Commercial, Lucknow city

SIX/P-12

Assessment of Water Parameters for the Growth of Toxic Microalgae in Major Water Bodies of Uttar Pradesh, India

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Water quality parameters were assessed to study its effect on the growth of toxic microalgae in major water bodies of Uttar Pradesh, India. Growth of toxic microalgae in water bodies can be used as indicator

of water pollution. Water samples were collected from different location of Ganga river (Kanpur and Varanasi), Gomti river (Lucknow), Sai river (Lucknow and Raibareli) and Sardha canal (Unnao). Physico-chemical parameters pH, DO, conductivity, phosphate, nitrate, sulphate, iron, chromium and chlorine was estimated periodically in the month of February, May, August and November. Sardha canal was found be highly polluted followed by Ganga, Gomti and Sai river, respectively. *Osillatoria tenuis* isolated form Sardha canal (Unnao, UP) was found to contain high concentration (1.6 ppb) of microcystin (algal toxin). The microcystin content in water bodies should not be more than 1 ppb as per WHO guidelines. The microcystin obtained from *Osillatoria tenuis* was detected at Rt 19.8 min using High Performance Liquid Chromatography analysis coupled with Photo Diode Array detection (200-300 nm). Effect of nutrient stress was also monitored to study its effect on growth of toxic microalgae. Phosphate and nitrate in the water are the most important regulatory factors for microalgal growth and toxin production. Toxic *Oscillatoria tenuis* with highest concentration of microcystin was selected to study the effect of phosphate and nitrate stress (x) in the ratio of 1:4 on the biomass and total protein content of the cyanobacterium. Growth characteristics of the organism in term of total biomass and total protein content were evaluated. *Oscillatoria tenuis* growing in standard algal growth media BG 11 was used as positive control while nutrient depleted media is used as negative control. *Oscillatoria tenuis* growing in moderate combination of nitrate (16x) and phosphate (4x) showed optimum growth but the protein content was increased to 18.4 % with respect to positive control. Identification of toxic algal species and their component would be helpful in understanding the mechanism of toxicity and regulation of toxic algal blooms in fresh water bodies.

Key words: Water quality, Toxic microalgae, Microcystin, Nutrient stress, Growth

SIX/P-13

Ecological Study of a Pond in Relation of its Bioproductivity at Banda, U.P., India

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Assessment of hydrobiological features viz. Colour, Turbidity, Water Temperature, pH, CO_2, D.O., B.O.D., Chloride, Carbonates, Bicarbonates, Total Alkalinity, Ammonical Nitrogen, Nitrate, Phosphate and Plankton (Phyto and Zoo) and fishes were studied of Pragi Talab at Banda during rainy season 2014. Water samples were taken from four points of the said pond, having in view to examine its entire ecology of the pond. Hydrobiological study is quit essential for the assessment of bio-productivity for which physical and chemical characteristic play main role. Lentic water are main source of bio-productivity, which are ecologically important which have medicinal and food value. As per the observations following APHA the productivity of the said pond is not upto the mark, because pond water is used mostly by washerman and vehicle washing. Thus the detergents and petroleum products cause harm the biota, besides; there is no embankment and trees. So the pond requires proper management scientifically for enhancement of bio-productivity. Besides meteorological conditions viz. Photoperiod, Atmospheric Temperature, Rainfall and Relative humidity were also recorded which have direct impact on waterbodies. On those guidelines the other unmanaged lentic waterbodies may be properly managed scientifically, so that their bio-productivity might be an asset for the wellbeing of the society. The parameters results were compared with ISI/WHO standards.

Key words: APHA, Hydrobiology, Assessment of bio-productivity, Role of lentic waterbodies in human welfare, Management of lentic waterbodies, ISI/WHO

SIX/P-14

Noise Pollution

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With the advancement in technologies, urbanization and globalisation many new environmental problems are emerging. Noise pollution is one of these. Like any other pollution, it has very deleterious effects on human health, behaviour and his activities. Noise is commonly seen near airports, railway lines, construction areas and factories. Many

laws are framed in order to tackle this problem. These laws help in finding appropriate solutions and create awareness among people. Late night parties, discos, bars playing loud music are also responsible for noise pollution. People residing in areas close to discos, airports and bars are badly affected by this pollution. This noisy environment interferes with sleep, concentration and other activities of people. Along with humans, animals too have problems in communication. New devices like Wireless Sensor Networks, sound level meters, sound monitors are installed in order to check noise levels.

Key words: Noise, Sound, Decibel, Predator-prey interaction, Globalisation, Natural balance

SIX/P-15

A Clean Technology Approach of Cachar Paper Mill, Assam, India: A Unit of Hindustan Paper Corporation Limited

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The pursuit of clean technology in any pulp and paper mills calls for involvement of full range of its production related and non production related departments. The approach must be flexible enough to adopt a systematic step by step approach to ensure maximum exploitation of clean technology potential. An attempt has been made in this paper special reference to Cachar Paper Mill a unit of Hindustan Paper Corporation Limited. This paper deals with available clean technology and its management approaches of CPM which is a pulp and paper based industry. As the pulp and paper industry is among 20 highly polluting industries in our country so it is very important to know the process and management techniques which are very crucial to achieve the clean and environment.

