BOOK of ABSTRACT

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PREFACE

Our environment has always been under natural stresses but its degradation was not as severe as it is today. The importance of the study of environmental hazards and their impact on living beings needs no emphasis. The effect of environmental pollution on vegetation is astounding. As a sequel to the current popular trend of plant biology research synchronized with studies of phenomena in relation to environmental stress, an enormous body of knowledge about the plant- pollution relationship has been generated.

This treatise "ABSTRACT BOOK' is a compilation of four hundred and six 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 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. Late abstracts have been printed but un-indexed and are appended. 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.

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- Publication Committee
ICPEP-3

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SESSION-I

BIOINDICATION and BIOREMEDIATION

SI/L-1 A Review of the Role of Macrophytes in Nutrient Removal using Constructed Wetlands

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There are basically two types of constructed wetlands - Free Water Surface Systems (FWS) and Subsurface Flow Systems (SSF). FWS wetlands are composed of shallow (20-50 cm) vegetated channels or basins and deeper (50 cm - 2 m) open-water ponds. SSF wetlands, also known as reed-bed or root-zone wastewater treatment systems, are gravel and/or soil/sand-filled trenches, channels or basins with no standing water, and support emergent vegetation. FWS systems are more suitable in subtropical/tropical conditions where year-round plant growth occurs. SSF systems are most prevalent temperate regions. The effectiveness of water-quality improvement is dependent upon an array of complex and interacting processes, which can broadly be classified in three categories - physical, biological and chemical. Most processes are facilitated by the wetland vegetation. The wetland plants referred to as macrophytes in constructed wetland technology, remove soluble inorganic nutrients. However the interaction between macrophytes and microbes is essential for nitrogen removal. In aerobic microenvironments around the rhizosphere, nitrification of ammonium occurs. These nitrates can then be taken up directly by the roots. The dead organic matter of macrophytes provides a carbon source for denitrifying bacteria. The macrophytes either directly or indirectly play an important role in nutrient removal and storage. The removal of soluble inorganic nitrogen and phosphorus via absorption from either the water column or the sediment, assimilation and storage in plant tissue is a direct mechanism of nutrient sequestration. The provision of plant surfaces (leaves, stems and roots) for attached microbiota, epiphytic microflora and associated biofilm communities enables microbial assimilation, transformation and storage of nutrients.

Key words: Biomass, constructed wetlands, macrophytes, nutrients

SI/L-2 Detoxification of Heavy Metal Ions and Organic Xenobiotics in Plants

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Plants can face a number of foreign (xenobiotic) compounds during their life. These xenobiotics include ions of heavy metals such as lead, cadmium or copper (beyond the physiological relevance), as well as toxins of microorganisms and agrochemicals. A central role in the plant responses towards these challenges plays the tripeptide glutathione (GSH) by (i) combating metal ions-induced oxidative reactions, (ii) binding heavy-metals via GSH-derived phytochelatins (PCs) which render the toxic ions largely physiologically inactive, and (iii) by GSH-xenobiotic conjugate (GS-conjugate) formation. GS-conjugates are actively sequestered in the vacuole by the action of ATP-driven ABC-type transporters. While a large body of research has disclosed metal tolerance mechanisms in metal hyperaccumulators, plants that can accumulate heavy metals to levels absolutely toxic to animals (beyond 1% dry weight), that are not mediated by PCs, it is becoming clear that PCs provide a basic form of metal-tolerance and homeostasis even in some fungi and the worm *Caenorhabditis elegans*. PCs are generated by the action of a specific dipeptidyl-transferase, PC synthase (PCS). PCS catalyses the repeated transfer of glutamylcysteinyl units of GSH onto GSH or PC. PCs bind the heavy-metal ions more avidly than the monothiol GSH. Interestingly, PCS also catalyses the turnover of GS-conjugates to glutamylcysteinyl-conjugates by removing the carboxylterminal glycine. The glutamylcysteinyl-conjugate formation of herbicides has been disclosed in the pioneering work of Gerald L. Lamoureux and identified as being part of a catabolic pathway that is characteristic for plants. Our studies with PCS-knockout lines of *Arabidopsis* unequivocally reveal that PCS constitutes the major activity for glutamylcysteinyl-conjugate formation. Thus, PCS appear to fulfil a second function in plants, not only in heavy metal detoxification but also in the detoxification pathway of GS-conjugates.

Key words: Glutathione, phytochelatin, herbicide, phytochelatin synthase

SI/L-3 Bioremediation for Heavy Metals through Symbiosis between Leguminous Plants and Rhizobia

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Accumulation of heavy metals, such as As, Cd, Cr, Cu, Ni, Pb and Zn, is harmful to living organisms in contact with the soil and groundwater. Cadmium contamination in rice grains is one of the important issues in Asian countries. A novel bioremediation system, “symbiotic engineering”, using symbiosis between leguminous plants and rhizobia was developed.

We synthesized the tetrameric metallothionein gene (*MTL4*, Murooka *et al*., Biocatalysis Biotransformation, 19: 399-412, 2001) and cDNA encoding the phytochelatin synthase gene (*AtPCS*) from *Arabidopsis*. The *MTL4* and *AtPCS* genes were fused to the *nifH* promoter, which generated nodule-specific expression of these genes in *Mesorhizobium huakuii* subsp. *rengei* B3, which can infect and form nodules on Chinese milk vetch, *Astragalus sinicus* (Sriprang et al. *Appl. Environ. Microbiol* 69: 1791-1796).

By the expression of the *AtPCS* gene, phytochelatin [(g-Glu-Cys)$_n$-Gly ; PCs] was formed in *M. huakuii* subsp. *rengei* strain B3 and increased the ability of cells to bind Cd^{2+} by 9- to 19-fold approximately. When recombinant strain B3 established the symbiotic relationship with *Astragalus sinicus*, the symbionts increased Cd^{2+} accumulation in root nodules by 1.5-fold. The expression of the both *MTL4* and *AtPCS* genes showed additive effect on cadmium accumulation in nodules. Furthermore, we expressed the *AtPCS* gene and iron-regulated transporter (IRT1) in strain B3 to stimulate the uptake of cadmium into the nodules. The expression of both the *AtPCS* and *IRT1* genes in recombinant strain B3 increased the ability of cells to bind Cd^{2+} 1.7 to 2.5-fold compared to cells expressing only *AtPCS*. In rice paddy soil, addition of recombinant strain B3 significantly increased the accumulation of cadmium in roots and nodules of *A. sinicus*.

Thus, this system uses the advantages of both plants and rhizobia, in particular, engineered genes can be transformed to plants through infection with recombinant bacteria.

Key words: Environment, Heavy metals, Cadmium, Rice, Symbiosis, *Astragalus sinicus*

SI/L-4 Phytoremediation of Selenium and other Toxic Trace Elements

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Phytoremediation research in our laboratory involves studies ranging from the molecular to the field level. Our results show that constructed wetlands are efficient in removing heavy metals and selenium (Se) from agricultural irrigation drainage water (contaminated with Se) and industrial wastewaters (electric utility and oil refinery effluents contaminated with heavy metals and trace elements). Our molecular research showed that Indian mustard (*Brassica juncea*) plants can be genetically engineered to enhance tolerance and uptake of heavy metals and Se; for example, overexpression of genes encoding enzymes involved in phytochelatin synthesis increased the uptake of cadmium (and other trace elements such as arsenic) in transgenic plants better than 2- to 3-fold compared to wildtype plants. Overexpression of genes encoding ATP sulfurylase and methylmethionine transferase increased the ability of Indian mustard plants to tolerate, take up and volatilize Se. Furthermore, we showed that overexpression of the gene for selenocysteine methyltransferase (a gene isolated from the Se hyperaccumulator, *Astragalus bisulcatus*) resulted in the introduction of a new biochemical pathway into Indian mustard; this new pathway allowed for the accumulation of extremely high concentrations of Se in the form of the non-protein (and therefore non-toxic) amino acid, methylselenocysteine. Field trials of genetically engineered Indian mustard revealed that plants overexpressing the enzyme ATP sulfurylase were substantially better than wildtype in removing Se from Se-contaminated soil.

Key words: Phytoremediation, selenium, *Brassica juncea*, phytochelatin

SI/O-1 Screening of Adapted Plant Species for Phytoremediation of Contaminated Soils in Azerbaijan

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Wormwood (*Artemisia L.*) plants are known from literature to be capable to accumulate in their bodies several heavy metals from soil. But indigenous *Artemisia* species and other attendant plant genotypes widespread on heavy metal polluted sites of Azerbaijan were not investigated in this respect. To identify plant genotypes with high heavy metal accumulation capacity, a screening study has been conducted on different plant species from Azerbaijan flora growing on contaminated sites of Absheron region of Azerbaijan. Three locations with high levels of oil, chemical, metallurgical and atmospheric cement pollution were chosen for this investigation: Sumgait (aluminum and chemical plants), Binegedi (oil production and steel plant) and Lokbatan (oil production and cement plant). Four indigenous *Artemisia* species (*A.fragrans, A.scoparia, A.arenaria, A.szovitsiana, A.caucasica*) and five another attendant plant species (*Argusia sibirica*, *Gamanthus pilosus, Atriplex tatarica, Kallidium caspicum, Bassia hyssopsifolia*) growing on these locations were examined for their capacity to accumulate heavy metals. Plant and surface soil samples were collected and analyzed for copper (Cu), lead (Pb), nickel (Ni), zinc (Zn) and cadmium (Cd) concentration by using ICP-AES.

Plant available soil fraction concentrations of heavy metals exhibited that all three locations were contaminated with high levels of all 5 metals, particularly by Zn, Cu and Pb. Plant species tested differed greatly in their capacity to accumulate heavy metals depending on the location and their habitat. Nevertheless, they were found to grow vigorously on all three sites with different contamination sources with comparatively large biomass. Heavy metal concentrations in *A.fragrans* growing around of steel plant (Binegedi) averaged for all 5 metals several times more than in the same plant species collected around of oil derricks (Binegedi) and from Lokbatan location. Among the plant species investigated, the highest heavy metal concentration was noted in shoots of *A.scoparia* growing around of steel plant (as mg kg^{-1}, Zn: 736; Pb: 160; Ni: 5,4; Cu: 34 and Cd: 4). All 4 species of *Artemisia* were effective to accumulate Zn in their shoots at very high concentrations (up to 20-280 times higher than in soils). While in root heavy metal accumulation was much lesser than in shoot. Among the attendant plant species *Argusia sibirica* and *Bassia hyssopsifolia* collected from these sites with high concentration of Zn, Cu and Pb in soils were distinguished by more high accumulation of these metals in their body.

By considering its large biomass and high adaptation ability to contaminated soils *A.scoparia* is a promising *Artemisia* species for phytoremediation of soils contaminated with excessive amounts of heavy metals.

Key words: Artemisia sp., heavy metals, plant and soil contamination, phytoremediation

SI/O-2 Concentration of Chlorophyll *a*, *b*, and Total of *Psidium guajava* L. cv Paluma and *P. cattleyanum* Sabine as an Indicatory Parameter of Exposure to Atmospheric Pollution

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The contents of chlorophyll *a, b* total and chlorophyll *a/b* ratio was determined in *Psidium guajava* cv Paluma and *P. cattleyanum* plants exposed in two sites subject to the presence of ozone: the Manequinho Lopes Nursey, close to the Ibirapuera Park (average ozone concentration at the time: 76 ppb), and the State Park of "Fontes do Ipiranga" in an area of the Botanical Institute (144 ppb), and in a site free from this pollutant: a greenhouse with filtered air. Thirty specimens were exposed, a leaf of each was collected for the extraction of pigments with dimethylsulphoxide (DMSO). Both species showed a reduction in *a, b* and total chlorophyll content in the sites exposed to ozone, this reduction was more intense in exposed plants in the Botanical Institute. *P. guajava* proved to be more sensitive to this type of pollution, and can be considered as an efficient indicator for monitoring by means of the analysis of leaf pigments.

Key words: Air pollution, biomonitoring, chlorophyll, *Psidium guajava*, *Psidium cattleyanum*

SI/O-3 Organochlorine Insecticides in Edible Oils and their Possible Removal

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Persistence of organochlorine insecticides is associated with high lipid content of seeds. The use of organochlorine insecticides has been prohibited in most of the countries but about 70% of banned pesticides are still being used in our country because of their low cost.

Pesticides are being used on large scale for oilseed crops in order to control pest problems and to raise the crop yields. Edible oils are vitally important part of our food, body massage and cosmetic industry. Edible oils and oilseeds have been implicated as a source of contamination of human fat. The edible oils, available commercially, are often contaminated and adulterated causing ill effects and human ailments.

The present study, however, deals with the analysis of organochlorine insecticides such as DDT metabolites and HCH isomers in most commonly used edible oils *viz.* mustard, groundnut, sunflower procured from Lucknow, Kanpur, Varanasi, Mumbai and Kolkata. Removal of insecticides from edible oils has been tried by chemical as well as biological means and encouraging results were obtained.

Key words: Organochlorine insecticides, edible oil, residue, removal

SI/O-4 Phytodetection of Ambient Ozone Toxicity by Clover and Tobacco in Ukraine

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Tropospheric ozone is considered the most widespread and the most important phytotoxic air pollutant because it occurs not only in urban and industrial areas but also in suburban and rural areas. Increase in concentrations of ozone has been a cause of concern for the last two decades. There is now strong scientific evidence that production of sensitive agricultural crops, such as wheat and beans, is declining as a result of ozone levels occurring across large-scale areas of Europe. Other plants (tobacco, spinach, clover and others) exhibit characteristic visible leaf injuries following ozone episodes. By exposing special ozone sensitive indicator test-plants (tobacco, clover, knapweed and others) to ambient air, the reaction to ozone episodes or cumulative season long exposures could be considered.

Ambient ozone toxicity was assessed using subterranean clover (*Trifolium subterraneum* cv. Geraldton) and ozone sensitive (Bel-W3) cultivars of tobacco (*Nicotiana tabaccum* L.). Test-plants cultivated in ozone-free air were exposed in the field (semi-urban monitoring station located at the National Botanic Garden of the National Academy of Sciences of Ukraine in Kyiv city) during the summers 2004 and 2005. During the period of experiments, the ambient ozone concentrations were continuously monitored by UV ozone analyzer and the moving averages of the short term AOT40 were calculated. The foliar injury (%), photosynthetic pigments content in leaves and biomass of above-mentioned test-plants were evaluated. A number of antioxidants (EDU, quercetin, catechin) and the fungicide agrochemical "Topaz" (containing 10% of penconazol), as well as 5% water extract from leaves of marigold (*Tagetes patula* L.), basil (*Ocimum basilicum* L.), clary (*Salvia sclarea* L.) were applied as foliar sprays. After 10-14 days from the beginning of the experiments typical visible ozone injury symptoms of clover and tobacco were developed mainly on the control (water sprayed) plants and to a lesser degree on plants treated with antioxidants. The number of injured leaves gradually increased during the following days. All used substances showed partial ozone protective effect. The most effective among synthetic antioxidants was EDU, and among native plant extracts – those from marigold and basil.

Key words: Ambient ozone, bioindication, clover, tobacco, ozone pytotoxicity, antioxidants

SI/O-5 Comparative Accumulation and Tolerance of Heavy Metals by Aquatic Macrophytes (*Typha anguistata, Phragmites communis* and *Cyperus aloecupirodes*) in Wetland Ecosystem

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A comparative tolerance and bioaccumulation pattern was studied in three wetland plant species i.e. *Typha anguistata, Phragmites cummunis* and *Cyperus aloecupirodes* for eight heavy metals i.e. Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn found in distillery wastewater. The metal analysis of different parts of these tested wetland plant after two months treatment with distillery wastewater showed that these plant species have 20 times high accumulation and tolerance potential as compare with the concentration of all tested heavy metals found in distillery wastewater. The roots of *Typha anguistata* has accumulated maximum concentration of all the tested metals than stem and leaf but shoot showed the maximum accumulation of iron followed by zinc, manganese, copper, chromium, lead and cadmium. Similarly, the shoot of *Phragmites cummunis* also showed that it has accumulated maximum concentration of iron than root and leaf. But, in case of *Cyperus aloecupiroides* a variable pattern of metal accumulation for different metals was observed in different parts. As the leaf of *Cyperus aloecupiroides* showed that these have accumulated the maximum concentration of Mn. But, the accumulation order of Fe, Zn, Pb, Ni, Cd, Cr and Cu in different parts of *Cyperus aloecupiroides* was Root>Shoot>Leaf. Hence, In this study it was revealed that these wetland plant species have high potential for bioremediation of the industrial waste and can be used safely for biotreatment of various types of industrial waste to makes suitable for aquaculture and ferti-irrigation.