Key words: BOD, COD, Clean technology approach, Paper and pulp industry

SIX/P-16

Arsenic Pollution Scenario in Eastern U.P., India: A Review

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Arsenic pollution in India has been identified in many states namely, Assam, Bihar and West Bengal. The worst and most investigated region is West Bengal, and according to United Nations Children's Fund, over 13.8 million people are at risk. But in recent decades, arsenic pollution is also being reported from eastern region of Uttar Pradesh State. There has been wide spread of arsenic contaminated soil in India, of which the eastern district of Uttar Pradesh (UP) is least focused. Very recently it is reported that 20 district of UP is severely toxic zone of arsenic contamination (above 0.05mg/L), where arsenic presence has been found to be more than five times of permissible limit. Three districts (Ballia, Gazipur and Varanasi) of Uttar-Pradesh were found to contain arsenic concentration above 10 mg L^{-1} which is a WHO recommended provisional guideline value of arsenic in drinking water. Humans, plants and animals from these villages are exposed to the grave danger of Arsenic poisoning as this problem is largely unrecognized and unaware. Therefore, there is an urgent need for detailed study and mitigation endeavour from arsenic pollution. This paper intent to give an overview of the arsenic contamination in eastern U.P. and the research work carried till date.

Key words: Arsenic, Uttar Pradesh, Soil, Water

SIX/P-17

Physico-Chemical Analysis of Water Quality at Different Site of River Gomti, India

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The world is facing problems with a wide variety of pollutants both inorganic and organic in nautre.

Healthy soil, clean water and air are the soul of life. Of these water pollution especially river pollution, the major source of water use are becomes heavily polluted due to discharge of various type of effluents into the river without prior treatment. River Gomti orginates from Pilibhit district of Uttar Pradhesh and ends to river Ganges. The major city located along the bank of river Gomti is Sitapur, Lucknow, Barabanki and Sultanpur.

In order to assess the river quality of Gomti in Lucknow, a study was conducted at different site viz., Gau ghat, Mohan Meikin, Saheed Smarak, Nishat Ganj bridge, Pipraghat and Malhaur to findout water quality status at these sites. Results revealed that BOD and PO_4^{-3} was found maximum in Pipraghat i.e., 14.373 mg/l and 3.88 mg/l respectively while lower value was observed at sahid smarak (1.48 mg/l a). However, lower value of PO_4^{-3} was found in Mohan meakin (0.073 mg/l). The concentration of dissolved oxygen (DO) was high in Gaugaht i.e., 5.92 and the value of DO was nil in Pipraghat. Similarly, the value of total solid was high in 9.46 mg/l in Pipraghat and low in Hanuman setu. Despite, in Gomti river some heavy metals were also found which are under analysis.

Keywords: Gomti river, Physico-chemical parameter, BOD, Total solids, DO

SX/O-1

Buddhism Based Local Environmental Conservation Practices: A Case Study on Sikkim Himalaya

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The global culture of consumerism is so devastating for our planet which leads to many global crisis; the loss of biological diversity is one of them. The tiny Himalayan state of Sikkim in the eastern part of India which is known for its amazing forest cover, biodiversity and Buddhism is also experiencing this crisis. Buddhist philosophy and its values are a positive force in nature conservation and revitalization in the region, and serves as a tool for conserving biodiversity. With religious or mystical beliefs and historical background, Sikkim harbours many sacred landscapes, peaks, mountain, rocks, forest, lakes, streams, rivers and even monastic sanctuaries. This sustainable way of life, religious heritage and ritual practices transforms the entire state into sacred landscape. Of late, decline in traditional beliefs, urbanization, development projects and other socio- economic factors have undermined the status of these places and practices in the region. The state has numerous snow-fed streams and rivers; development of power projects and pharmaceutical companies is high on agenda of the Government. Authorities are not maintaining the regulatory framework which is setup by Supreme Court of India, like special provision Act, 1998 for the places of worship and Article 48 (A) and 51 (A) (g) of the constitution for environment protection. Consequences of these are demographic changes besides destroying the fragile terrain, natural resources and environment, loss of biodiversity, decline of sacred places, and devaluation of indigenous knowledge which has so far been protected by local communities. There is immense concern among ethnic people, religious groups and civil society and they are engaged in peaceful protest against such projects. The future implication should be on protection of traditional beliefs, sacred places, prefer micro projects which will have a much smaller ecological and climate related footprint. Therefore developing strategies for the global biodiversity conservation are best achieved by long term participation and understanding of local communities and recognition of the Buddhist philosophy as the active, even dynamic role it could play in conservation especially in fragile ecosystem like of Sikkim.

Key words: Sikkim Himalaya, Buddhist values, Sacred landscape, Traditional beliefs, Conservation

SX/O-2

eDOTS_GNDUBG: An Electronic Database of Trees and Shrubs of Guru Nanak Dev University Botanical Garden

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Since we are living in an era of globalization of information, where the importance of globalization of biodiversity related information is also being recognized worldwide, proper documentation of our genetic wealth has become an essential component of the study of plants which helps to collect and organize properly an enormous quantity of information. It is possible by the creation of digital databases (*in silico* documentation) of biodiversity of different regions of the world. Considering this we have initiated the development of an electronic database of trees and shrubs of Punjab (eDOTS). This database has been prepared using ASP.NET and will serve the purpose of storing, organization and providing efficient retrieval of information on all trees and shrubs of Punjab. The focus of the database will be on providing text cum graphic information of each plant. To begin with, we have digitalized information regarding most of the trees and shrubs of Guru Nanak Dev University Botanical Garden (*eDOTS_GNDUBG*). GNDU Botanical Garden, established in the year 1975, has a collection of nearly 500 plant species (including cacti, medicinal, and seasonal plants) which are arranged section wise as per Bentham and Hooker's system of classification. This database will serve the dual purpose of providing data cum multimedia information of each plant species. Focus of the database is on full description of botanical characters; photographs of different views/parts of the plants; flowering time; fruiting time and economic importance of each plant. Reports have been prepared to retrieve information

about different plants along with their photographs using different search ways including Plant search, Family wise search, Section wise or Location wise search. This is a user friendly database which can even be used by a layman to identify or know about a plant because the detailed information on each plant has been supported by respective images. This database can be viewed at www.gndu.ac.in/gndu2014/edots/about_edots.aspx.

Key words: eDOTS, Database, Plants, GNDU, Trees and shrubs

SX/O-3

Digitization of Herbarium of Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar (Series Bicarpellatae of Sub-Class Gamopetalae)

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Biodiversity referring to millions of different life forms present on this earth forming the core of our life support system, is so important for the sustainable existence of all living beings on this earth that removal of even a single species can upset the balance and disrupt or destroy the ecosystem threatening all forms of life with in it. The world today has come to realize the importance of biodiversity friendly policies to improve economy and alleviate poverty. In these on-going multi-prolonged efforts to halt species extinction and to promote the conservation of our plant genetic resources, the use of digital storage systems which allow efficient retrieval and manipulation of data is increasing. Digitalization of herbarium is a suitable method of recording information about herbarium specimens. The herbarium at Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar has a collection of herbarium sheets belonging to nearly 3000 plant species collected from different regions of India. We have initiated an effort to digitalize the herbarium specimens housed at herbarium of Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar. This paper deals with digitalization of herbarium sheets of plant specimens belonging to series Bicarpellatae of sub-class gamopetalae of dicots and includes specimens belonging to families viz. Oleaceae, Salvodoraceae, Apocynaceae, Asclepiadaceae, Loganiaceae, Gentianaceae, Polemoniaceae, Poragineae, Convolvulaceae, Solanaceae, Scrophularianeae, Orobanchaceae, Lentibularieae, Bignoniaceae, Acanthaceae, Verbenaceae, Labiatae and Plantagineae.

Key words: Digitalization, Gamopetalae, Herbarium, Bicarpellatae

SX/O-4

Clinical Studies of Shell Extract of Almond (*Prunus amygdalus* L.) against Tinea Infection

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Environmental pollutants are dramatically increasing etiology and pathogenesis of skin diseases rate of populations around the world. The present study mainly focuses on the clinical application of waste material shell part of Almond *(P. amygdalus)* used to cure of *Tinea corporis* skin infection by new biotechnological techniques. The study is based upon the reduction of clinically sign and symptoms and mycological inhibition of environmental causative pathogenic fungi *M. canis, M. gypsum, T. mentagrophyte and A. niger* at 90% MIC control method for the evaluation of therapeutic potential against dermal mycosis. The present study is attempted to summarize the therapeutic importance of shell for medical practitioners and manufacturers for the development of a new antimycotic drugs can reduce the environmental burden for skin to provide safe and harmless substitute for harmful chemicals and synthetic products.

Key words: *P. amygdalus*, *Tinea corporis*, Pathogenic fungi

SX/O-5

Organic Farming for Improving Environmental Health

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Organic farming in India is not new and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco friendly pollution free environment. Main objectives of organic farming are to develop a sustainable agriculture system for guaranteed adequate food production in the foreseeable future, to develop self-sufficient agriculture system which would rely as much as possible upon resources from within its own resources and to develop an alternative strategy over chemical farming which would be a guideline for the working of biological processes in natural eco-systems. The methods that make use of the various traditional agricultural practices like minimum tillage, composting, crop rotation, biological pest control, etc., and exclude the application of synthetic fertilizers, insecticides, growth regulators, and genetic modification of crop species, are included in organic farming. The use of modern technology in combination with organic practices helps in creating a balanced and sustainable environment for crop growth. Organic farming takes a holistic approach in growing crops, rather than exploiting the available natural resources. Organic farming basically consists of simple and eco-friendly techniques in farming. Use of compost fertilizers, crop rotation, and biological pest control, are some of the features of this type of farming. Polly culture is a completely different approach towards farming, in this method, a variety of crops is cultivated on a single piece of land. It helps to attract different soil microbes. Some crops act as repellents to pest and these results in pest control in an organic manner. Composts are used to enhance soil fertility in organic farming. Green manuring also is a good way to add nutrients to the soil. It is the practice of growing plants with prolific leaf growth like Alfalfa, and burying them in the soil before cultivating the main crop. Such crops add organic matter to the soil, which are very necessary for plant growth. The prime objective behind following the methodology of sustainable agriculture is to maintain the ecosystem. Thus, it includes the preservation of nutrients present in the soil, keeping it aerated, and use of fertilizers that decompose in soil. The result of practicing this type of agriculture is the maintenance of healthy soil, which should be able to nourish plant growth for a longer period.

It is necessary to follow organic farming techniques for sustainable growth of crops. It not only helps in growing the plants at a lesser cost compared to the traditional method, but also maintains the balance of our ecosystem. Organic farming proves to be more profitable than the age-old traditional farming methods, It has been found that organic farming reduces the production cost by about 25 - 30%, as it does not involve the use of synthetic fertilizers and pesticides, which thus makes organic farming very cost-effective. This type of farming leads to a less toxic environment as far as the air, water and soil is concerned. Soil is the most important component in farming, and organic farming preserves the soil by reducing soil erosion up to a large extent. Organic farming also enables the farmers to use the soil for a longer period of time to grow crops, as soil fertility is maintained for a long time in such a case. This kind of farming is not only beneficial to the farmers, but it also has proved useful for the dairy industry. Cattle grazing on organic farmlands have been found to be less prone to diseases, and they also yield more milk. These are definitely good signs for a consumer of these dairy products from a health perspective, and for a dairy organization from the profit perspective.