Key words: *Typha anguistata, Phragmites cummunis, Cyperus aloecupirodes,* bioaccumulation, tolerance, wetland plant, bioremediation.

SI/O-6 Uptake and Controlled Release of Phosporus and Metals by an Encapsulated Cyanobacterium

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Cultured cells of the cyanobacterium *Plectonema boryanum* were grown in a phosphorus-rich medium to a high titer, and subsequently placed in an osmotically similar medium lacking phosphorus for five days. The cells were then reintroduced into the phosphorus-rich medium once again and exposed to 20 ppm lead (Pb) or selenium (Se) for 10 hr. Analysis of beads and the fluid contents for phosphorus (P), Pb and/or Se were conducted with ICP-MS. The result was the rapid incorporation of P into polyphosphate bodies, which also sequestered the heavy metals. A full uptake of both Pb and Se occurred in the first 10 min of exposure to the metals. There was no significant change in uptake of either metal after 4 hr exposure or later.

The cells were then encapsulated into alginate beads and subjected to a nitrogen gas flow through the medium that simulated microaerophyllic conditions. The level of the oxygenation was monitored by the dye resazurin, which colorimetrically changed from intense blue to pink (pink indicating a low level of oxygen). This treatment held Pb at a low concentration level, which dropped from 12 ppm to ~3.0 ppm in the first hour. P concentration was also reduced more than 10-fold over this time interval. Under nitrogen flow conditions (microaerophyllic) for 1 hr. there was no change in Pb or P levels as compared with 10 min nitrogen exposure. The alginate beads with cells lost nearly all Se, and exhibited more than a 10-fold loss of P (from 3.0 to 0.25 ppm) during the same time interval. Alginate beads with encapsulated cells of *P. boryanum* in Se under nitrogen treatment for 10 min retained Se at near initial levels, and also retained P at full levels. This study strongly indicates that there are significant differences in the ability of polyphosphate bodies of *P. boryanum* to accumulate and retain different heavy metals, and that release of certain metals can be established by short-term microaerophyllic conditions.

Key words: Cyanobacterium, microaerophyllic, phosphorous, metal uptake

SI/O-7 Use of Farmer Approach in Developing Indicators for Soil-Plant Environmental Assessment

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Soil-plant environment degradation is one serious problem in Vietnam. Many forest areas, being cleared for agricultural activities every year, resulted in increasing barren land areas. This causes problems in soil environment as increasing degraded soil fertility. In addition, the backward agricultural system leads to problem of soil degradation.

The use of farmer's knowledge is an important approach to develop indicators for evaluation of soil-plant environment. Our study indicated that farmers have intuitive knowledge derived from their long experience, thus their perceptions are useful for planning soil-plant conservation programmes. Farmers recognize many important indicators affecting soil and crop yields, for example, increase of soil acidity, depletion of organic C, losses in soil fertility, and soil compactness.

Plant indicators are also important for evaluation of soil environment. The occurrence of some wild plant species in the fields was viewed as an indicator of some soil properties' degradation. Experienced farmers linked the presence of certain weed species (*Blatus cochinchinensis, Medimilla spirei* and *Lophathe rumgracille*) in the tea fields to increased acidity. Likewise, species such as *Chrysopogon asculatus* were used as indicators of poor nutrient potential (soil fertility) and dryness of the soil, both of which are indicators of soil degradation. These perceptions of farmers closely link the results of scientific research. The farmers' approach (qualitative) for assessment of soil-plant environment has been widely applied in upland areas of Vietnam.

Although this approach has some limitations as it only provides qualitative assessment, yet it is useful being easy and applicable to developing countries like Vietnam.

Key words: Soil degradation, plant indicators, acidity, farmers

SI/O-8 Reduction of Toxic Cr(VI) by *Bacillus cereus* S-6 Isolated from Chromium Polluted Soil

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A chromium-resistant bacterial strain S-6 was isolated from chromium-contaminated soil. On the basis of different morphological, biochemical characteristics and 16S rRNA gene analysis the strain was identified as *Bacillus cereus* S-6. Hexavalent chromium resistance of the strain shows that it could tolerate very high concentration of K_2CrO_4 both in nutrient (25 mg ml^{-1} in nutrient broth and 50 mg ml^{-1} on nutrient agar) as well as in acetate-minimal medium (15 mg ml^{-1}). Chromate uptake and reduction studies revealed that strain *Bacillus cereus* S-6 not only accumulate but can also reduce handsome amount of toxic Cr (VI) in to Cr (III). Heavy metals (Ni, Mn, Zn, Cu and Co) at low concentration did not affect the reduction capability of the strain. It could also reduce hexavalent chromium in industrial effluents.

Key words: *Bacillus cereus* S-6, heavy metal, chromium uptake, Cr(VI) reduction, industrial effluent, bioremediation

SI/O-9 Late Pleistocene Marine and Terrestrial Palynomorphs in Chaganacherry, Kerala: Palaeoclimate and Palaeoshoreline Indicators

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Chaganacherry lies in the south western part of Kottayam district, Kerala. The geomorphology includes mounds, slopes and ridges beneath which is a layer rich in organic matter that varies from 3 to 0.6 m in the entire Chaganacherry area. Palynology, mineralogy and geochemistry in two well sections were studied from Vazhapally zone, Chaganacherry which is located 25 kms east from present Alleppey shoreline. The geochemical study of the sediment reveals high iron, sulfates (15.077 per cent) and organic matter (36.11 per cent). The organic soil is highly acidic (1 pH). The sediment also consists of fine ash and abundant macro and microscopic resin fragments, carbonized organic matter and residue minerals derived from basic rock. The glassy shards showing inclusions of small air bubbles and fine organic matter are common. Palynological study shows abundance of true mangroves belonging to Rhizophoraceae family, marine dinocysts and rich terrestrial land plant diversity. The high plant diversity suggests favourable warm and humid climate that prevailed during the period. The organic matter in both the wells date back to > 40,000 yrs. BP (^{14}C dates). For the last half-century geologists have assumed: (1) late-Pleistocene high sea-levels at 80-120 thousand years before present (ka) and, (2) recent Holocene sea level high stand at 0-5 ka. Thus, it is inferred that the mangroves indicating palaeoshoreline (25 km inland from the present shoreline) in Chaganacherry should be of the first event rather than the second because the radiocarbon dates of the mangrove bearing sediment is older than 40,000 yrs. BP. Several records of regressive palaeoshorelines during the last glacial period are recorded off shore along the Indian coastline. However, the Holocene sea level rise after the LGM reached land several kms inland until ~6000 yrs. BP. High percentage of glass shards in the sediment showing characteristic aeolian features could be of Youngest Toba Tuff that covered a large area of the atmosphere around 74,000 yrs. BP. The large scale spread of. ash cover in the atmosphere induced cooler and dry climate; perhaps the beginning of last glacial cycle (Late Pleistocene). Adverse cool and dry climate accompanied by rapid fall in sea level in the beginning of the last glacial period ruined the rich plant diversity in Chaganacherry and may have affected the vegetation in the entire continent.

Key words: Pleistocene, palynomorphs, mangroves, radiocarbondate

SI/O-10 Risk-Based Environmental Decision-Making Software for Site Remediation

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Integrated Saudi Aramco Risk-Based Corrective Action (ISARBCA) is user-friendly decision-making software developed at Memorial University of Newfoundland in Canada for Saudi Aramco site remediation assessment. This user-friendly software, which is based on a systemic and scientifically sound methodology, has potential in determining the extent contamination using multi-media fate and transport model and quantifying associated risk to the selected receptors exposed to the contaminants through different pathways. The software is also linked with a comprehensive remediation technology database which helps in evaluating available remediation technologies for site-specific situations and optimizing the extent of cleanup. ISARBCA also allows "natural attenuation", mainly based on bioremediation principle, as one

of the remediation alternatives. Using ISARBCA, natural attenuation for different reaction kinetics and decay coefficients can be studied with time. If the contamination at a site can be contained and if the natural attenuation rates are promising, "no action" as one of the remedial options can be used for site remediation. Many hydrocarbon-contaminated sites can be evaluated and designated under "natural attenuation" option using this approach. This software interfaces with (a) risk assessment and risk characterization models; (b) chemical toxicology and environmental partitioning databases; (c) remediation technology database; and (d) multi-media contaminant fate and transport models. All these modules will briefly be discussed in the paper.

This paper will also highlight the potential of ISARBCA software in upgrading site remediation practice to a very systematic, thorough and cost effective manners either by reduction of contaminants using various technologies in the software or by reducing the potential of exposure through the application of institutional controls and the natural attenuation of contaminants. Since this software is based on three-tier approach, unlike other conventional remediation methods, ISARBCA does not require a great deal of data collection in the beginning. For developing countries like India, where decision-making for site assessment is usually based on limited data, ISARBCA is quite promising.

Methodology and data requirements in various tiers of assessment will be presented with case studies. The paper will also focus on the feasibility of bioremediation as a remediation tool for numerous low risk contaminated sites in developed and developing countries. Various applications of ISARBCA in developing risk-based solution for oil spills on land, leakage from underground storage tanks, oily sludge pit remediation study, brown-field assessment, and site restoration and development of closure plan for contaminated sites will be presented.

Key words: Bioremediation, corrective action, decision-making, natural attenuation, remediation technology, risk assessment

SI/O-11 Effect of Industrial Waste on Nitrogen Assimilatory and Antioxidant Enzymes during Germination and Growth of *Amaranthus* Seedlings

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Pollution and contamination of soil is one of the major concerns these days. Industrial wastes and domestic discharge have heavy pollutants that affect plant growth and metabolism considerably. The use of chemical fertilizers and pesticides has caused tremendous harm to the environment. Microorganisms and biofertilizers are only hope for agricultural and environmental needs. The work has been going on for a long time on the use of fungi, bacteria and cyanobacteria as biofertilizers. The biofertilizers have been known to provide plants better nutrition, tolerance to adverse conditions and disease resistance etc. Industrial wastes such as press mud (PM) and biocompost (BC) are supposed to be rich in carbohydrates and nitrogen, which are the most essential element for plant growth and metabolism. Although such waste has recently attracted the attention of the many scientists all over the world but still there is not much known about effects of these wastes on physiological and biochemical parameters and enzymes related to nitrogen metabolism and stress tolerance. Therefore, the effects of sugar Industry wastes (PM and BC) on the germination, early growth and enzymes related to nitrogen assimilation and stress tolerances are presented. The results show stimulatory effect of press mud and biocompost on germination and growth of seedlings during first 48 hours. These effects were mediated through the regulation of the activities of nitrogen assimilatory and antioxidant enzymes.

Key words: Nitrogen assimilation, industrial waste, antioxidant enzymes, *Amaranthus*

SI/O-12 Vetiver Eco-Technology in Water Remediation and Social Forestry

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Increasing industrialization and intensive agriculture continue to threat our water resources. Not only the water resources are fast depleting but their water quality is deteriorating and contaminated with industrial effluents, making it unsuitable for irrigation and survival of flora and fauna. Most lakes and water bodies are under eutrophication, and most of the water from natural resources is unsuitable for urban utilization. It is therefore, necessary to search for natural remedies as a primary measure to mitigate deterioration of water quality. Vetiver (*Vetiveria zizanioides* (L) Nash.) - a miracle grass offers sustainable solution. This species is native to hygro-envoironment, and is extremely tolerant to draught as well as submergence, and holds excellent features for wastewater treatment and environmental protection. The species holds tremendous potential for removing heavy metals, toxic chemicals and inorganic leachates from the soil and water bodies so inflicted.

Experiments conducted on range of soil and water climatic conditions reveal that vetiver helps in water purification from aquifers by absorption of toxic substances. The peculiarity of this miracle grass lies in its potential to grow along the banks as well as floats on water surface. Curiously, the roots of this species are the source of valuable essential oil. As such vetiver ecotechnology has the potential to offer twin advantage in a social forestry system: (i) of water purification by removing toxic chemicals from the aquifers, and (ii) the roots harvested from water grown plants could be utilized for essential oil extraction.

Key words: Vetiver ecotechnology, water purification, phytoremediation, pollution mitigation, social forestry

SI/O-13 Studies on Removal of Fluoride from Water by Used Tea Leaves Carbon

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Fluoride content of more than 1.5 mg/l in drinking water causes the disease 'Fluorosis'. The concentration of fluoride in ground water is attributed to rocks through which it flows. Fluoride containing waste water, is also one of the contributing factors for high fluoride concentration in ground water.

Many adsorbents have been tried for the removal of fluoride from ground water and waste water. In view of high defluoridation capacity exhibited by waste organic materials and carbon prepared from waste organic materials, the study was carried out to examine the suitability of used tea leaves and carbon prepared from it.

The water samples from wells of Radhapuram Taluk were collected and the physico-chemical characteristic were determined. Basic parameters for fluoride removal such as pH, adsorbent dose and contact time were found out for batch process using adsorbents. Fluoride removal was maximum for used tea leaves and used tea leaves carbon at pH 1.5 and 6.0 isotherm and kinetic studies were carried out to evaluate the parameters.

After batch study, further study was made using column process to bring out the effect of bed depth and flow rate. Regeneration was accomplished by 2% alum solution. The capacities of both the adsorbents were found to be 0.515 mg/g and 0.465 mg/g.

Key words: Fluoride, fluorosis, adsorption, used tea leaves, defluoridation

SI/O-14 Phytotechnologies - Breakthroughs and Bottlenecks

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The breakthroughs and bottle necks for the emerging phytotechnolgies with reference to metals, metalloids and radionuclides are presented in this lecture. Soil conservation and restoration of degraded soils (wasteland/marginal land) is the most serious environmental concern to India. Trees and grass grown together have prevented soil and nutrient loss from different land use systems in Shivaliks (foot hills of Himalayas, one of the most fragile ecosystems). This has included combinations of Eucalyptus-Bhabar grass; *Acacia catechu*-forage grass; *Leucaena*-Napier grass; Teak- *Leucaena*- Bhabar; *Eucalyptus-Leucaena*-Turmeric; Poplar-*Leucaena*-Bhabar and Sesamum-Rape seed. Silvi-pastoral model comprising of *Prosopis juliflora* and *Leptochloa fusca* was successful for restoration of alkali soils.

The constraints related to plant establishment, and amendment of the physical and chemical properties of the toxic metalliferous soils depends upon the choice of appropriate plant species that will be able to grow in such a hostile environment. Plants tolerant to toxic levels of trace elements respond by exclusion, indication or accumulation of metals. Thus, more information about plant communities that are growing on metal contaminated soils is essential to determine their application for mine stabilization/remediation and biogeochemical exploration. Agricultural production in metal/radionuclide-contaminated soil is of human health concern in soil because of high levels of metallic and radionuclides residues in agricultural food products. Therefore, interest arises in developing more integrated and ecologically based approaches. In this regard, industrial crops not used for food production such as fiber crops are though of as an alternative option. Two fiber crops viz, hemp (*Cannabis sativa* L.) and flax (*Linum usitatissimum* L.) were preferred for cultivation, as extensive knowledge of these crops is available on their use, however, information on the radionuclide transfer to fiber crops is limited.

Fibre and energy crops; plants, that are amenable to genetic manipulation via *in vitro* culture techniques might play significant role for the success of phytoremediation for sustainable land use.