Key words: Organic farming, Green manuring, Eco-systems, Sustainable agriculture, Environment

SX/O-6

Green Computing And Its Importance

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Green computing, green IT or ICT Sustainability, refers to environmentally sustainable computing or IT. Green computing is an effective and efficient way of designing, manufacturing and using of computing products that would help to preserve natural resources and reduce the harmful impact on the environment. It is the environmentally sustainable use of computers and related resources like - monitors, printer, storage devices, networking and communication systems - efficiently and effectively with minimal or no impact on the environment. It is the study and practice of efficient and eco-friendly computing. The goal of Green computing is to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Nowadays computers not only used in offices but also at homes. As the number of computers is increasing day by day, the amount of electricity consumed by them increased the carbon contents in atmosphere. However the IT department is usually uses the most amount of power which in turn is a source for toxic waste. Making IT "Green" can not only save money but also help to save our world by reducing and/or eliminating wasteful practices and using nontoxic materials.

This paper examines the need and provides guidelines which highlights our responsibilities as computer users and encourage us to take some actions in the betterment of the environment. Subsequently, this paper helps to identify key issues relevant to green computing and evaluate different approaches to these problems.

Key words: Green computing, Green IT, Energy efficiency, Virtualization, Energy star, E-waste

SX/O-7

Nutritional Composition of Value Added Products Prepared From the Green Leafy Vegetables

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Green leafy vegetables are rich sources of antioxidants. Antioxidants are intimately involved in the prevention of cellular damage - the common pathway for cancer, aging, and a variety of diseases. Several berries, fruits, nuts, seeds, vegetables, drinks and spices have been found to be high in total antioxidants. antioxidants helps in quenching of free radicals arising from environmental sources. The green leafy vegetables are rich source of calcium, iron, and beta carotene and vitamin C. Fenugreek and cauliflower leaves are rich in calcium, iron and beta carotene. The study was aimed to formulate and analyze the value added products prepared from two different fresh green leafy vegetables (fenugreek leaves and cauliflower leaves) by incorporating 20 percent and 10 percent respectively. Value added products were analyzed for proximate constituents, minerals and total carotene. Results showed that the product were enriched with fresh fenugreek and cauliflower leaves are rich in protein, calcium, iron, and total carotene. Moisture, fat, fibre and total carotene content was higher in paneer fenugreek pakoda 52.49 g/100g, 6.36 g/100g, 1.43g/100g and 3447.10ìg/100g respectively. On the other hand protein, energy , carbohydrate, iron and calcium content was higher in paneer cauliflower stuffed paratha 12.65g/100g, 289.6 kcal/100g, 42.90g/100g, 10.92mg/100g and 305.66 mg/100g, respectively. Therefore it can be concluded that the incorporation of the leaves of fenugreek and cauliflower in various food items can improve the nutritional qualities.

Key words: Nutritional composition, Green leafy vegetables, Fenugreek leaves, Cauliflower leaves

SX/O-8

Microbial Forensics

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Microbial Forensics is a new developed discipline with a foundation which is completely dedicated to the characterization, analysis and interpretation of an act of a biocrime. Microbial Forensic act as the identification tool in case of biocrime or a bioterrorism. It is an evolving sub-discipline of forensic sciences, which combines several disciplines including microbiology, genomics and biochemistry. Microbial Forensic investigations are carried out to obtain the relevant information regarding

the source of material used in an act of bioterrorism, biocrime or any type of unintentional release of a micro-organism or a toxin with an aspect of causing harm to the humanity in one or the other way and once the toxin is released it proves to be fatal for the humanity. Attribution could be a key to criminal prosecution of the individual or individuals for supporting actions that may be taken as a result of national policy decisions. The new disciplines of microbial forensics is in the process of being founded from an array of established and emerging fields such as microbiology, microbial genomics and phylogenetic analysis. Forensic Investigation use physical evidence to attempt to obtain information on microorganism, the person involved and the places involved the process and instrumentation used to develop or disperse the weapon of the criminal act. Because of the advances in technology challenges to national security will continue to arise. Microbial Forensics measures molecular variations between related molecular microbial strains and their use to relationship or transmission route of a particular microbial strain. Results of such analysis may be related to intentional use of microbial agents for bioterrorism or the accidental use of any offensive micro-organisms or toxins of public health importance specifically for the purpose of determining the origin. Building awareness of and capacity in microbial forensics can assist our understanding of what may have occurred during a bio threat event and international collaborations that engage the broader scientific and policy making communities are likely to strengthen over microbial forensic capabilities.

Key words: Bioterrorism, Microbial forensics, Bio threat, Biocrime

SX/O-9

Seaweed Cultivation Activity for Livelihood Generation in the State of Odisha

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The red algal species *kapapphycus alvarezii* is a source of a galactan colloid caragenean which is a key substance in today's food and dairy industry. This red algal species is cultivated only in warm waters in Philippines, Malaysia, Indonesia, Tanzania etc. The demand for the seaweed has been increasing globally. The science and society division of Department of Science and Technology, Govt. of India sanctioned a project entitled "Development and demonstration of appropriate strategies for marine algae cultivation and processing for livelihood generation in coastal areas of Odisha state". The state has potential for marine algae cultivation due to its vast coastline, suitable environmental parameters, quite good number of coastal villages and good labour for seaweed farming activities. The prospect of seaweed cultivation is a promising alternative to maintain the socio-economic condition of the coastal women. The objective of sea farming was to develop technologies for cultivation of high value seaweeds widely used for industrial purposes with improvement of the coastal fisheries communities in Odisha state. The red algal genus *Gracillaria verrucosa* cultivation in Chilika lake started as a pilot scale study by DST, Govt. of India can be well established activity in future. The farming of the red alga *Kapapphycus alvarezii* is only practised now in Odisha state under Rasthriya Krushi Vikash Yojana as a pilot scale studies initiated in Ganjam district by CES, Ministry of Forest and Environment, Gov. of Odisha. In the pilot scale culture activities, culture experiments are conducted at some coastal sites of Ganjam district to evaluate the possibilities and feasibility of cultivation of the red alga. Different culture methodologies were adopted and standardised for the pilot scale study. Seaweed farming is a labour intensive activity and it can be the best medium for employment of uneducated people and also support women empowerment. Seaweeds are the ultimate sustainable marine crop that cleans the nutrients from the sea as they grow. Being inspired by the seaweed farming, the fishery women will concentrate more on seaweed farming activity as a livelihood generation of income in future.

Key words: *Kapapphycus alvarezii*, Seaweed, *Gracillaria verrucosa*, Chilika lake, Livelihood

SX/O-10

Visual Pollution in an Urban and a Suburban Setup with Special Reference to Cables/Wires

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Our first impression of a community, rural or urban, is generally its visual environment which is the mosaic of natural and built forms. Visual pollution is defined as the whole of irregular formations, represents unorganized dumping of litters, billboards, cables, wires, worn-out buildings etc. that affects people's ability to enjoy a view or vista. Recently, pollution signifies an inclusion of those affecting in a subtle way such as visual pollution. This work aims at drawing attention to the hazardous effects of the visual pollutants with special reference to unorganized cables/wires, to realize that the visual environment is as important a part of the fabric of communities as clean water and animal habitat. Different places of Kolkata (South and North) and of Barrackpore and Barasat of 24-Paraganas (N) district, West-Bengal, India were explored for abundance of visual pollutants, especially the ubiquitous cables/wires. Possibilities of some associated hazards were observed. Visually pleasant and unpleasant sights were compared and the psyche of people was followed. It was found that the cityscape was strewn with visual pollutants, cables contaminating every nook and corner. This unsightly presence creates deep displeasure, aesthetic-appeal, causes declining effect on civic sense of the community and hence psychological-health too. This is compounded with possibility of health hazards of different dimensions including hazards caused by magnetic-field around cables, may create a short-circuit problem which may be extremely dangerous on water-logged roads. Some birds get electrocuted often due to exposed cables. Thus, the sight of a beautiful natural environment stimulates human beings. Conversely, the ugly sight triggers irritability. Children growing up near it get used to it losing their ability to understand the need for correcting it. This results in character-changing effects, the identity of the community is affected and entire life-style is deteriorated.

Key words: Visual pollution, Cables, West Bengal, Aesthetic-appeal, Psychological-health

SX/O-11

Impact of Life Style on Human Health: Preservation of Biodiversity to be made an Integral Part of Healthy Life Style

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Life style means the way in which people live. Way of living means full range of various activities and attitude, which are learnt from parents, friends and society. Healthy life style is essential for good health. According to WHO health is a state of complete physical, mental as well as social well being, not merely an absence of disease or infirmity. All the three physical, mental and social well beings are related to each other. A person who is physically healthy will be alert, person who is socially healthy will be confident enough, while person who is mentally healthy will be free from all worries. Change in any one aspect of health, affects on other aspect of health and then person becomes unhealthy. Many of the health problems may be caused due to unhealthy life style. Some of them are Asthma, Diabetes, Heart problems, Lung cancer, Oral cancer, Obesity etc. to some extent. Some of them can be prevented by changing the life style which should be healthy. It is said that rather than to cure a disease, prevention is more important. If at all disease develops, it can be managed by using some plants parts up to some extent, as herbal medicines are eco friendly. Since herbal medicines are available because of biodiversity, all the efforts should be made to preserve biodiversity. Therefore we can say change in life style is the need of today i.e. unhealthy to healthy life style. And preservation of biodiversity is an integral part of healthy life style.

Key words: Life style, Health problems, Plants, Herbal medicines, Biodiversity

SX/O-12

Contamination of Coins with Allergenic Fungal Organisms

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Air borne microbes (Fungi and bacteria) are implicated in the causation of allergic diseases and infections in immune compromised patients. As the dominant group of eukaryotes that radiated about 3 million years ago, the fungi and constitute an independent group equal in rank to that of plants and animals. The fungi that produce spores and get airborne are called "aerospores". They cause a number of infections in tropical country like India.

A study was made to find out associated fungal organisms from new and old coins. The paper deals with many such fungal organisms which were found associated with coins. A heterogenous mixture of bacteria and fungi was recorded in different coins. The Indian and foreign coins collected in two different seasons showed presence of 14 different fungi. The number of fungi isolated were more during rainy season than in coins collected in winter. *Rhizopus stolonifer Penicillium citrinum*, *Alternaria alternata* and *Aspergillus niger* were frequently isolated. Many of such fungal organisms are reported to have allergenic potential. It is recommended that coins must be washed with hot water at regular intervals to reduce to pollution load.

Key words: Coins, Fungal organisms, *Aspergillus*, *Penicillium*, Allergy

SX/O-13

Makhana System in North and North Eastern India: A Key to Sustainable Agriculture and Food Security

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Makhana (*Euryale ferox* Salisb.) is a major aquaphyte growing naturally in the stagnant fresh water pools of north and north eastern India. However, Darbhanga, Kosi and Purnea division of north Bihar are the major areas of its cultivation. "Beels" of Assam and Maldah area in West Bengal also support the semi-wild populations of this plant. Fishing community inhabiting the Mithila area has developed the expertise of its cultivation as well as intricate harvest and post-harvest operations over generations. Of late, the plant is known to be in possession of significant nutraceutical properties that make it effective against a no. of human ailments including diabetic nephropathy and cardiovascular complications.

The plant is a primitive dicot having a combination with monocot characters. It grows under integrated aquaculture system, providing significant habitat to the air breathing fishes. All efforts are being made to raise two Makhana crops in a sequential manner in a single year. Heavy autochthonous deposits of the plant debris support the detritivorous fishes. Leaving sufficient open spaces in the middle or margins of the ponds support the integration of carp fishes with the system.