Trees - *Eucalyptus tereticornis, Populus deltoids, Terminalia arjuna*, *Acacia auriculiformis, Syzigium cumini, Albizia lebbek, Dalbergia sissoo* and *Pongamia pinnata*; grasses - Para grass, Cord grass, lemon grass and *Setaria* grass exhibit tolerance to a wide range of soils contaminated with inorganic and organic pollutants. This kind of integrated approach would stabilize/remediate polluted (inorganic and organic) soils for sustainable development.

Key words: Phytotechnologies, phytoremediation, break throughs, bottle necks, sustainable development, trees, grasses, legumes

SI/O-15 Integrated Phytoremediation Techniques for Removal of Metals from Industrial Waste

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Phytoremediation is emerging as a novel strategy to remove, degrade and contain pollutants from water, air and soil using plants and their processes, thus prevent toxic impacts. It is known that plants concentrate and translocate metals from their surroundings and accumulate them in their tissue at high concentration so that they can be easily harvested and removed from the site.

The present study was undertaken with a view to develop integrated phytoremediation techniques for treatment and management of tannery effluent and sludge through plant biomass and bacterial inoculum. Several chromate tolerant bacterial strains isolated from tannery effluent showed high tolerance and Cr accumulation potential. The potential aquatic plants identified during the study viz., *Pistia stratiotes, Hydrilla verticillata, Vallisneria spiralis* and *Baccopa monnierii* were found efficient in reducing the level of Cr from tannery effluent. Inoculation of rhizobacteria isolated from rhizospheric zone of *Scirpus lacustris* growing in different Cr concentration resulted into enhanced growth and metal accumulation in the plant. Potential metal tolerant plants having woody biomass like; *Prosopis juliflora, Terminalia arjuna, Eucalyptus terecornis, Populus alba, Dendrocalamus stictus* have successfully been grown on tannery sludge dumps. Planting pits were amended with sand, cow dung manure and inoculums of chromate tolerant bacterial strains, which helped in establishment of saplings. These plants were found growing fast as evidenced by periodical measurements of plant height, canopy area and DBH and accumulated substantial amounts of many toxic metal in the order Fe > Cr > Mn > Pb > Zn > Cu > Ni. The treated sludge, slurry and phytomass were anaerobically composted. Moisture content of the composting mass was maintained equal through out the composting period. Various amendments using clay, bauxite, fly ash etc. are being tried to evaluate their efficiency in increasing the pH of compost. After composting of the phytomass, various useful byproducts such as biogas and organic manure for growing crops etc. could be obtained. Importance of these findings will be discussed in relation to utilization of phytoremediated biomass as a source of energy.

Key words: Phytoremediation, toxic metals, tannery effluent, compost

SI/O-16 Using River Benthic Macroinvertebrates from Indonesia as Bioindicator of Detergent Pollution

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The objective of this research is to determine the responses of benthic macroinvertebrates that can be used effectively as bioindicator of detergent pollution level in freshwater ecosystem. The methodology included: (1) comparative study of river habitat topology and the interaction of detergent pollution level with population of benthic macroinvertebrates. (2) acute and subacute toxicity testing to determine the sensitivity potency of the sensitive benthic macroinvertebrates towards detergent surfactant (Linear Alkyl Benzene Sulphonate/LAS and Alkyl Benzene Sulphonate/ABS); and (3) verification testing to determine the appropriate methods for standardizing, using benthic macroinvertebrates as bioindicator of detergent pollution level in freshwater ecosystem. The result showed that some gastropods and annelids had positive interaction with detergent pollution level in the river. The result of acute toxicity testing showed that *Lymnaea rubiginosa* and *Melanoides granifera* are significantly more sensitive to detergent surfactant, compared with the others. This sensitivity is not affected by the difference of gastropods habitat (polluted or not). LAS surfactant (from 1.8 ppm) and ABS (from 5.35 ppm) can cause abnormality to snail (*L. rubiginosa)* embryo development. These abnormality can be observed from irregularity of blastomers formation, lysis, shell of embryo didn't complete, small shell, and embryo hasn't shell. Detergent surfactant (LAS and ABS) could influence the abnormality of planaria (*Dugesia trigina)* regeneration (from 0.25 ppm) and inhibiting the addition of the planaria body long as the result of regeneration (from 0.5 ppm). There are four types of abnormalities: (1) regeneration of planaria inhibited; (2) reopened of the scap; (3) autocutting of the body; (4) the part of the regeneration is broken. The conclusion of this research was that abnormality development of *L. rubiginosa* embryo and planaria (*Dugesia trigina*) regeneration

can be used as bioindicator of detergent pollution level in freshwater ecosystem.

Key words: Benthic macroinvertebrates, bioindicator, detergent pollution, Indonesia, river ecosystem

SI/O-17 Air Quality Assessment in an Industrial Area in France Using Monitoring Plants

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Sensitive bioindicators (tobacco cv. Bel W3 and Bel B; *Petunia* sp. cv. hybrida F1, *Tradescantia* sp. clone # 4430) and one accumulator plant (*Brassica oleracea*) were exposed in the city of Dunkerque, an important industrial area in northern France.

Main objectives of this experiment were: (1) to use different biological techniques for environmental impact assessment of ozone and VOCs and (2) to compare obtained results with those obtained with passive samplers (Radiello Company), canisters and air pollution automatic network. This work was also done in order to propose an alternative tool in areas devoid of technical equipment. This study lasted 6 months (May – October). Fifteen monitoring stations were distributed around Dunkerque conurbation taking into account three environment characteristics: 6 are located near industrial complexes, 5 in rural areas, 3 in urban environments and 1 control site situated in a greenhouse was considered. Those stations were equipped with tobacco and cabbage plants. Ten stations were equipped with passive samplers for O_3, 6 were equipped with the three sensitive indicator plants. Cabbages were exposed from 24h to 2 month to study VOC accumulation mechanism. VOC concentrations in leaves were measured using GC/MS. Data from tobacco and passive samplers were collected each week. Petunias were exposed one month according to Garrec and Van Haluwyn (2002); *Tradescantia* inflorescences were exposed 24 h, and *Tradescantia* Micronucleus Test was performed according to Klumpp *et al.* (2004). Canisters were exposed within different periods. All data were interpreted using statistical analysis (Statistica software). Results from the automatic network showed that ozone pollution was quite homogeneous in each station during the period of experimentation. Data from passive samplers were globally correlated with data from automatic network. Results from biomonitoring were in agreement with results from those methods. Concerning O_3, we've observed greater damages in rural stations as in industrial and urban ones. Different VOCs were identified in cabbage leaves, depending on stations (greater concentrations and diversity of products in industrial. areas) and exposure periods. We never found benzene despite the fact that it was present in canister sampling. First results on biomarkers (GSH, MDA and SOD) showed variations of concentrations related to stations and exposure periods. Micronucleus tests and *Petunia* observations showed greater impacts of pollutants in industrial areas. This study enabled us to observe environmental impact of atmospheric ozone and several VOCs in a particular area. These experiments conducted us to associate several complementary techniques for ozone and VOCs monitoring. By the use of bioindicator plants, a more precise picture of pollutant impacts was demonstrated. Furthermore, the combination of bioindicator plants and physico-chemical tools should play an important role in the areas devoid of automatic air pollution network

Key words: Bioindicators, VOCs, Ozone, environmental assessment

SI/O-18 Evaluation of Phytoremediation Technology for Oil Contaminated Soil in Arid Regions

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Saudi Aramco has the most updated environmental and safety management programmes but despite all kinds of measures taken, accidental spills occur during processing, storage, and transport of crude oil and processed products. Such spills can cause contamination of sites, which may require site cleanup. Considering high oil production rate (up to 12 million barrels a day) and high refining capacities (up to 2.5 million barrels a day) within Saudi Arabia, a large amount of waste is generated which also requires cost-effective and environmentally safe treatment technology. Phytoremediation is an emerging and promising technology. This paper focusses mainly on the potential application of phytoremediation to remediate sites, which are contaminated with hydrocarbons and metals. An overview of this technology, in terms of its growth, challenges, and its potential use in arid regions is presented. Various mechanisms involved in phytoremediation, such as phytoextraction, phytotransformation, phytostimulation, and phytovolatilization are discussed with case studies. Indigenous plant species, which can grow in the harsh Saudi climatic conditions and those plants which require less water and can tolerate high salinity, are identified and tabulated. In order to apply this technology at some selected Saudi Aramco sites, a systematic procedure with laboratory and field protocols is discussed in the paper. It is expected that if phytoremediation technology is properly implemented in Saudi Arabia, it will help in developing greenbelt and at the same time making the technology ecologically viable, biologically safe, and economically feasible.

Key words: Phytoremediation, oil contamination, salinity, hydrocarbon, metals

SI/O-19 Monitoring of Herbicide (MH) Toxicity by using Pollen as Indicators Pollen of *Phaseolus aureus* – A Critical Review – I

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Foliar applications of 5, 10, 25, 50, 100, 200-200-1000, 1000-1000-5000 mg ml^{-1} maleic hydrazide (MH) (1,2-dihydropyridazine, 3-6-dione) were made on 3 weeks old crop (pre-flowering stage) of *Phaseolus aureus* Roxb. - Var. J -781 – mung to find out the effect of MH on the physiology of pollen on successive flowers (*viz.* F, F-24, F-48, F-72 series *i.e.* open flowers and the flower buds which require 24, 48, 72 hours to open respectively.) The observations on the physiology of pollen were made after 5 weeks of treatment. Pollen viability was tested by using 2,3,5-Triphenyl tetrazolium chloride (Hauser and Morrison, 1964). An optimum concentrations of sucrose (10% for F-24 Series, 20% for F and F-48 Series, 30% for F-72 Series) were used for the germination of pollen of successive flowers.

Foliar applications of all the concentrations of MH above 800 mg ml^{-1} prevented the flowering of *P. aureus.* After 5 weeks of treatment the effect of 5-50 mg ml^{-1} MH is nullified on the fertility of pollen of all the 4 series of *P. aureus*, while the treatment of the lowest concentration of MH is nullified on the germination of pollen and tube growth. None of the concentrations of MH could suppress the cent percent pollen fertility which is essential for the successful plant breeding program This proves that the existing method *i.e.* chemical induction of pollen sterility fails here. Hence we have to find out an alternative method of plant breeding. All the concentrations of MH above 200 mg ml^{-1} suppressed the germinability of pollen of all the 4 series. When there is no

germination of pollen then the transfer of the male gametes to the female does not take place and the question of the seed-setting does not arises. Hence we should explore this new method of plant breeding which is economical.

Key words: Herbicides, toxicology, palynology, crop physiology

SI/O-20 The BERN Model : Bioindication for Ecosystem Regeneration towards Natural Conditions

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As a Signatory to the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone within the UNECE Convention on Long-range Transboundary Air Pollution, Germany's responsibility is to contribute work-products towards the fulfillment of the medium-term work plan of the UNECE Working Group on Effects (WGE). In order to integrate ecosystematic connections when establishing cause-effect relationships and determining Critical Loads, the BERN model was developed on the basis of empirical compilations in Germany. Nearly all biological components in a natural or semi-natural ecosystem are adapted to harmonious balanced relationship with the essential nutrients, which include nitrogen (N), phosphorus (P) and carbon (C), as well as base cations (Bc: sum of calcium [Ca], potassium [K] and magnesium [Mg]) and the supply of water and temperature. In the presence of a harmonious equilibrium of nutrients, water and energy also called natural or semi-natural plant community spontaneously settles in. Indicators of the endogenic change are characterized by the change of the vegetation structure. Disharmonious conditions caused by anthropogenic depositions of acidifying and eutrophying air pollutants (sulphur and nitrogen) result in the reduction of the vitality and the ecosystematic functionality - at first for single individuals, then later for the local population. Finally the natural plant community, as such, is no longer existent - only fragments remain or non nature-identical derivate communities of few species develop. However, where nutrient input (e.g., with simultaneous nitrogen eutrophication and deposition of base cations) achieves a new harmonious nutrient equilibrium at a higher level, there will still be the death of the primarily existing dominant and other constant plant species and their community, but many other plant species will migrate in, which altogether can develop a new natural-identical plant community typical for the new habitat type. The same occurrence has been known to occur with simultaneous acidification (with sulphur) and nitrogen deprivation.

The BERN model database includes, in the first stage, the fundamental niches of the plant species with their blurred thresholds of the suitable site parameters (base saturation, C/N-ratio, soil moisture, length of vegetation period and continentality index). In the second stage, the really niche of the whole plant community had been modeled by combining the fundamental niches of the constant plant species with the minimum operator of the fuzzy logic. The real existing combinations of site factors are classified to site types and the typical adapted natural plant communities are allocated to these site types as bioindicators for a harmonious equilibrium of properties. This database enables the user of the BERN-model to assess the current regeneration ability, to quantify the critical limits and critical loads of natural and semi-natural plant communities, to determine the dynamic change of vegetation structure in the past and future depending on history and future scenarios of using, depositions and climate change and to determine the future options of regeneration targets.

Key words: bioindication, natural plant community, regeneration ability, critical limits, climate change, regeneration targets

SI/O-21 Role of Two Wetland Species in Bioremediation of High Selenium Concentration from the Environment

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Selenium is essential to animal diet in the range of 0.1 to 0.3 ppm and its adequate level in human being is 110 mg per person per day. It occurs naturally in the biosphere and causes chronic selenosis (Se poisoning) due to high intake (5 mg/day) through occupational inhalation. Deficiency of selenium caused Keshan disease (KD, Cardiaomyopathy and Kaschin-Beck disease (KBD, osteoorthrosis) in China. It is potent toxicant of human being, livestock, plants, waterfowl and certain bacteria. There is wide spread discharge of selenium from the industrial and agricultural sources. Constructed wetland is semi-controlled complex water saturated habitat, which provides mechanical and biogeochemical filter capable of removing different types of contaminants from waste water and other polluted water. We investigated the possible fate of selenium in the constructed wetland and ecotechnological role of *Typha latifolia* L. and *Phragmites austarlis* (cav.) Trin. Ex Steud., in the removal of selenium.

Se (20 mg l^{-1}) was supplied continuously through constructed wetland gravel media bed (aquatic model vegetation facility, AMOVA) vegetated with two helophyte species. The total area of each bed channel was 4.55 m^2. Migration of selenium from inlet to other points along the horizontal beds of species occurred with different flow velocity. In the *Typha* bed, Se migrated faster than *Phragmites* bed.

After 25 days of the experiment 50% of supplied Se remained in the outlet water of the *Typha* bed put *Phragmites* was able to remove Se at short distance. Better capacity of *Phragmites* vegetation for Se removal may be due to its high density during the experiment period. The underground parts in total, accumulated Se more than twice (6.8 mg g^{-1}) than the above ground parts (2.3 mg g^{-1}). *Phragmites* accumulated Se in the leaves and stems, but not in the rhizomes. The *Typha* bed removed only 50% of Se mainly through accumulation in the below ground parts and aboveground parts and less through volatilization

Key words: Wetland, Selenium, *Typha latifolia, Phragmites austarlis*

SI/O-22 Bioremediation of Municipal Wastewater (Sewage) using Earthworms: a Cost-Effective Sustainable Technology

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Municipal wastewater has high BOD and COD loadings, dissolved and suspended solids and other impurities like phosphates and nitrates resulting from washing soap and detergents. Earthworms have been found to remove BOD_5 by 90 %, COD by 80-90 %, total dissolved solids (TDS) by 90-92 % and the total suspended solids (TSS) by 90-95 % from wastewater by the general mechanism of biodegradation of organic wastes in the wastewater and also by up taking the heavy metals and solids from wastewater. This is a odor-free process and the resulting vermifiltered water is clean enough to be reused for gardening and other non-potable purposes.