The state of Bihar is all set to make blue revolution a success. Makhana system does have good potential to help meet this target. In addition, Makhana is being integrated with water chestnut, wheat or potato in the rotational cropping system. Eastern districts of Purnea and Katihar witness its cultivation in the field system as well. This is on account of the high water table in the Kosi belt where water could be easily procured under the "bamboo tube well" system. Edible part of the plant is the perisperm in its seeds that is rich in quality of starch and protein. On account of being almost fatless, Makhana is in high demand in western countries. It is a good source of micronutrients. There is a need of utilization of non-seed parts that are usually discarded.

Makhana is deeply associated with Hindu rituals and in Mithila area there is a practice of sending Makhana as a gift from bride's side to the groom's side on the occasion of Kojagara festival. The seeds are known to have aphrodisiac and spermatogenic properties. The paper takes into account the facets of Makhana system in north and north eastern India as a key to sustainable agriculture and food security.

Key words: Makhana, North Bihar, Integrated aquaculture, Nutracentical

SX/P-1

A Report on Wild Edible Plants of Banda District (U.P.), With Special Reference to Their Ethnobotanical Significance

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In India about 800 species of wild edible plants are consumed as food plants chiefly by tribal peoples. The literature survey reveals that there is a very limited and scattered information on wild edible plants.

A study of wild edible food Plants of Banda dist. was carried out during the year 2013- 2014. A total of 20 Wild plant species belonging to 18 families were enumerated in the present communication. The report of ethnobotanical significance of these plants have also been described in this paper.

There is an urgent need to explore, protect and conserve these plants species as these plants play a very important role in full filling the nutrient supplement and prove food material at the time of scarcity.

Key words: Ethenobotanical significance, Wild edible, Nutrient supplement

SX/P-2

Environmental Effect on Cultural and Natural Heritage of Poonch Region

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Poonch is a fertile area for the promotion of eco-tourism, cultural tourism and pilgrim tourism. This is evident from the number of lush green areas, meadows, high pastures, and monuments like forts, palaces, temples, *ziarats*, gurdwaras, etc, dotting the cultural landscape of Poonch region Impact of the climate change on heritage is major issue which needs to be taken care of. Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It is the change in average weather conditions, or in the distribution of weather around the average conditions like more or fewer extreme weather events. Climate change is caused by various factors including, biotic processes, plate tectonics, variations in solar radiation received by earth, and human-induced alterations of the natural world. Such factors latter causes the global warming. Change in climate is the most serious threat which both natural and cultural heritage of this region is facing like rising temperatures, drier summers, wetter winters and risk of floods. Climate of this region is becoming more unpredictable with the frequent and extreme weather events like heat waves, heavy rainfall, drought and high wind. As a result of this change many species of plants are lost as conditions become unsuitable and many other species replace them. Most of the species of birds and animals have also migrated to other regions. This change also causes the deterioration of monuments as a small change in temperature directly results in change in RH (relative humidity) and causes the deterioration of stone and ceramic artifacts containing salts, with the result of this salt crystallizing occurs and causes weathering. It also changes monumental aesthetic qualities like its colour (black, green, yellow, etc), which is clearly visible in Poonch fort, Moti Mahal and Sheesh Mahal,etc. Thus, there is a dire need to protect, preserve and conserve our heritage and contextualize cultural heritage in relation to the dynamics of sustainable development. One also needs to look into environmental protection laws of both cultural and natural sites where large religious events are held.

Key words: Heritage, Conservation, Climate, Poonch district, Jammu

SX/P-3

Silent Victims: Emerging Issue of Environment

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The present theory of environmental issue (Ragnar Nurkse and AC Pigou) is based on hypothesis that largest polluters suffers most than small polluters. To disprove this, I formulate certain principle that governs the shifting of air pollution from top to less polluting nations vide Conductivity Effect of Nature and its impact on various segments such as health insurance, pharmacy company a health education and requirement of doctor population ratio .Due to moving of air, pollution particles in less polluted nation is higher than Self Generated Pollution. As long as difference in density of pollution varies in different

nation in short period due to difference air pollution, the Particle never travels from least to most pollutes, rather most to less .However benefit development obtained at cost of pollution has been never shares among and only cost shares with less .This is called External Surplus Pollution Effect. The fresh air is received in exchange of polluted air without any monetary price and, the organs in the environment are forced to receive elements of definite negative value from polluted nations and which in turn exchanged with Commodity market and human resource market until all were seriously affected is termed as 'environment market' .This process is done through vide conductivity effect of nature. The Conceptual vs. Empirical methodology is used.More people from less polluted, most of whom were malnutrition is often falling victims of air pollution other nation and put forth new demand and formula for determining for compensation to victim nations

Key words: Conductivity Effect of Nature (CEN), Surplus pollution, Zero conductivity effect of nature, Self Generated Pollution (SGP), External Surplus Effect of pollution (ESP Effect)

SX/P-4

ENVIS-NBRI Centre Functioning as Node for Awareness about Plants and Pollution

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Environmental information plays a vital role not only in formulating environmental management policies but also in the decision making process aiming at environmental protection and improvement of environment for sustaining good quality of life for the living beings. Hence, management of environment is key component and thus plays an important role in effecting a balance between the demands and resources available for keeping the environmental quality at a satisfactory level. Realizing such need Ministry of Environment, Forests and Climate Change set up an Environmental Information System (ENVIS) in 1983 as a plan programme, ENVIS is a comprehensive network of centres with the objectives of environmental information collection, collation, storage, retrieval and dissemination to various users, which include decision-makers, researchers, academicians, policy planners and research scientists, etc. ENVIS network at present consists of a chain of 67 network partners out of which 39 are on subject-specific and 28 on State/UT related issues.

The Environmental Information System (ENVIS Centre) at CSIR-National Botanical Research Institute is focused on "Plants and Pollution". The Centre started functioning as node for "Plants as Indicators of Pollution" in January 2003. This became full-fledged ENVIS Centre in Januray 2005. ENVIS-NBRI systematically collects, compiles and disseminates data on Plants and Pollution, which is of immense use to several research organizations, town planners, policy makers, teachers and other stakeholders. NBRI-ENVIS, has published newsletters on 'Plants in Urban Planning' and 'Constructed Wetlands', Genetically Modified crops and Environment, Climate Change and Medicinal Plants, Plant Signaling in Changing Environment and Bibliography on 'Transgenic plants for phytoremediation', for circulation among different stakeholders in India. Monthly e-News Bulletins and News bulletins are prepared on various themes like Nature, Health and Pollution, Atmospheric Nutrient etc. and are uploaded on the website. The Kids Centre is updated on different topics like 'Biology-G.K', 'List of National Plants', Videos on Phytoremediation, Food Webs, Nitrogen cycle, Pollution Indicator, 'Environmental Kids' and 'Types of climate'. The Subject area Modules are updated with different topics like "Green planner, Biomonitors of Pollution, Plants as indicator of Pollution, Thinking of Planting"etc. In Publication module the new topics are updated like E-Books, Patent, Journals, Posters, and Videos on Lichens and Air Pollution, Green Building Concepts, and Phytoremediation project. Different sections of bibliography are updated with latest references. During the year NBRI-ENVIS website received 220540 hits and 108 queries, all have been answered. New databases have been developed and uploaded in website on subject 'Arsenic', 'Endosulphan', 'Chromium', Cadmium and Plants and Lindane Insecticide etc. Different modules of NBRI ENVIS website (http://nbrienvis.nic.in) including Hindi web-pages have been regularly updated.

Key words: ENVIS, Plants and pollution, Environment, Engineering, Networking

SX/P-5

Energy Conservation in Households in Urban Areas in India

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India, as a country is very rich in terms of natural resources however as citizens, we have not respected this fact and have been continuously exploiting nature's gift to mankind. Further as the population is ever increasing, the load on the consumption of resources is unprecedented. This has led to the depletion of natural resources such as coal, oil, gas etc., apart from the pollution it causes. It is time that we shift from use of these conventional resources to more effective new ways of energy generation. We should develop and encourage usage of renewable resources such as wind and solar in households to conserve energy in place of the above mentioned nonrenewable energy sources. This paper deals with the most effective ways in which the households in India can conserve energy thus reducing effect on environment and depletion of limited resources.

Key words: Energy consumption, Resources, India, Renewable resources and environment

SX/P-6

Hospital Waste, a Serious Hazard, Its Management and Handling: A Review

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This review focuses new strategies regarding hospital waste management as it is an important public health concern worldwide Medical care is very important for our life and health, but the waste generated from various medical actions will be a real trouble of living nature and human world. Inappropriate management of waste is having hazardous impact on the society, the health care employees and on the surroundings. The management of hospital waste requires specific treatment for its removal and disposal from the health care establishments hygienically and economically to minimizes the risk to public health and to the environment. The present review article deals with the basic issues as definition, categories, problems relating to hospital waste, procedure of handling and disposal method of hospital waste by reviewing recent literature and survey. It was found that a variety of methods were used by the medical facilities to dispose their wastes including burning burial, entombing, selling, dumping, and removal by municipal bins. The waste disposal practice was found to be quite hazardous and clinical and non-clinical both type of wastes were found to be thrown together. This review emphasizes the knowledge and awareness of individuals involved in medical waste generation, handling and disposal, and the potential impacts of the waste on both human health and the natural environment. Proper handling, treatment and disposal of biomedical waste play a significant role in hospital infection management programme. Hospital waste management primarily involves preventing transmission of illness from patient to patient, from patient to medical expert to prevent damage to the health care employee and staff in maintenance services, whereas management of medicine waste, to anticipate all-purpose exposure to the dangerous effects of the different types of waste as cytotoxic, genotoxic and chemical medicine waste generated in hospitals. Hence properly designed and applied, waste management is somewhat unbeaten jointly as an economical compliance-related observation. This critical review discusses regarding the gathering, segregation, treatment and disposal of hospital waste and its numerous varieties.

Key words: Hospital waste, Hospital Waste Management (HWM), Biomedical waste, Medicine waste

SX/P-7

Importance of Greenhouse Cultivation to Create Favorable Microclimates at Global Level

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In the present paper, thermal modeling of a greenhouse has been carried out by using the heat and mass transfer relation. Greenhouse cultivation has been evolved to create favorable Microclimates where vegetable Production can be made possible throughout the year as required. Greenhouse creates a suitable environment for the plants and to make possible growth as well as fruiting as compared to open field cultivation. The environment in this context refers to light, temperature, air composition and nature of root medium. This greenhouse technology has tremendous scope in horticultural sector, specially in production of hybrid seeds, vegetables, ornamental plants and cut flowers production which fetches maximum foreign exchange. The following section deals the historical background and status of greenhouse in world as well as in India as regards to constituents of environment, types, classification, design and heat transfer Mechanism in greenhouse.