Thus the system combines the dual bioremediation activity for the wastewater- primarily the vermin-remediation (vermifiltration) by the action of live earthworms and phyto-remediation by the action of canna lily. While the earthworms degrade the organic impurities and

ingest heavy metals, the plants tackle the inorganic impurities of the wastewater. Dissolves and suspended organic and inorganic solids are trapped by adsorption and stabilized through complex biodegradation processes that take place in the 'living soil' inhabited by earthworms and the aerobic microbes. Intensification of soil processes and aeration by the earthworms enable the soil stabilization and filtration system to become effective and smaller in size. Suspended solids are trapped on top of the vermifilter and processed by earthworms and fed to the soil microbes immobilized in the vermifilter. Earthworms also grazes on the surplus harmful and ineffective microbes in the wastewater selectively, prevent choking of the medium and maintain a culture of effective biodegrader microbes to function. Vermifilters provide a high specific area – up to 800 sq m/g and voidage up to 60 %. It also provides a wet strength of about 1 ton / sq meter which is a remarkable feature for a biofilter. It has no nuisance value, no foul odor, if we avoid overloading. In the vermifilteration technology there is 'no sludge' formation and only vermicastings are produced which is a nutritive fertilizer.

Key words: Vermifiltration, biofilter, vermicastings, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD)

SI/O-23 Cadmium, Nickle and Vanadium Accumulation by Four Strains of Marine Bacteria

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Four marine bacteria isolated from the east Anzali marsh sediments of Caspian Sea, were tested for heavy metals such as Cadmium, Nickle and Vanadium tolerance. Three of these isolates were resistant to heavy metals Cadmium, Nickel and Vanadium and the last one to every 3 metals.

Heavy metals uptake was determined by flow injection analysis in both biomass as well as the supernatant. These bacteria showed enhanced absorbance and growth in the presence of Cadmium and Nickel at 80-100 mg l^{-1} and Vanadium at 40 mg l^{-1} concentrations. Uptake of Cadmium and Nickel was high, rapid and the amount increased in direct proportion to concentration from 5 to 100 mg l^{-1} Cadmium, Nickel and 5 to 40 mg l^{-1} Vanadium. The largest amount of heavy metals uptake observed to occur in stationary phase, when incubated at 30°C at 72 h (by Atomic Adsorption assay). The results revealed that a sum total of about 40-50% Cadmium and 50-60% Nickel was accumulated by these bacteria. The cells of marine bacteria immobilized in sodium alginate gel showed more efficiency in biosorbing heavy metals than free cells. The Scanning Electron Microscopy results of this study indicate that the marine bacteria were capable of accumulating several metals. Accumulation of Cadmium and Nickel was higher than Vanadium. This indicated that these organisms could prove to be a potential candidate in the field of bioremediation with respect to Cadmium, Nickel and Vanadium removal in aqueous effluents.

Key words: Bioremediation, marine bacteria, cadmium, nickel, vanadium

SI/O-24 Study on Nitrogen Pollution Effects on Epiphytic Lichen Communities

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The main objective of this work is to study epiphytic lichen communities in relation to NO_2 and NH_3 atmospheric pollution data. This study was done in a zone of 100 km^2 (100 plots), located in Saint Omer, in the Pas de Calais region. This city (16,600 inhabitants) has a little industrial area mainly composed by glassworks, cement works and paper manufacturing. A swamp covers a large area in the north. Agricultural fields cover the rest of the studied zone.

This study was made during the summer 2004. NO_2 and NH_3 pollution was evaluated using passive samplers (Radiello Company) disposed in 19 stations regularly spaced. Passive−samplers were exposed during 3 periods, one week each (1 week, 3 times). Lichen-communities were studied according to Van Haluwyn and Lerond's methodology (Van Haluwyn et Lerond, 1986).

Results obtained from passive samplers showed a moderate NO_2 pollution mainly due to traffic and industries. Those concerning NH_3 are more heterogeneous between weeks and in different places. This pollutant is present all over the zone, more in agricultural places. Even if it's not possible to put in advance, more precisely, some sources, all pollutants are present in the zone.

Three hundred fifty four trees were observed, on 79 plots. Only macrolichens were considered. First, we noted an abundance of species as *Xanthoria parietina, Physcia tenella, Physconia grisea*… in comparison with *Parmelia* species. All those species belong to the alliance *Physcion adscendentis* Barkm. 1958. They are neutrophilous to nitrophilous. On the other side *Parmelia* species such as *Parmelia caperata*, *P. revoluta* considered as characteristics of the *Parmelietum caperato revolutae* community are relatively rare. There's no clear separation between acidophilous and nitrophilous communities as previously observed in other cities or near a motorway (Cuny *et al.*, 2001, Cuny et *al.,* 2003). These communities are mixed and the increasing development of nitrophilous species, which are more competitive, leads to an impoverishment of acidophilous groups.

As previously observed in two other cities in the northern France, lichen communities become poorer with a majority of species belonging to nitrophilous groups. It's not possible to distinguish effects from NOx or NH_3 on lichen flora, because of the presence of these two pollutants in the same places. It's possible that these pollutants have the same effect on lichen communities. In another way, particulate matter deposition could play a key rule in the evolution of lichen flora. Particulate matters are pollutants emitted by industries, vehicles and soils. We can assume that particles could bring to the lichen substrate favourable elements for nitrophilous species.

Key words: Lichen, NO_2, NH_3, traffic, agriculture

SI/O-25 Strategies for Phytoremediation of Heavy Metal Pollution Involving Phytochelatins by the Plants

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Phytoremediation, an emerging cleanup technology for contaminated soils, groundwater, and wastewater, that is both low-tech and low-cost, is defined as the engineered use of green plants to remove, contain, or render harmless such environmental contaminants as heavy metals, trace elements, organic compounds, and radioactive compounds in soil or water.

Due to increased industrial and anthropogenic activities, our natural resources such as water and soils are increasingly contaminated with toxic metal ions. Potential metal tolerant plants having metal accumulating ability were identified. Free floating, submerged and emergent and other plants viz., *Hydrodictyon reticulatum, Lemna minor, Spirodela polyrrhiza, Chara corollina, Ceratophyllum demersum, Vallisneria spiralis, Alternanthera sessiles, Baccopa monnieri,*

Hydrilla verticillata, Potamogeton crispus, P. pectinatus, Vicia faba, Salix acmophylla, Salix babylonica, Nymphaea alba and *Nelumbo nucifera* were identified as accumulators for various metals like, Cu, Cr, Cd, Zn, Ni, Pb, Fe, Mn and Hg. *Microcystis aeuruginosa* accumulated higher amounts of Fe, Mn and Pb and worked as an indicator of Cr contamination in Nainital Lake.

Aquatic plants *B. monnieri, H. verticillata* and *C. demersum* have been found to accumulate Pb, Cd and As. These plants synthesized various species of PCs as their metal detoxifying system coupled with the stimulated activities of antioxidant systems.

Cloning of PC synthase gene from an aquatic plant, *C. demersum* and its expression after Cd exposure have been performed. To isolate PC synthase from *Certophyllum,* a set of degenerate primers were employed to carryout RTPCR using total RNA from 1 µM Cd exposed plants. An amplified product of 715 bp was amplified and cloned in pCRÒ 2.1-TOPO vector. The nucleotide and deduced amino acid sequences show approximately 70% homology to PC synthase gene known from other plants. Transcript accumulation of PC synthase was observed in plants exposed to Cd. This result is in accordance with biochemical data, which suggest an increase in non-protein thiols and PCs levels to a concentration of 10 µM. Efforts are being made to enhance phytoremediation potential of selected plants overexpressing PC synthase activity.

Key words: Heavy metals, phytoremedaiton, phytochelatins, phytochelatin synthase

SI/P-1 Removal and Recovery of Cd (II) from Water and Wastewater by using Sawdust

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Sawdust, a non-conventional adsorbent has been utilized for the removal of Cd(II) from aqueous solution. Effect of initial metal ion concentration, contact time, temperature and pH on Cd (II) adsorption by sawdust was investigated in batch mode studies. The maximum adsorption was observed at pH 6. The equilibrium data is well described by the Langmuir and Freundlich isotherm equation. The Lagergren rate constants have been calculated and follows first order kinetics. The desorption studies show that column operation provides better results (23%) than batch process (18%).

Key words: Sawdust, adsorption isotherm, adsorption dynamic, desorption etc.

SI/P-2 Canonical Correspondence Analysis (CCA) as a Tool for the Interpretation of Bioindication Plant Response to Ambient Air Pollution

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Tropospheric ozone is a very phytotoxic air pollutant causing visible leaf damage and yield losses. It is secondary air pollution created during photochemical reactions from precursors emitted by cars. All scenarios predict a growth of tropospheric ozone concentration in the next hundred years, so it is very important to monitor and check its impact on living organisms. Bioindicator plants are very useful tools for assessing ozone concentration and for the evaluation of plant response to ozone stress. There are numerous studies concerning plant reaction in the control of air condition, but still there is a limited amount of information about plant response under ambient air conditions, including other factors differentiating their reaction, such as other air pollutants or meteorological parameters. The aim of the investigations was to compare reactions of ozone - sensitive and resistant plants with environmental parameters under ambient air conditions.

The bioindication investigations were conducted during the 2002 and 2004 vegetation seasons in the city of Poznañ and its environs (Poland). Sensitive and resistant clones of tobacco plants were exposed bi-weekly under ambient air conditions. The percentage of leaf injury of sensitive clones and physiological reaction parameters of both clones, such as plant growth, chlorophyll and dry mass content, were measured. For a proper analysis of plant response meteorological data (solar radiation, air temperature, wind speed) and air pollutant concentrations (ground level ozone, nitrogen dioxide, and particulate matter) were compared with the obtained results.

The great amount of measured and compared parameters is difficult to evaluate cumulatively. The Canonical Correspondence Analysis (CCA) yields information about the variable inclination of plant reaction and environmental parameters. This multidimensional analysis revealed the positive correlation between tropospheric ozone concentration, wind speed, temperature, solar radiation and leaf injury of sensitive clones and dry matter content of both clones. Moreover, this analysis revealed a very interesting result – leaf growth is positively correlated with solar radiation and negatively - with ozone concentration and leaf injury. Simultaneously this test gave information about a negative relationship between ground ozone level and physiological parameters such as chlorophyll content in leaf dry matter (sensitive and resistant clones). There is no clear correlation between ozone and nitrogen dioxide concentration.

The CCA is a very useful tool for multi-dimensional analysis when great amounts of impact parameters are found, such as bioindication investigations to evaluate plant response to tropospheric ozone in connection with other environmental parameters occurring under ambient air conditions.

Key words: Canonical Correspondence Analysis (CCA), ozone, bioindication, tobacco plants, physiological parameters, meteorological parameters

SI/P-3 Bio-Monitoring Trace Element Air Pollution in and Around Mumbai Using Mosses

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Biomonitoring is an important tool in assessing the trace element dispersion at a mesoscale or even at a regional scale, because it allows assessment of details at a local scale. This is a property hardly attainable by other approaches. Mosses obtain most of the supply of elements from precipitation and dry deposition of airborne particulates. They possess high capacity to retain metals from air owing to the absence of cuticle in their tissues and due to the abundance of cation exchange sites on their cell walls. In our study we have used two epiphytic mosses *Macromitrium sulcatum*(Hook.)Bird. and *Stereophyllum anceps*(Harv.)Jaeg. as possible biomonitor after studying the accumulation of heavy metals and trace elements from 12 places in and around Mumbai. Concentration of As, Cd, Co, Cr, Cu, Ni, V and Pb have been monitored using the mosses by inductively coupled plasma spectroscopy (ICP-MS). The statistical analyses were done for the mentioned elements in the two mosses. The regional background for each of the elements were estimated and it was shown that for some of the trace and toxic elements like As, Cr, Ni and Pb the values near polluted and industrial sites exceeded the background by five to nine orders of magnitude. The results indicated the following: (1) These mosses can be used as bioindicators to monitor and follow up the presence of heavy metals and other trace elements in the

environment. (2) The epiphytic mosses used in this study have no contact with the soil and hence can be used to demonstrate whether the contamination problem is due to atmospheric deposition. (3) The ratio between different elements can be used to follow the changing pollution scenario. (4) The biological period of some elements in mosses can be estimated more accurately.

Key words: Biomonitor, *Stereophyllum anceps, Macromitrium sulcatum,* trace element

SI/P-4 Use of Macrophytes (Artificial Wetlands) in the Treatment of Municipal Wastewater

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In the present scenario the wastewater are polluting the environment, especially producing the diseases, epidemics etc. which are causing the health of the individuals and require medicines, treatment, attendant etc. which effects both on economical and working hours loss.

The present wastewater treatment systems are costly, not easily operable, they are power dependent (electricity) and the results shown by them are not up to the satisfaction. Keeping all these in views a pilot wetland has been constructed at National Institute of Technology Warangal, AP. The dimensions are 21.5 m long, 5.5m wide and 2.5m deep. The bottom was made leak proof and put with 70cm clayey soil to support the growth of wetland vegetation. The wetland vegetation was *Typha latifolia*, which is locally available in plenty. The effective depth of wastewater was 0.3m, and the free board 1.0m.

The study has been conducted with the following objectives: (i) To study the improvement in the wastewater quality, (ii) To study the processes involved in the treatment, (iii) To find the appropriate design method and (iv) Suitable macrophytes.

The experimental studies on constructed wetland were conducted during April 2001 to May 2002 to cover all the seasons of the year. The incoming municipal wastewater was free from toxic compounds and the BOD, COD, TSS and other pollution parameters were medium in concentrations. The dissolved oxygen was absent.

The experimental results show that, the efficiency of treatment through constructed wetland in removing BOD, COD, TSS has increased with increase in temperature. No significant change was found in the mineral dissolved solids. It was observed that, the DO level at the outlet were 3-4 mg l^{-1} for most of the time during the study period.

From the studies, it is observed that these systems are efficient, and are suitable for small communities in the developing countries, since they are easily operable, low cost in establishment and maintenance and the results are good as compared to the existing conventional treatment systems.

Key words: Macrophytes, wetland, municipal wastewater

SI/P-5 Identification of Algal Indicators for Toxicity Assessment of Metal Contaminated Fresh Water Bodies

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One of the most concerned issues in the present time is metal contamination of fresh water bodies, which is toxic and harmful to aquatic life and human beings. Research is concentrated on development of methods that would identify early warning effects on biota caused by a variety of trace metals present in the fresh water environment. Algal indicators are significant as they show sensitivity towards metallic pollutants. The purpose of the present study was to report the preliminary data on metal contamination (Cr, Cu, Fe, Mn, Zn, and Ni) of different lentic and lotic fresh water bodies of Lucknow, Unnao, and Kanpur districts of Uttar Pradesh, India which are being polluted through various point and non point sources and to screen and identify algal bioindicator, which might be helpful as an early warning system for metal laden fresh water bodies. Algae, sediment and water samples were collected during three seasons (summer, winter and rainy) of a year. The study area for algal collection was selected in the littoral zone of all the sampling sites.

Based on the analysis of physico-chemical characteristics of water bodies and algal diversity, most of the studied water bodies were found to be eutrophic in nature supporting occasional and frequent algal blooms. The major high biomass producing algal forms growing in these water bodies accumulated substantial amounts of many metals, which could be of use in developing a strategy for pollution monitoring as well as metal decontamination.

Key words: Algal indicators, metal contamination, anthropogenic activities, water bodies

SI/P-6 Potentiality of Algal Biomass for Removal of Metals from Ganga Water Polluted through Fly ash Leaching

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The ability of both blue green and green algae for bioaccumulation of trace metals, present in surface water of river Ganga polluted through fly ash leaching, has been investigated with respect to seasonal fluctuations in physico-chemical properties and metal concentrations in water and their impact on algal community. During the study, out of 38 blue green and green algae, encountered, eight species were high biomass producing, the metal accumulation potential of these strains varied from species to species. Among the blue green algae the maximum accumulation of nickel, copper, zinc, and lead was shown by *Oscillatoria amoena,* which was 724.61, 292.60, 277.06 and 238.12mg g^{-1} dw, respectively. This species also showed appreciable accumulation of iron (1,396 g g^{-1} dw) and manganese (7,565 mg g^{-1} dw), but maximum accumulation of these metals (1,409 Fe and 11,904 Mn mg g^{-1} dw) was shown by *Oscillatoria curviceps.* The green alga *Hydrodictyon reticulatum* accumulated appreciable amount of Fe (7,491 mg g^{-1} dw) followed by Pb (224 mg g^{-1} dw), Zn (544 mg g^{-1} dw), Mn (202 mg g^{-1} dw), Cu (78 mg g^{-1} dw), Ni (23.49 g g^{-1}dw) in a preferential order of Fe> Zn>Pb>Mn>Cu>Ni from Cu, 0.022-0.039; Mn, 0.277-0.378; Zn, 0.116-0.232; Fe, 13.12-23.91; Ni, 1.45-3.05 and Pb 0.08-0.24 mg l^{-1} back ground concentration present in surface water of river Ganga. However, the preferential order of accumulation of varied from species to species and even in the species of the same genus. Interestingly, all the six heterocystous strains were found at fly ash contaminated site near village Arkha but metal accumulation potential have been observed maximum in non-heterocystus forms viz., *O. amoena, O. curviceps,* and *P. papyraceum.* Thus, these taxon have been found adapted to grow on fly ash contaminated water. Further, high biomass-producing forms seems to have metal bioremediation potential from metal polluted aquatic ecosystem.