Key words: Greenhouse cultivation, Favorable microclimates, Global level, Horticultural sector, heat and mass transfer

An Observation on Potential under Utilised Wild Food Plants of Uttar Pradesh Sustainins the Effect of Climate Change

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Many people of developing as well as developed countries in the world are seriously facing hunger, malnutrition, under nourishment, lack of adequate vitamin and minerals in their diet. Malnutrition among the children is rampant resulting different diseases and disorders, anaemia a very serious problem throughout the world. India has passed through various revolutions and achieved unprecedented development in the productivity of food crop and many crops have increased manifold production and productivity, but the challenges of malnutrition and threat of climate change continues vigorously. The underutilized wild edible plants and crops appear to be the crop of future and need focused attention for popularization and conservation as it can meet nutritional needs and sustain the effect of climate change.

Present paper highlights some of the wild edible plants species like *Basella alba, Bauhinia purpurea, Boerahavia diffusa, Capparis zeylanica, Crotalaria juncea, Diplazium esculetum, Ipomoea aquatica, Physalis minima, Portulaca oleracea, Alangium salvifolium, Anthocephalus chinensis, Antidesma ghaesembilla, Averrhoa carambola, Bridelia squamosa, Buchanania lanzan, Carissa opaca, Cordia dichotoma, Dillenia pentagyna, Diospyros exculpta, Fiscus racemosa, F. virens, Flacourtia indica, F. jangomas, Grewia hirsute, Limonia elephantum, Madhuca longifolia, Manilkara hexandra, Pueraria tuberosa, Rumex dentatus, Schliechera oleosa, Spondias pinnata* and *Xeromphis uliginosa* etc. for their conservation, protection and popularization developing newer tastes, texture flavour in several nutritional food recipe, further the effect of climate change should also be studied in human welfare.

Key words: Malnutrition, Nourishment, Vitamin and minerals

Luxuriant Growth of Lichen *Roccella montagnei* Bél in Islands of Marine National Park, Gujarat

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India is a mega biodiversity country equally rich in lichen diversity represented by 2,350 species. The vast geography of the country with varied climate, landscape and geology generate ecological interesting habitats for the occurrence of unique lichen communities. Gujarat state is located in the west coast of India not only has the long coastline but also has second largest tidal forest after Sundarbans. In a recent lichen study excursion to Marine National Park (MNP) of the state it is observed that the Park has a unique lichen diversity represented by 24 species, but a fruticose lichen *Roccella montagnei* Bél was growing luxuriantly in most of the islands surveyed. The genus *Roccella* is probably the only fruticose member of family Roccellaceae which comprises of 40 species worldwide. The species of *Roccella* are mostly distributed along the coastal, arid or subtropical regions in Mediterranean climates extending into adjacent temperate and tropical regions. *R. montagnei* is one of the most common and widespread taxa of all *Roccella* species distributed in coastal Asia, New Caledonia, Northern Australia, Phillippines, South Africa and Cape Verde. In India *R. montagnei* is distributed in Gujarat, Karnataka, Kerala, Orissa, Pondicherry and Tamil Nadu. The thalii of *R. montagnei* are either erect or hanging the substratum with flat, tapering branches, creamish or pinkish colour. The lichen produces roccellic acid, erythrin and lecanoric acid as secondary metabolites. These metabolites give a unique dying properties to the lichens and hence used for preparation of acid-base indicating litmus paper. Further, the extracts of the lichen have exhibited anti-inflamatory, antibacterial and antifungal activities. In our survey at MNP among all the lichen species recorded *R. montagnei* was the

only fruticose form documented. It was found growing on mangrove plants such as *Avicennia marina* and *Rhizophora mucronata,* but it was dominant on *Ceriops tagal*. The lichen grows from bottom to top of its host plant masking its original appearance. In our exploration in whole of Gujarat state and other parts of the country such a luxuriant growth of *Roccella* was not seen anywhere; hence it tempted us to record our observation. The isolated habitats with negligible anthropogenic disturbances, clean air may be the reason for such a luxuriant growth. The humid environment with saline breeze may be favouring the growth of the lichen. However, critical research is needed to ascertain the reasons for such a abundant growth of *Roccella* in MNP. *R. montagnei* being pharmaceutically potential lichen MNP can serve as sustainable lichen harvest site at least for laboratory experiments.

Key words: Arthoniales, Biodiversity, West Coast, Jamnagar, Lichenized Fungi

Impact of Ganga Action Plan on Pollution Status of River Ganga

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Ganga has been a cradle of human civilization since time immemorial. Millions depend on this great river for physical and spiritual sustenance. Rapidly increasing population, rising standards of living and exponential growth of industrialization and urbanisation have exposed the water resources, in general, and rivers, in particular, to various forms of degradation. Realising that the rivers of the country were in a serious state of degradation, a beginning towards their restoration was made with the launching of the Ganga Action Plan (GAP) in 1985.The objective, at the time of launching the Ganga Action Plan in 1985, was to improve the water quality of Ganga to acceptable standards by preventing the pollution load from reaching the river. Later, in 1987, on the recommendations of the Monitoring Committee of GAP, the objective of the Plan was modified to restoring the river water quality to the designated best use class of Ganga. The Ganga river water quality evaluated on the basis of pollution indicators (DO, BOD and *Coliforms*) indicates that dissolved oxygen levels have improved in the main stem of Ganga. The faecal Coliform remains the only parameter on which the observed values exceed the permissible limits of 2500 MPN/100 ml at most places except in the upper reaches up to Haridwar. GAP has been a mixed success. Though the programme yielded good results in many stretches, the problem of pollution in river Ganga has not been fully addressed. The river water quality has improved at many locations despite significantly increased demographic and other pressures. However, the critical parameters of water quality, which adversely impact human health, exceed the prescribed standard limits at major locations. Hence, there is a need for revamping the river conservation programme in view of it's shortcomings.

Key words: Ganga Action Plan, Pollution, Coliforms, BOD, DO

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ICPEP-5
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