Key words: Fly ash leachates, bioaccumulation, trace metals, algae, Ganga water

SI/P-7 Promotion of Wheat Cultivated in Heavy Metal Contaminated Soil using Biofertilizers, Fungi and Actinomycetes as Bioremediators with Application of ^{15}N Technique

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Series of laboratory and greenhouse experiments were carried out for examining the effect of identified isolates of bacteria, fungi, yeasts and actinomycetes (BFYA) as bioremediators as well as some of the biofertilizers including *Rhizobium*, *Azospirillum brasilense* and arbuscular mycorrhizal fungi, on wheat growth. These systems were applied in heavy metal contaminated soil, irrigated with sewage effluent for several years. Results showed that the growth of wheat was not drastically affected by the high concentrations of heavy metals when soil was inoculated with BFYA group as compared to the untreated control. This group of microflora was identified as heavy metal-lover, so its ability to accumulate such metals in their body cells was clear. Accordingly, a reduction of these metals in soil and grown plants was seen. In some cases, biofertilizers, i.e. *Rhizobium*, *A. brasilense* and arbuscular mycorrhizal fungi play such role in declining the content of Zn, Cu, Fe, Pb and Co up taken by the different parts of wheat (shoot, root, and spikes). The inoculation with such biofertilizers induced increments in dry weight, grain yield and P and N uptake by plant. The data of ^{15}N isotope dilution revealed that both the mechanisms of biological nitrogen fixation and growth promoting regulation occurred. In this respect, it is worthy to mention that *Rhizobium*, as symbiotic bacteria, has a considerable role with such cereal crop via BNF or enhancement of plant growth. On the other hand, both the *A. brasilense* and arbuscular mycorrhizae promoted the plant growth and enhanced the nutrient uptake especially P and N where it behaves as a plant helper. Also, the data confirmed that these microorganisms assist the plant to get more nitrogen from the soil pool as compared to those derived from fertilizer.

Generally, we can conclude that the inoculation with heavy-metal tolerant group (BFYA), in combination with different biofertilizers, reduced the content of such metals in soil and allowed the wheat plants to grow well in the heavy metal polluted soil.

Key words: Bioremediation, BFYA, contaminated soil, heavy metals, ^{15}N technique, wheat

SI/P-8 Phytoremediatiion - A Greener Solution to Metal Contaminated Soil

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Phytoremediation is done in a variety of ways. The plants can be introduced into an environment and allowed to absorb contaminants into its leaves and roots. Phytoremediation can and has been used to clean up metals, pesticides, solvents, explosives, crude oil, polyaromatic hydrocarbons, land fill leachates, agricultural runoff, acid mine drainage and radioactive contamination.

Thlaspi caerulescens is a small weedy member of the broccoli and cabbage family. *T. caerulescens* is one such plant which can extract hazardous substances such as cadmium and zinc from the soil. Giant underground networks formed by the roots of living plants function as polar driven pumps that extract and concentrate essential elements and compounds from soil and water. It thrives on soils having high levels of zinc and cadmium. *Thlaspi* accumulates these metals in its shoots at astoundingly high levels. A typical plant may accumulate about 100 ppm Zn and 1 ppm Cd in its shoots and above which is considered poisonous. This plant can have 1000 ppm of Zn and 20-50 ppm of Cd. Later on this can be extracted from *T. caerulescens*.

As much of the world's agricultural land is already under cultivation or is being lost due to industrialization there is increasing pressure for farmers to cultivate marginal lands such as the huge expenses of acid soils that are not currently used for production. The use of plants with the capability of scavenging the heavy metals can make contaminated lands again suitable for agriculture.

Key words: Phytoremediation, metal contamination, *Thlaspi caerulescens*

SI/P-9 Effects of Cadmium on Calcium, Iron, Zinc, Magnesium Sodium and Potassium Uptake in Soybean (*Glycine max* L. cv. Williams)

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Three day – old etiolated soybean seedlings were grown in Hoagland solution in presence of Cd $(NO_3)_2.4H_2O$ (0, 1, 5 and 20 ppm Cd^{+2}). Cd uptake and its effects on Ca, Fe, Mg, Zn, Na and K uptake and their transport to different parts of plants were studied. Cd interfere with uptake and transport of these metal ions. The interaction depends on the Cd concentration and nature of ions. With increasing Cd content in nutrient solution, the content of Cd in root, stem and leaves of soybean plants were increased but transport to leaves was low. With increasing Cd in Hoagland solution, concentration of Zn, Mg and Na in shoots and roots of plants increased. But decreasing of K and Fe contents were seen with increasing Cd contents in nutrient solution.

Key words: Soybean, ion contents, Fe, Zn, K, Na, Mg, uptake, ransport

SI/P-10 Chemical Fractionation and Heavy Metal Accumulation in the Plant of *Linum usitatissimum* L. (var. *garima*) Grown on Soil Amended with Tannery Sludge : Selection of Single Extractant

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A pot experiment was carried out to study the single and sequential extractions of metals in different amendment of tannery sludge and the potential of the plants of *Linum usitatissimum* L. for the removal of metals from tannery waste contaminated site. The results obtained from sequential extraction schemes indicate that metals (K, Cr and Ni) from different amendments are most abundant in the residual fraction while, Na and Cd are bound to carbonate fraction. The pools of Zn, Fe, Cu and Pb are changed with the addition of tannery sludge. No such change was observed in case of Mn and K. However, the results of Principal Component Analysis (PCA) showed strong association among Pb, Zn, Cr and partial association with Cd. The sludge amendments and soil samples were also extracted with five different single extractant. From the analysis of the results of different extractants, the extraction efficiency are as follows EDTA > DTPA > NH_4NO_3 = $CaCl_2$ = $NaNO_3$ The correlation analysis between extractable metals in the different amendments of sludge and metal accumulation in the plant showed better correlation with EDTA extractable metals. Cluster Analysis (CA) showed close relationship among DTPA, NH_4NO_3 and $CaCl_2$. The accumulation of toxic metals (Cr, Ni and Cd) in the plants was found to increase with increase in sludge ratio, whereas, the accu-

mulation of Pb decreased. Plants have shown significantly high accumulation of Na and K followed by other micro elements (Fe, Zn and Mn) and toxic metals (Pb, Cd and Ni). Interestingly, the plants of *L. usitatissimum* have not shown the accumulation of major toxic metal generated from tannery industries i.e., Cr and the plant may be grown on tannery waste contaminated soil.

Key words: Tannery sludge, EDTA, DTPA, $CaCl_2$, NH_4NO_3, $NaNO_3$, *Linum usitatissimum*

SI/P-11 Phytochelatins and Glutathione Metabolism in Cadmium Tolerance in *Cicer arietinum* L.

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Plants respond to heavy metals, such as cadmium, with the biosynthesis of a class of cysteine-rich, heavy metal-binding peptides called phytochelatins (PCs). PCs are synthesized by an enzymatic process from the tripeptide, glutathione (GSH) and consist of repeated gamma-glutamyl cysteinyl groups with a C-terminal glycine.

GSH is synthesized in a two-step pathway from its constituent amino acids by the enzymes gamma-glutamylcysteine synthetase and GSH synthetase. The roles of PC and GSH in the heavy metal detoxification in plants were examined using two varieties (CSG-8962 and C-235) of *Cicer arietinum* L. The seedlings were grown for 5 days and treated with 0-20 mM Cd SO_4 for 3 days.

The cv. CSG-8962 seedlings exhibited more Cd tolerance than cv. C-235, where the roots were more damaged than shoots. Both the seedlings synthesized the large amounts of PCs and homo-phytochelatins (hPCs) in roots, but only a little in shoots in response to Cd. The Cd treatments also caused a marked increase in the levels of GSH and cysteine in both root and shoot tissues, suggesting that Cd may activate the GSH biosynthesis and hence enhance PC synthesis in the plants. In *Cicer arietinum* possible PC-dependent and independent mechanisms for Cd tolerance are discussed in the conference.

Key words: Phytochelatin, glutathione, cadmium, *Cicer arietinum*

SI/P-12 Application of Cyanobacteria in Toxic Environment

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In general all heavy metals are toxic to algae at higher concentrations. Due to advantages of algal biomass large scale ponds are being used in several countries for heavy metal removal from aquatic toxic environment. Herein, an attempt has been made to study the feasibility and economics of removing heavy metals from waste water resulting in high quality of reusable effluent water and valuable algal biomass which, in turn, could be used for different purposes such as production of fertilizer, fodders and bio-gas etc.

Key words: Cyanobacteria, heavy metal, effluent water, algal bloom

SI/P-13 Heavy Metal Analysis in *Raphanus sativus* and Environment

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This paper contains results of a study carried out in agricultural fields of Sanganer, town. This town is situated about 20 kms away from the city center, Jaipur. In the study area (Amanishah Nalla Sanganer, Jaipur) vegetables are grown in the fields receiving sewerage and textile waste water. Water, soil and crop plant (samples) were collected from the agricultural fields of "Sanganer" for analysis. Waste water (from Amanishah Nalla) used in irrigation of agricultural fields in Amanishah Nalla of Sanganer town was found to contain 2.52 mg/l of Zinc, 1.95 mg/l of Copper, 1.12 mg/l of Nickel, 0.72 mg/l of Cadmium, 1.52 mg/l of Chromium, 2.11 mg/l of Lead and 0.99 mg/l of Cobalt as the highest amount of respective heavy metals.

Soil from agricultural fields contained 2.91 mg/g of Zinc, 2.23 mg/g of Copper, 1.31 mg/g of Nickel, 1.11 mg/g of Cadmium, 2.13 mg/g of Chromium, 3.12 mg/g of Lead and 1.10 mg/g of Co as the highest amount in the agricultural fields of Sanganer. *Raphanus sativus* (plant material) grown in the study in the study area was analyzed for heavy metal contents. Plant material (root, stem or leaves) contained 1.25 mg/g of Copper, 0.709mg/g of Nickel, 0.359 mg/g of Cadmium, 0.70 mg/g of Chromium, 1.019 mg/g of Lead and 0.376 mg/g of Cobalt as the highest amount of heavy metals. Consumption of such vegetables (grown in agricultural fields containing polluted soil and waste water) by human beings containing heavy metals in higher concentrations is a matter of concern since it may cause health hazards associated with different heavy metals.

Key words: Heavy metal, *Raphanus sativus,* environmental impact

SI/P-14 An Investigation of Bioaccumulation of Trace Elements from Urban Atmospheric Particulates in Kolkata City

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Plants growing in conditions of atmospheric pollution are sensitive indicators of level and characters of accumulation specially trace elements which depend on composition of suspended particulates. Accumulation of trace elements including heavy metal in canopy foliage of selected plant species like *Ficus bengalensis, Ficus religiosa, Polyalthia longifolia, Anthocephalus chinensis, Putranjiva roxburghii, Alstonia scholaris* was monitored during the year of 2004 from urban areas of Kolkata city. The concentrations of elements like Al, S, Cl, Ca, Mn, Cr, Cu, Fe, As, Sr, Zn and Pb were quantitatively measured using EDXRF (Energy Dispersive X-Ray Fluorescence). Significant differential accumulation of elemental concentrations and their specific relations with sampling site and selected plant species were also investigated. The highest differences in elemental concentrations in different investigated sites were found for Al, Fe, Pb, Mn, Zn and Cu in different plant species. Therefore the capacity of taking up and accumulating trace elements specially heavy metals in tree foliages, the advantage of a big biomass and easy disposal makes it possible for plants to remove toxicants by phytoremediation *in situ*.

Key words: Bioaccumulation, trace elements, atmospheric particulates, urban canopy, leaves

SI/P-15 Mosses as Bioindicators : In Determining the Status of Environmental Health of Shervaroy Hills of Eastern Ghats, South India

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The importance of conserving and managing the biological wealth of this Planet as a foundation for sustainable development has been recognized by almost all nations of the world in subscribing, at least in principle to the convention on Biological diversity and to Agenda 21 of

the Earth Summit, which gives heavy emphasis to the need to improve collection, documentation, management and dissemination of scientific information on biodiversity. A global biodiversity survey appears to be the best strategy to follow and this should be immediately initiated and its ultimate aim should be full identification and biogeography of all species, especially endemics and other threatened categories. Adequate knowledge about the plants is necessary for planning sustainable development of any region like India, where the flora is rich in diversity and endemism.

One of the groups of plants that have been highly neglected so far from the point of view of either surveys and inventories or scientific study are the Bryophytes. During the last two decades, the role of Bryophytes (especially Mosses) as environmental indicators, has been emphasized. The Mosses form the most dominant group among the Bryophytes, For determining the elemental status of the environment, mosses are of special interest. The functional problems in environmental health can be obtained only through biomonitoring at the level of communities and ecosystems. Certain moss species are capable of coping with the polluted condition pretty well and sometimes even manage to gain out of the fussy and altered atmosphere as a result of human activities. There is an alarming rate of depletion in biological diversity in Shervaroy Hills of Eastern Ghats (study area), due to human interference, besides Natural calamities, Urbanization, Industrialization, Tourism, and over exploitation of natural resources like mining. These have caused great threat to most of the flora. Several rare species are disappearing from their original site, while some are at the verge of extinction. Therefore, there is an urgent need to arrest this suicidal trend, and conservation of plant diversity is absolutely essential. Mosses are especially suitable for biological monitoring and serve as good indicator for determining the health of the environment. This paper will highlight the status of the environmental / habitat health of Shervaroys using mosses as bioindicators.

Key words: Bryophyte, moss, bioindicator, environmental health, Eastern Ghats

SI/P-16 Treatment of Lindane and Lead in Wastewater using Fluidized Bed Plug Flow Bioreactor

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Treating wastewater using Fluidized bed bioreactor (FBBR) is relatively new technique and has been hailed as the most significant development in wastewater treatment. The application of FBBR technology for wastewater treatment is a breakaway from traditional technology since it combines the best features of activated sludge process and trickling filtration.

In this study, an attempt has been made to treat lindane and lead simultaneously from wastewater by *Pseudomonas cruciviae* and *Zoogloea ramigera* using three-phase fluidized bed plug flow bioreactor. In this process the flow characteristic in the tubular type reactor is kept to be plug flow. Keeping the size ratio of height to diameter equal to 50.

The effect of various operating variables such as Granular Activated Carbon (GAC) dosage and its size, contact time and cell concentration under batch condition were studied and optimized. It was optimized that the maximum removal efficiency of 82.10% (lindane) and 97.82% (lead) at the GAC dosage of 4g, size of 1mm. A cell concentration of 342 mg l^{-1} and a contact time of 3 days were also optimized for lindane at a concentration of 10 mg $l^{-1}$and lead at a concentration of 100 mg/L. The substrate (lindane and lead) was maintained at pH of 5 and a temperature of 30^{o}C.

A laboratory scale three-phase fluidized bed plug flow bioreactor was used to study the removal efficiency of lindane and lead from wastewater using granular activated carbon as a support media and cells forming as a biofilm on granular activated carbon. The experiment was conducted with simulated lindane and lead solutions at five different concentrations (lindane; 2, 4, 6, 8, and 10 mg l^{-1} and lead; 20, 40, 60, 80 and 100 mg l^{-1}.

The minimum gas fluidization velocity and liquid fluidization velocity were determined to be 7.58 m/s and 11.79x10^{-5} m/s, respectively from bed pressure measurements. The column study was conducted by maintaining a recycle ratio of 0.25. The effluent samples from the reactor were collected and analyzed for the parameters lindane, lead and cell concentrations.

In the column study, the removal efficiency of lindane was high (97.85%) at 10 mg l^{-1} and lead (99.30%) at 100 mg l^{-1}. The removal efficiency at other concentrations were 96.50% for 2 mg l^{-1}, 97.10% for 4 mg l^{-1}, 97.00% for 6 mg l^{-1} and 97.63% for 8 mg l^{-1} (lindane) and 97.60% for 20 mg l^{-1}, 97.25 for 40 mg l^{-1}, 96.65% for 60 mg l^{-1} and 99.01% for 80 mg l^{-1} (lead).

Models have been developed for the kinetic studies, considering the effect of both the adsorption into granular activated carbon and biological reaction due to microorganisms. Monod model and Freundlich Isotherm models were used to investigate the kinetic behaviour of the removal of lindane and lead. The mathematical equations were solved using Runge-Kutta fourth order numerical integration method.

Key words: Wastewater treatment, fluidized bed, lindane, lead

SI/P-17 Mucilaginous Seeds of *Hyptis suaveolens* (L.) Poit. : A Biosorbent for Arsenic Removal

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Polysaccharides from microbial biomass or agriculturally based products have been shown to bind heavy metals. *Hyptis suaveolens* seeds could serve as natural immobilized source of agriculturally based polysaccharide. The seeds became swollen in wetting and consist of a mucilaginous fibrous outer layer. Kinetic profiles were tested on different pretreatment mode with acid, alkali, alcohol, and boiled water. Seeds boiled in water exhibited highest arsenic uptake. Effects of adsorbent dose, pH, and other interfering ions such as Zn^{++}, Ca^{++}, Mg^{++}, CO^{++} and Cl^{-} ions on arsenic sorption were studied. Adsorption isotherm studies revealed a better correlation with Langmuir isotherm plot and maximum adsorption capacity 3.79mg/g.

Key words: *Hyptis suaveolens*, mucilaginous seed, arsenic biosorption

SI/P-18 Biomonitoring of Environmental Pollution through Bioindicators

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Environmental quality is an integral part of development. Without environmental ethics development is simply undermined. The healthy green rural environment in recent years has encountered divergent environmental hazards as an addition to their existing issues of social and economic hardships. In the present context, the environmental pollution can be biomonitored through bioindicators. Monitoring the state of environment through the performance of living organisms (bioindicators), directly depicts the impacts of environmental pollution on organisms, and can potentially detect the long-term exposure of a site to environmentally harmful chemicals. In addition, they also provide an overall picture of the impact of environmental factors that often cannot be detected by measuring even a wide range of physiochemical variables. A useful bioindicators may be a tree, a woody shrub, a non-woody herb species microorganisms or animal species.

Key words: Bioindicators, algae, mosses, microbes

SI/P-19 Phytochelatin Synthesis and Response of Antioxidants during Cadmium Stress in *Bacopa monnieri* L.

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The phytotoxicity imposed by cadmium (Cd) and its detoxifying responses of *Bacopa monnieri* L. have been investigated. Effect on biomass, photosynthetic pigments and protein level were evaluated as gross effects, while lipid peroxidation and electrolyte leakage reflected oxidative stress. Induction of phytochelatins and enzymatic and non-enzymatic antioxidants were monitored as plants primary and secondary metal detoxifying responses, respectively. Plants accumulated substantial amount of Cd in different plant parts, the maximum being in roots. Cadmium induced oxidative stress, which was indicated by increase in lipid peroxidation and electrical conductivity with increase in metal concentration and exposure duration. Photosynthetic pigments showed progressive decline while protein showed slight induction at lower concentrations. Enzymes *viz*., superoxide dismutase (SOD, EC 1.15.1.1), guaiacol peroxidase (GPX, EC 1.11.1.7), ascorbate peroxidase (APX, EC 1.11.1.11) and glutathione reductase (GR, EC 1.6.4.2) showed induction except catalase (CAT, EC 1.11.1.6) which showed decreasing trend. Initially, an enhanced level of cysteine, glutathione and non-protein thiols was observed, which depleted with increase in exposure concentration and duration. Phytochelatins induced significantly at 10 ìM Cd in roots and at 50 ìM Cd in leaves. The phytochelatins decreased in roots at 50 ìM Cd which may be correlated with reduced level of GSH, probably due to reduced GR activity, which exerted increased oxidative stress as also evident by the phenotypic changes in the plant like browning of roots and slight yellowing of leaves. Thus, besides synthesis of phytochelatins, availability of GSH and concerted activity of GR seem to play a central role for *Bacopa* plants to combat oxidative stress caused by metal and to detoxify it.

Key words: Antioxidant enzymes, *Bacopa monnieri*, cadmium, glutathione, phytochelatin

SI/P-20 Lichen Flora of Pune City (India) with Reference to Air Pollution

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Lichens have long been recognized as indicators of air pollution. Lichens show their sensitivity to air pollution in various ways such as absence of sensitive species, decline in diversity, modification in morphology, anatomy and physiology. Air pollution study with the help of lichens is gaining importance in India. Recently, few cities such as Faizabad, Bangalore, Lucknow and Kolkata have been explored lichenologically in relation to air pollution. In the present communication we deal with lichen flora of Pune City in relation to air pollution.

A total of 20 streets/sites of Pune City have been surveyed for lichens. Around 100 lichen samples were collected from 11 streets/sites, which revealed the occurrence of 20 species of lichens. Out of the twenty streets/sites, it was not possible to collect the lichen samples from the nine streets, as they were growing quite high on the tree branches. However, the presence of lichen (mostly *Pyxine petricola* Nyl. in Crombie) was noted. Of the 20 species of lichens *Dirinaria confusa* var. *saxicola* (Ras.) Awasthi, is a new record for Indian lichen flora while a species of *Anisomeridium* and three species of *Buellia* are either new to science or new records for India and their detailed study is in progress. Of the various lichens found in Pune City *P. petricola* is the most common species and found growing in almost all the surveyed areas. Among the different localities Chatushrungi Hill and Empress Garden have the maximum diversity of lichens with eight species followed by Pune University Campus with seven species. All the lichens recorded from Chatushrungi Hill are found growing on rocks as there were no trees in that area.

Frequency of lichen occurrence in different streets/site of Pune City was calculated. Lichens are luxuriant in Pune University Campus with 36.43%, followed by Empress Garden with 26.55%. The thick tree cover together with less traffic activity in the Pune University campus and Empress Garden area are probably the reason for luxuriant growth of lichens. The tree cover reduces the effect of air pollution and provides shade and humidity suitable for lichens to colonize. The city centre as seen in case of East Street, Lakshmi and Shivaji Road areas with scattered trees and high traffic activity has few or no lichens.

Key words: Lichen, Pune, India, air pollution

SI/P-21 Toxicity and Bioaccumulation of Cadmium in some Marine Microalgae Island Form Coastal Environment of Gopalpur Sea, Orrisa

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Cadmium is a ubiquitous non-essential element that possesses high toxicity and is easily accumulated form the environment by aquatic organisms. The effect of cadmium on the growth of 8 microalgae representing 2 green algae, 2 diatoms and 4 blue-green algae were investigated in axenic laboratory cultures. The planktonic *Chlamydomonas* sp. and *Senedesmus* sp. were more tolerant to cadmium and stimulatory response in growth rate was observed at all tested concentrations (0.05-4 mg l^{-1}). The two diatoms, *Chaetoceros* sp. and *Skeletonema costatum* show higher sensitivity to cadmium concentrations. Variations in sensitivity to cadmium existed among the 4 blue-green algal isolates. *Oscillatoria limnetica* and *Microcystis* sp. were more tolerant to cadmium and stimulatory response in growth rate was observed at all tested concentrations. *Anabaena circinalis* and *Gloeotrichia* sp. were observed to be less tolerant to cadmium in comparison to *O. limnetica* and *Microcystis* sp. The specificity of cadmium on different algal isolates has been demonstrated. The effect of salinity, phosphate and pH was invested as a mechanism of their protection against cadmium toxicity.

Key words: Cadmium, bioaccumulation, marine microalgae

SI/P-22 An Approach to Study the Metal Accumulation from Distillery Effluents by Some Aquatic Macrophytes

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With an advent of time and increased industrialization the whole world is getting worried of the pollution problem, day by day which is posing problem to the civilized living. Among the liquid industrial waste, the distillery waste poses a serious problem to our environment. The paper presents studies on pollution removal efficiency of some aquatic macrophytes (*Eichornia crassipes, Hydrilla verticillata, Phragmites karka* and *Potamogeton pectinatus*) The experiments were carried out with or without these macrophytes at different concentrations of distillery effluent for varying exposure periods (7, 14 and 21 days).

Phragmites karka and *Potamogeton pectinatus* seems to be very efficient and economical for removal of pollution load (metals) from distillery effluents. Hence these aquatic plants seems to offer a very cheap and useful for effective reduction of metals, pH, TDS, BOD and COD from distillery effluents, thereby solving the problems of pollution load from wastewater.

Key words: Distillery, effluents, macrophytes, metal accumulation

SI/P-23 Screening of Heavy Metals in the Ambient Air of a Sub-Tropical Industrial Area, using Leaves of *Ficus infectoria*: A Keystone Species

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To answer the growing concern among residents about probable health and environmental effects of heavy metals due to industrial activities, this Biomonitoring study was performed. Heavy metal concentration in *Ficus infectoria* (Pakur) leaves was studied in a subtropical open cast coalmine area, Bina, India. Samples were collected from five sampling sites representing varying degree of mining and vehicular activities. Samples were collected every two months during October 2004 to September 2005. Our studies have shown that *Ficus infectoria* (Pakur) can provide useful information about the spatiotemporal variations of heavy metals and can be an efficient Biomonitoring agent.

Key words: Air quality, biomonitoring, coalmine, heavy metal, health

SI/P-24 Phytoremediation potential of *Azolla pinnata* to remove heavy metals [Hg(II) and Cd(II)] from industrial effluents of G.B. Pant Sagar, Singrauli, India

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Industrialization and aquatic pollution are intimately linked with each other. Discharge of thermal power plants, coal mines and chlor-alkali industry pose serious threat to aquatic ecosystem and human beings due to presence of various heavy metals.

Present paper aimed to investigate the capacity of a small water fern, *Azolla pinnata* R. BR (Azollaceae), to purify waters polluted by Hg, and Cd. *Azolla pinnata* endemic to India is a potential hyperaccumulator of heavy metals. During 12 days of the experiment the fern was grown on the nutrient solution containing Hg^{2+} and Cd^{2+} each in a concentration 0.1, 0.5 and 1.0 mg dm^{-3}. The presence of these ions caused marked inhibition of *A. pinnata* growth, the highest in the presence of Hg (II) ions at 0.5 mg dm^{-3}, in comparison to the control. After day 12 of the experiment, metal contents in the solution were well below the permissible limit. The fern accumulated a lesser quantity of the metals from 0.1 mg dm^{-3} treatments compared to 0.5 and 1.0 mg dm^{-3} treatments. In the *Azolla pinnata* tissues the concentration of heavy metals under investigation ranged from 71 to 650 mg kg^{-1} dm; the highest level being found for Cd (III) containing nutrient solution. A significant positive correlation between applied doses of metals and metal accumulated in biomass obtained after the microcosm investigation. The study recommended the use of *Azolla pinnata* as biofertilizer from cultures of unpolluted sites, free of metals.

Key words: *Azolla*, heavy metals, phytoremediation, thermal power plant, Chlor-alkali effluent

SI/P-25 Role of Indian Mustard (*Brassica compestris* L.) Plant in Remediation of Industrial Waste with Special Reference to Cadmium

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Plant based bioremediation may offer a viable solution to the problem of agricultural and industrial waste materials. Plants have the ability to extract and concentrate heavy metals from the contaminated soil. In the present study, a hydroponic experiment using Indian mustard (*Brassica compestris*) was conducted to investigate the effect of different concentrations of cadmium (10 to 160 mM) and a fixed concentration (500mM) of EDTA (Ethylene Diamine Tetra Acetic Acid) for 7 and 14 days on accumulation of Cd and its toxicity. The results showed that Cd alone induced the growth of *B. compestris* plants, at lower concentrations up to 40 mM. On addition of EDTA induction in the growth was noticed at 20 mM in 7 days. Further, a treatment with Cd at 160 mM for 14 days caused decrease in fresh biomass of root and shoot, total protein content and total chlorophyll up to 44, 37, 57.7 and 49.7% respectively while Cd + EDTA, caused the decrease in the above parameters by 63, 50, 66 and 53.2% with respect to their controls indicating more toxicity in case of Cd + EDTA. It was also found that the Cd accumulation in the root and shoot was 9125.23, 4915.79 mg g^{-1} dw respectively after 14 days while in case of Cd + EDTA. it was 6212.15 and 3511.123 mg g^{-1} dw respectively. All the parameters showed increase up to 40 mM cadmium concentration while it was up to 20 mM in case of Cd + EDTA. The result of the above experiment suggests that *B. compestris* plant could be used in the treatment of metal contaminated wastes.

Key words: *Brassica compestris*, photosynthetic pigments, cadmium, EDTA, bioaccumulation

SI/P-26 Biomonitoring of Sulfur and Heavy Metals around a Coal-Fired Thermal Power Plant

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In present investigation, biomonitoring of sulfur and heavy metals, resulting from a thermal power plant in India has been studied within 15 km range. The leaves of *Ficus religiosa, F. benghalensis, Mangifera indica* and *Azadirachta indica* trees have been used to observe the dispersion of fugitive emissions from a thermal power plant and its impact over surrounding vegetation. The results obtained, from different locations chosen at various distances to the thermal power plant, have shown that the contaminating agents are quite dense and effective; particularly in the prevailing wind direction and within 15 km range. Contaminating agents or fugitive emissions gradually lose their density and impact beyond this range. Collection and analyses of soil samples regarding sulfur and heavy metals from the same locations have shown the similarity with the data obtained from the leaves.

Key words: Biomonitoring, fugitive emissions, tree leaves, air pollution, soil pollution

SI/P-27 Bioremediation of Surface Soil Salinity by Some Aizoaceae Species

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Salinity in surface soil developed through saline water irrigation is a serious problem for agricultural production especially in arid and semi-arid regions. Chemical methods of reclamation require high capital input and do not support sustainable yield. Furthermore their prolonged application has undesired effects. Biological methods like growing halophytes offer potential means of reclamation. Besides being solar energy driven and low cost method, their reclamation efficiency is also comparable to chemicals means. Keeping these facts in view we have tested the feasibility of *Trianthema triquatra*, *Sesuvium sesuviodes* and *Trianthema portulacastrum*, for their utilization in bioremediation of saline soils. Cation accumulation pattern and growth of all these three plant species under saline conditions have been investigated. All these three species found to be good accumulator of

sodium as they are fast growing species under saline condition. Because of their short life period, these plant species can be used as quick means for biological remediation process especially from 0-20 cm. depth levels. Efficiency in sodium accumulation was variable in all the three species tested here. A field experiment was carried out with *Trianthema triquetra*. Soil chemical and physical parameters like soil pH, soil EC, exchangeable cations, exchangeable sodium percentage (ESP), Sodium absorption ratio (SAR) were all significantly modulated by growing this plant. We recommend use of this plant for bioremediation purpose.

Key words: Salinity, Halophyte, Bioremediation, Aizoaceae, *Trianthema* sps.

SI/P-28 Evaluation of Chromium Bioremediation Potential of Some Chromate-Resistant Bacteria Isolated from Tannery Effluent

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Tanning industry is one of the well developed industrial sector in India. The unique aspect is that it turns out best possible quality leathers from the relatively low quality hides. Chromium is the main pollutant released out from tanneries. Cr^{+6} is a strong oxidizing agent with the ability to move across biological membranes where it binds to intracellular proteins and interacts with nucleic acid. It is considered toxic and mutagenic, much more than Cr^{+3}. Due to these differences, the reduction of Cr^{+6} to Cr^{+3} may provide a useful remedial technique for Cr^{+6} contaminated soils and water. Bioremediation is emerging as most ideal alternative technique for reducing the different pollutants from the contaminated locations and prevents toxic impacts.

The objective of the present study was to isolate chromate – resistant bacterial strains from the tannery effluent and to evaluate the bioremediation potential under varied levels of Cr^{+6} contamination. The strains showed multiple metal and antibiotic resistances. Growth behaviour tested by applying different chromium concentration showed that all the strains were able to grow at elevated Cr concentration up to 200 mg ml^{-1}, however the lag phase was extended depending upon the Cr concentration in the medium. Chromium accumulation of isolates showed great bioremediation potential and it can also help in removal and recovery of chromium from the effluent. However, its biochemical characterization and biotransformation potential needs to be established to make the organism more useful. Importance of these findings has been discussed in relation to Cr removal from tannery effluent.

Key words: Bioremediation, chromium, bacteria, tannery, effluent.

SI/P-29 Biomonitoring of Lead in Atmospheric Environment of Lucknow Urban Centre, The Ganga Plain, India

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The Lucknow Urban Center in the Ganga Plain, northern India has been selected for the present biomonitoring of lead levels in the atmospheric environment from leaves of the *Dalbergia sissoo* tree. A total of 26 leaf samples were collected in spring, monsoon and winter seasons from 6 highways and 8 urban roadside locations in 2003-04 and were analysed by Atomic Absorption Spectrophotometry method. Lead concentrations range from 2.1 to 28.2 ìg g^{-1}(dry wt.) and were reported low in spring season, increased in monsoon to winter seasons. This accumulative response of lead in the tree leaves is directly linked with the exposure time of automobile emission. Highway localities show higher lead concentrations by a factor of 2 as compared to urban localities. Highest concentration (28.2 ìg g^{-1} dry wt.) was recorded at National Highway No. 24 in winter season. Based on another study, it can be reported that mean lead concentration in the tree leaves during winter season also dropped from 17.9 ìg g^{-1} in 1994 to 8.1 ìg g^{-1} in 2004. In the Lucknow Urban Environment, there is drastic reduction of lead content by 98%, 85% and 55% in the petrol, the urban air, and the *Dalbergia sissoo* leaves respectively from 1994 to 2004 in response to the use of unleaded petrol. Despite of increasing urban population, urban area, vehicle population and traffic density, the introduction of unleaded-petrol keeps lead level in the urban environment lower than the past. Development of data and information through this study will provide a better basis for optimizing future environmental monitoring, planning and programs to reduce the environmental lead exposure to million of people especially future young generation living in an urban environment of the Ganga Plain.

Key words: Biomonitoring, *Dalbergia sissoo*, lead pollution, unleaded-petrol, urban environment

SI/P-30 Assessment of Metal Accumulation Potential and Ecophysiological Effects in *Potamogeton pectinatus*. L. Treated with Distillery Effluent

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India has emerged during recent years as the largest sugarcane producing country in the world. There are about 285 distillery units in India producing 2.7 billion litres of alcohol and generating about 40 billion litres of waste water annually. This massive quantity, if disposed untreated can cause considerable stress on courses leading to damage to aquatic life. Physico-chemical analysis revealed that the effluent was dark brown in colour having high BOD (756.66 µg ml^{-1}) and COD (2097.67µg ml^{-1}). It was slightly alkaline, pH (7.4) with high sulphate content (1712.33 µg ml^{-1}). The effluent was contaminated with high concentration of metals like Fe, Cu, Zn, Mn i.e., 7.61, 1.13, 0.76 and 0.44 µg ml^{-1}, respectively, which may be toxic both to the flora and fauna.

Aquatic macrophytes have potential to purify waste water and are effective in removing heavy metals. The uptake of metals (Fe, Cu, Zn and Mn) following exposure of *Potamogeton pectinatus* L. was studied after 7 and 14 d. The result showed a concentration and duration dependent accumulation of metals in plant tissues. Maximum accumulation of Fe (689.03 µg g^{-1} dw) was recorded in plant growing in 100 % concentration, after14 d of treatment. The metal contaminated distillery effluent had differential effects on biomass, chlorophyll *a, b* and total chlorophyll and protein content of *P. pectinatus* at different duration. Results showed that *P. pectinatus* could be a suitable plant for the phytoremediation of metal polluted water, as it accumulated significant amounts of Cu, Fe, Zn, Mn from different concentration of distillery effluent during a period of two weeks. The plants can be harvested easily after treatment and utilized for biogas production and other commercially viable products or plant may be incinerated and the resultant ash can be subjected to chemical procedure for recovery of metals. Experiments are underway for safe utilization of treated plant biomass; however, field trial will be required.

Key words: Industrial waste, bioaccumulation, toxic metals, aquatic macrophytes

SI/P-31 Abatement of Aquatic Pollution Caused by a Weed *Eichhornea crassipes* using the Worm, *Eisenia fetida*

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The efficacy of dung worm, *Eisenia fetida* in the transformation of *Eichhornea crassipes* – a free floating aquatic weed, into an useful organic bio-fertilizer was evaluated. Initial pH, C: N ratio, and amount of phosphate, potash, Zn, Fe, Cu, Mn and S were recorded more in the substrate medium having pieces of *E. crassipes* (1:0) than that of the medium having the pieces of *E. crassipes* and cattle dung in the ratio of 1:1. Level of pH and C: N was found decreased in the control and experimental pots of both the media but the decrement was greater in the experimental pots than those of their respective controls; while significant increase in the amount of phosphate, potash, Zn, Fe, Cu and Mn was noticed. Such alterations were more in the experimental pots (having the worms) than that of their respective controls (devoid of worms). Incidentally, the amount of S lowered in the pots of both the media after 60 days.

Per cent increase in the body weight and length of worms was 1.26 and 1.36 times more in the medium 1.1 than 1.0. Number of cocoons was 2.34 times more in the substrate medium 1:1. Alterations in physico-chemical parameters of both the media suggest that *E. crassipes* – a notorious aquatic weed could easily be processed by worm, *E. fetida* into an useful bio-compost.

Key words: Aquatic pollution, weed, *Eichhornea crassipes*, earthworm, *Eisenia fetida*, bio-fertilizer

SI/P-32 Lead Accumulation and its Phytotoxic Effects on *Eichhornia crassipes*

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Among several aquatic plants, water hyacinth (*Eichhornia crassipes*) is a prolific aquatic weed of cosmopolitan distribution and can be used in phytoremediation because of its ability to absorb and concentrate certain chemicals including toxic metals.

Plants of *E.crassipes* were exposed to solution containing 0.01, 0.1, 2.5, 5.0 and 10.0 ppm of lead for 24, 48, 72 and 96 h. Leaf and root samples from treated culture were taken and analysed for bioconcentration. Accumulation of metals was observed to be greater in roots (791 mg g^{-1} dw) in comparison to leaves (328.3 mg g^{-1} dw). Maximum accumulation was found in roots. The accumulation in root and leaf tissues was found to be both concentration and duration dependent indicating that *E.crassipes* is a good absorbent of aquatic Pb. Phytotoxicity of Pb showed that chlorophyll *a*, *b* and total chlorophyll were stimulated from 0.01 ppm to 0.1 ppm and inhibited at concentration ranging from 1.0 ppm to 10.0 ppm with the duration of exposure. Carotenoid content was induced from 0.01 ppm to 2.5 ppm and decreased from 5.0 ppm to 10.0 ppm. At higher Pb level, inhibition of chlorophyll and induction of carotenoid was recorded with concentration and duration.

Root meristems were studied for mitotic index, which was induced from 0.01 ppm to 0.1 ppm and decreased from 1.0 ppm to 10.0 ppm. It is concluded that lead inhibits cell division. Numerous micronuclei were also observed.

The result indicated that water hyacinth is a good sensor to monitor low level of aquatic lead. The plant is found to be tolerant to the elevated lead concentration up to 0.1 ppm as there is no inhibition of chlorophyll and carotenoid. So this bioassay can be used for biomonitoring and control of heavy metal pollution in the aquatic environment.

Key words: *Eichhornia crassipes*, lead, phytoremediation

SI/P-33 Evaluation of Plant Hairy Roots for Remediation of Organic and Inorganic Pollutants

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Phytoremediation, the use of green plants to extract, sequester and detoxify pollutants has recently been recognized as a cheap and ecofriendly alternate technology that can be tried out for the remediation of organic contaminants. The application of hairy roots to phytoremediation has been suggested, mainly because of their biochemical resemblance to the roots of the plant from which they have derived. Remediation of phenol, a major pollutant in aqueous effluents was thus studied using plant hairy root cultures of *Brassica juncea, Azadirachta indica, Raphanus sativus* and *Beta vulgaris*. Among the four different plant hairy roots screened, *Brassica juncea* showed the highest potential for phenol remediation followed by *Beta vulgaris*, *Raphanus sativus* and *Azadirachta indica*. Feasibility of using *Brassica juncea* hairy roots was further investigated by studying the effect of phenol concentration, reuse in a batch system and in a continuous process. Results have shown that they were able to effectively act over broad range of phenol concentration (50-1000ppm). In reuse studies, roots were used for four cycles and showed marginal decrease in phenol remediation in subsequent reuses. When roots were packed in column reactor, at low flow rate (2 ml h^{-1}) amount of phenol removal corresponded with that of taken up by hairy roots in batch mode. Unlike most of the studies reported earlier, phenol removal by the hairy roots was seen to take place without addition of external hydrogen peroxide. Studies were then undertaken to understand this aspect of remediation which will be discussed during presentation. Often it has not been taken in account that in industrial area organic pollution is many times accompanied by inorganic ones mainly of heavy metals. Our focus has thus been to evaluate the potential of these hairy roots for simultaneous removal of toxic metal like cadmium along with phenol and was found remediating both effectively.

Key words: Phenol, hydrogen peroxide, peroxidases, phytoremediation, plant hairy root

SI/P-34 Translocation of Metals in the Plant of Fenugreek Grown on Soil Amended with Tannery Sludge : Involvement of Antioxidants

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Agricultural and industrial activities cause heavy metal pollution in the soil, which adversely affect the plant growing therein. The plants of fenugreek (*Trigonella foenum-graecum)* were grown in soil amended with different percent of tannery sludge (10, 25, 35, 50 and 100% TS) to study the effect on antioxidant levels (carotenoid, cysteine, ascorbic acid, non-protein thiol and free proline contents) due to translocation of metals. The accumulation of the metals was found more in shoots than roots, except Fe and Cr. The level of metals in seeds of the plant increased with increase in sludge amendments ratio except, Mn. Chromium was found below detection limits in 10 and 25% TS. Correlation coefficient (ã) between total metal accumulation and EDTA extractable metals showed that Zn ($p< 0.01$), Cr ($p< 0.01$) and Cu ($p< 0.05$) are significantly correlated, whereas, correlation coefficient with pH showed significant positive relation with all the studied metals except Mn. Metals like Fe, Zn, and Cu showed significant positive correlation with EC, CEC and OM, in contrast, Mn have shown negative correlation. The analysis of the results showed that total chlorophyll content showed significant ($p<$

0.5) increase in the leaves of the plant grown in lower amendment of sludge (up to 35% TS at 30 d and 25% TS at 60 d) as compared to control. In roots, cysteine, non-protein thiol and proline contents increased upto 35% TS at both the exposure periods followed by decrease. However, an increase in ascorbic acid, free proline and MDA contents was observed in both parts of the plants grown on lower amendments at both the exposure periods. Principal component analysis (PCA) also supports the finding of these parameters in the plants grown on different amendments of tannery sludge. Thus, the increase in antioxidant levels cope up the stress induced in the plants grown on lower amendment of tannery sludge, however, toxicity was observed at higher amendments.

Key words: Fenugreek, tannery sludge, metals, EDTA, amendments

SI/P-35 Phytoextraction Capacity of the *Chenopodium album* L. Growing on Soil Amended with Tannery Sludge

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The metal accumulation potential of *Chenopodium album* L. grown on various amendments of tannery sludge (TS) was studied after planting sapling for 60 days. The analysis of the results showed that pH, cation exchange capacity, organic carbon and organic matter of amendments increased with the addition of tannery sludge. The levels of DTPA extractable metals increased with increase in sludge ratio, whereas, the level of Mn decreased. Shoot length of the plant increased by the addition of sludge, whereas, no marked change was observed in case of root length, fresh and dry weight of the plant. Accumulation of metals in the plants was found in the order; Fe > Mn > Zn > Cr > Cu > Pb > Ni > Cd, however, the level of Co was found below detection limits. Translocation of toxic metals (Cr, Pb, Cd) in different parts of the tested plant was found in the order; leaves > stems > roots. An increase in the photosynthetic pigments, carotenoid and leaf protein contents were observed with increase in sludge amendments. Correlation analysis between metal accumulation in the plants and DTPA extractable metals emphasized that Mn, Ni, Cr, Pb and Cd showed positive correlation, whereas, Fe, Zn and Cu showed negative correlation. Transfer factor analysis emphasized that 10% TS amendments are suitable for Cr phytoextraction. Overall analysis of the data exhibited that the plants may be used for phytoextraction of Cr from tannery waste contaminated soil and is a matter of serious concern whenever used for edible purposes.

Key words: Tannery sludge, C*henopodium album*, phytoextraction, DTPA, bioavailability

SI/P-36 Phytoremediation of Toxic Aqueous Solutions using *Ludurigia stolonifera*

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Ludurigia stolonifera (Family: Rhizophpraceae) was used to remediate the polluted water and reduce/uptake Cerium, Cadmium and Uranium. *L. stolonifera* was used to measure the maximum uptake of Cerium chloride, Cadmium chloride and Uranium nitrate. The maximum uptake of Cerium chloride in relation to different pH values, temperature, light, concentration and presence of some additives were also estimated.

Key words: Phytoremediation, *Ludurigia stolonifera*, cerium, cadmium, uranium

SI/P-37 Biochemical Responses of *Hydrilla verticillata* (l.f.) Royle to As(III) and As(V) Bioaccumulation

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Hydrilla verticillata, a fast growing aquatic weed, was investigated in the present study for its possible use to remediate As contaminated environments. Plants were treated with As(V) (0-250 mM) and As(III) (0-50 mM) for 7 days in laboratory. As - accumulation potential of plants and associated effects of metalloid in terms of morphological and physiological changes were determined. Accumulation of both As species increased in concentration and duration dependent manner. Maximum accumulation of As(V) and As(III) was 105.79 and 365.01 mg g^{-1} dw after 7 days at respective highest concentrations. Toxic effects were evident by changes in morphology of the plant, such as fragmentation, chlorosis, whitening of leaves and mucilaginous stem as well as by decrease in pigments, protein content and biomass with simultaneous increase in lipid peroxidation and ion leakage observed by both metals. Toxic effect was more severe with As(III) than As(V), which was correlated with its higher accumulation. The tolerance to metalloid was attributed to efficient antioxidant system with increased activities of enzymes, like superoxide dismutase (SOD), ascorbate peroxidase (APX), guaiacol peroxidase (GPX), catalase (CAT) and glutathione reductase (GR) and non-enzymatic antioxidants, like non-protein thiols and cysteine, however the induction was higher with As(V) than As(III). The analysis of glutathione (GSH) and phytochelatins (PCs) was done only with As(III) considering its higher accumulation to understand the mechanism of detoxification. GSH induced at 1 mM As(III) and reached to maximum level after 4d. Beyond 1 mM GSH levels declined at all durations. PCs (PC_2 and PC_3) were induced to significant levels at 5 and 10 mM after 4d with concomitant decrease in GSH. The study concluded that more accumulation of As(III) was probably due to its higher uptake by plants and efficient detoxification through synthesis of PCs. However, higher toxicity of As(III) was attributed to its faster uptake, while slow uptake and lower accumulation of As(V) allowed plants to tolerate higher concentrations due to induction of various metabolites and antioxidant enzymes, and plants experienced less toxicity. In view of fast growth and high accumulation potential of plants, these might be suitable candidate for remediation of As contaminated sites.

Key words: *Hydrilla verticillata,* phytochelatins, antioxidant enzymes, glutathione, arsenic

SI/P-38 Microbial Remediation Through Bioaccumulation of Metals

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Stress sites often have microbes suited to that environment and coexists with the scanty vegetation. The introduction of heavy metals, in various forms, in the environment, can produce considerable modifications of the microbial communities and their activities. Heavy metal stress at sites like fly ash dykes, mine spoiled sites exhibit an inhibitory action on microorganisms by blocking essential functional groups, displacing essential metal ions, or modifying the active conformations of biological molecules, although at low levels some metals such as Cu and Zn are essential for growth of microorganisms. Bacteria were isolated from fly ash infested soil sites. Isolates that showed bioaccumulation were identified. Minimal inhibitory concentrations of heavy metals (MICs) for each isolate were determined. In order to assess their metal uptake potential, liquid cultures with varying metal concentration were used. Effect of increasing metal concentration on

growth rate was determined. Isolates showed varying resistance to metals in liquid cultures. The order of toxicity of the metals to the bacterial strains was Ni> Cr> Cd> Zn. Certain isolates could accumulate 20-48 % of metals. The results were correlated with their antibiotic resistance. A growing body of evidence indicates that metal tolerance and antibiotic resistance are often found together in many clinical isolates and that metal and antibiotic resistance are closely associated. Simultaneous resistance to antibiotics and metals suggest that identified bacteria isolates have developed a mechanism, presumably they are rich in plasmids. In naturally polluted environments, the response of microbial communities to heavy metals depends on the concentration and availability of metals and is dependent on the actions of complex processes, controlled by multiple factors such as the type of metal, the nature of medium and microbial species. However, metal tolerance and metal accumulation in bacteria isolates were confirmed in simulated conditions in liquid cultures. These strains may be applicable in bioremediation of heavy metal contaminated sites due to their high metal accumulation capacity in aerobic conditions. Further studies to characterize the selected strains are in progress.

Key words: Heavy metals, fly-ash, bioaccumulation, microbes

SI/P-39 Biochemical Parameters of Plants as Indicators of Air Pollution

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In the present study, species like *Mangifera indica*, *Cassia fistula* and *Eucalyptus hybrid* were exposed to different air pollution load for short duration (active biomonitoring). Variation in biochemical parameters like chlorophyll, protein, soluble sugar, free amino acid, ascorbic acid, nitrate reductase, superoxide dismutase and peroxidase in leaves were found to be load dependent. These variations can be used as indicators of air pollution for early diagnosis of stress or as a marker for physiological damage to trees prior to the onset of visible injury symptoms. Just by analyzing these biochemical parameters air quality can be assessed.

Key words: Bioindicators, Superoxide Dismutase (SOD), Nitrate Reducatse (NR), peroxidase

SI/P-40 Biological Treatment of Textite Effluent-Use of Blue Green Alga, *Microcystis aeruginosa*

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The western Rajasthan is a part of 'Thar Desert'. The climatic conditions of this region are arid. Irregular and scanty rainfall, high temperatures, desiccating winds, salinity and alkalinity of soil and water are characteristics of the region. High population pressure, rapid industrialization and urbanization have caused water pollution and degradation of environment. This is manifested in the form of perceptible change in the ecology and natural water systems. A number of textile processing units around Jodhpur use high volume of fresh water and discharge highly polluted water on land through open channels in river 'Jojari'. Such textile effluent is dark colored. This contains types of azodyes and hazardous chemicals.

The process of using biological agent to remove toxic wastes from the environment, bioremediation, has been suggested as low cost waste treatment systems. The algae particularly the blue-green algae are useful in treating the Industrial effluent. These also produce a variety of useful byproducts. Attempts were made to develop a biological method to cleanse the waste water to reduce levels of pollutants of the textile effluent. We used a blue green alga, *Microcystis aeruginosa* to treat the textile effluent. The alga was collected from the fresh water pond of Gura -vishnoiyan (Near Jodhpur) and mass cultured in glass containers in laboratory. The algal biomass was harvested and washed with distilled water and dried at room temperature. One gram dry mass of alga was added to 100 ml. of sterilized filtered textile effluent. The spectrophotometric studies revealed that 60-70% of color intensity of the textile effluent was reduced. The pH and chloride contents were also reduced. Similarly total hardness of textile effluent was lowered down. Our studies revealed that algal biomass of *Microcystis aeruginosa* shows potential effect on polluted water and therefore can be used for bioremediation and recovery of water.

Key words: Blue green alga, textile effluent, biological treatment, *Microcystis aeruginosa,* biomass

SESSION-SII

ENVIRONMENT and BIODIVERSITY

SII/L-1 Community and Species Diversity in Dry Tropical Forest of Northern India

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The dry tropical ecosystems are among the world's most threatened, and the dry deciduous forest of northern India is being progressively converted to scrub, savanna and grasslands through industrialization, agriculture, fuelwood collection, lopping of trees for fodder and severe grazing/browsing. It is important therefore, to assess the diversity of this forest and to formulate appropriate conservation strategy. In this paper I summarize our recent studies on the diversity of a disturbed dry tropical forest of northern India. This forest is composed of a mosaic of noncontiguous patches representing different plant communities . Distribution of species and individuals is also patchy. A PCA ordination indicated that the variation in species composition of the sites is explained by the variation in soil nitrogen as well as the degree of disturbance. PCA ordination also showed uniqueness of sites in terms of seedling composition, but the seedling and adult distributions were not spatially associated. This indicated that seedling community on a site was distinct from the adult tree community. Evidentally, the distinct species composition at the different sites and at the two life-cycle stages (i.e., seedlings and adults) on the same site is indicative of marked spatiotemporal dynamics of the dry tropical forest. Studies revealed that species diversity increased linearly with an increase in total tree basal area, and with an increase in the number of stems additional species were encountered. This situation reflected a multi-species recruitment of individuals, and also greater equitability of distribution of individuals among species. A positive relationship between basal area and tree species diversity is an important characteristic of the species-poor dry forest, where recurring disturbance does not permit concentration of biomass or stems only in a few strong competitors. There has occurred a considerable amount of fragmentation. Temporal changes observed through satellite images and field observations indicated decreasing patch size. However, while in some patches the crown cover had increased (positive change) due to relative protection, in others it decreased (negative change) as a result of continued disturbance. The species loss due to decreasing patch size was greater in the negative change areas than in positive change areas. An analysis of plant functional types indicated that the predominant phenotypic traits exhibited by this forest, notwithstanding site characteristics such as disturbance or topography, were small leaf size, rough bark texture, medium leaf texture, and medium deciduousness. The major phenotypic traits of the forest were shared by all communities, howsoever different they may be in terms of species composition. Further, there is considerable redundancy within each functional trait group. An analysis of seed size indicated that small-seeded species, which were generally wind-dispersed, were more widely distributed, at the local scale, compared to large-seeded species. However, the proportional abundance and basal cover of seed size categories showed that the structure of the dry forest was largely determined by the medium- to large-seeded species. There was a considerable amount of redundancy within each seed size group, which added to the species diversity.

Key words: Species diversity, dry tropical forest, satellite images

SII/O-1 Conservation of Biodiversity in Puglia : The Study Case of Ostuni (Alto Salento)

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Puglia region is affected by a serious lack of wood-lands and more in general lands covered by spontaneous vegetation, in spite of this, biodiversity values of natural patches are high. In the last years big efforts have been made in the direction of nature conservation (creation of parks and protected areas), but landscape management in Puglia is still far from good environmental standards, in particular in areas where high impacts occurs. This becomes, particularly, evident in the coastal line, area with high density of population and characterized by a great touristic pressure in the summer period.

In general, Puglia's heritage appears as a rich system from cultural-historical-natural point of view, affected by a great fragility. In this scenario, conservation of natural resources becomes a priority in the landscape management of Puglia region. In consideration of its high environmental landscape's values, Ostuni's territory was chosen as study case. Ostuni is a wonderful town of upper Salento, the southern district of Puglia; this place is well known as "*La Città Bianca*", due to the white colour of its houses. Ostuni and its territory is one of the most important places for tourism in Puglia.

Ostuni's landscape is typically Mediterranean with wonderful coasts (rocky and sandy), a huge olive tree's *pianoro* with very old *Olea europaea* trees and hilly areas, covered by Mediterranean maquis. Landscape's diversity causes a richness in biodiversity with rare habitat such as communities of sand dunes, salty grasslands, coastal scrubs of *Juniperus oxycedrus* ssp. *macrocarpa* and *Juniperus turbinata,* garrigues with *Thymus capitatus* and *Fumana thymifolia,* termo-xerophilous Mediterranean sclerophillous scrubs and forests of *Quercetea ilicis,* coenoses of *Quercus trojana,* scrubs with *Quercus suber,* interesting for chorological implications.

These precious natural residual patches are endangered by human activities (tourism, urbanization, fires, land modification to obtain pastures and agricultural surface), therefore a new consideration of these resources is needed.

Key words: Biodiversity, fragility, Mediterranean, olive tree, oaks

SII/O-2 Biodiversity Analysis of Cyanobacterial Germplasm

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Cyanobacteria/blue green algae are a morphologically diverse, phylogenetically coherent group of gram - negative photosynthetic prokaryotes having chlorophyll *a*. These occur in widely different habitats ranging from fresh, brackish and marine waters to hot springs, Antarctic soils and deserts. Their taxonomy based upon morphological, nutritional or developmental features does not always correlate with evolutionary relationships. It is estimated that as many as 50% of cyanobacterial strains existing in culture collections have been identified incorrectly or assigned wrong taxonomic group. These organisms have been studied on the basis of morphological, biochemical and molecular characteristics. They are characterized by morphological diversity which has been used in the identification criteria. Strains showing morphological variability also exhibited physiological diversity. Growth rate, pigment analysis, cellular constituents, enzymes related to N-assimilatory activities showed intergeneric and intrageneric diversity. These parameters exhibited the overlapping of genera in the dendrograms developed. The most common advances in molecular systematics have yielded cyanobacterial phylogenies based upon DNA fingerprinting techniques. Further, molecular characterization of these isolates would help in assessing the genetic diversity amongst the isolates and its possible relatedness to morphological and physiological diversity. RAPD and RFLP profiles have been used to generate unique and identifying profiles of cyanobacterial isolates.

Key words: Blue green algae, diversity, morphology, physiology, DNA fingerprinting studies

SII/O-3 Indian Plant Diversity – A Vital Source for New Ornamentals

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All plant species which are presently under cultivation for various economic, medicinal and ornamental purposes, have originated through the germplasm resources of wild origin during the civilization process of mankind. The wild relatives of these species found in natural habitat contribute significantly and serve as a reservoir to the vast genetic resources for their future varietal improvement.

A glimpse of the history of the botanical explorations in India reveals that many British botanists/ horticulturists had extensively botanized in search of the wild relatives of established ornamental plants like: *Geranium, Rosa, Primula, Senecio, Rhododendron* and the orchids. They also collected several other beautiful herbs, shrubs and the tree species for introduction in the botanic gardens. These wild species are thriving well in many botanic gardens even today and have been exploited judiciously for various ornamental purposes in landscaping and ornamental horticulture. Little efforts have been made in our country to bring these beautiful plants under cultivation and for detailed studies about their acclimatization, multiplication and dissemination in the floricultural trade. It can provide tremendous scope for screening such beautiful taxa for their utilization as new ornamentals. In the present paper some of such plant species occurring in different geographical zones of the country have been discussed. It may provide ample scope for more ornamental plants and add new dimensions to the ornamental horticulture in India and abroad.

Key words: Plant diversity, horticulture, new ornamentals

SII/O-4 Studies on the Spatial Distribution of 114 Pteridophytic Species in 6 X 6 KM Grid Cells in Southern Sikkim – A Conservational Approach

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Sikkim state is rich in pteridophyte diversity but there is no distributional MAP in grid cell manner for assessing the spatial distribution of pteridophytes. Total 114 pteridophytic species were collected from different parts of Southern Sikkim within the range of 420 m to 4300 m altitudes; they were identified and plotted in 6 x 6 Km grid cell AP. 'Epiphyte richness' as well as 'Species richness' MAPs were prepared. Altitude-wise distributions of pteridophytic species were also determined. From the grid cell studies of 28 different places of Southern Sikkim, it was revealed that Western Sikkim was richer in the number of pteridophytic species than the Southern and Eastern parts of Sikkim. Altitudinally, the middle hill forest areas (900m –1500m) possess the ideal climatic conditions for the growth of pteridophytes as is evidenced by the occurrence of large number of pteridophytic species in these areas. Maenum, Versey and Pelling are very rich in epiphytic and terrestrial species of pteridophytes. This overview of knowledge regarding pteridophytic species distribution in Southern Sikkim will be of much help in formulating conservation strategies.

Key words: Spatial distribution, pteridophytes, grid cell, Southern Sikkim, conservation

SII/O-5 Biodiversity and Bioactivity in Hydrocarbon Contaminated Sediments

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Hydrocarbon contamination, in particular benzene, toluene, ethylbenzene, and xylenes (BTEX compounds) is of much environmental concern, due to their large usage in industry. Much attention is now drawn towards bioremediation processes concerning BTEX contamination in the environment. The ability of microorganisms to degrade such compounds has long been known. This study focuses on the soil environment where microorganisms capable of benzene degradation were isolated from BTEX contaminated soil samples. In the first phase of the study, a total of 19 strains of benzene degrading bacterial isolates were obtained which were characterised by biochemical, microbiological and molecular techniques. One strain of *Arthrobacter* sp. was eventually selected as most appropriate for a bioaugmentation study due its high solvent tolerance and ease of detection using molecular techniques. The second phase of the study performed over a period of two hundred days involved assessing and monitoring bacterial species in a microcosm contaminated soil laboratory environment. The indigenous microbial community were monitored by means of both PCR and RT-PCR–DGGE analysis of 16S rDNA and 16S rRNA. In addition, bioactivity and detection of degradative genes involved in benzene degradation were studied. Throughout the study, successive changes were observed amongst the microbial population, which was correlated to the changes in environmental conditions applied to the microcosm. Enumeration of both heterotrophic and benzene degraders were observed to fluctuate. In addition, the ratio of bioactivity measurements using radiolabelled [^{14}C]-benzene could not be correlated to bacterial counts. Despite the continuous detection of the *Arthrobacter* sp. via PCR-DGGE of 16S rDNA analysis, RT-PCR analysis only detected the strain on day 114. The ability of the inoculant strain to be sub-cultured and identified by the end of the study indicated that the latter was capable of survival. The detection of both DNA and RNA transcripts of the *bed*C1 gene throughout the study period indicates that the biodegradation of benzene can be attributed to the presence of the benzene dioxygenase enzyme involved in the initial microbial degradation pathway of benzene.

Key word: Bioremediation, bioaugmentation, biodiversity, BTEX, dioxygenase, DGGE

SII/O-6 Diversity Distribution and Conservational Priorities

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On the world stage, out of 12 Mega diversity countries and 18 hot spots, India ranks 10th in the total number of flowering plants, and has two hot spots i.e. Western Ghats and Eastern Himalaya. India supports 17,000 species of flowering plants, 5000 of these are exclusive to us i.e. endemic species. Amongst our Asian neighbours China has 30,000 and Indonesia 20,000. In contrast Brazil the world's richest country has 55,000 species of flowering plants; From the international conservation point of view, two attributes of biodiversity i.e. are important: (a) Species richness (the number of species in an area) and (b) Endemism (Species restricted to a given region and occur no where else).

These two key attributes of biodiversity reflect the complexity and uniqueness of natural ecosystems. Islands are suppose to be the treasure house of most of the endemic species because of their long isolation. Australia leads all countries of the world in the number of

species of mammals (210) and reptiles (605). Islands of Madagascar which is having highest percentage of endemism flowering plants (64.3%) is also important islands as for as endemism of Fauna is concerns. It has 67 endemic species of mammals, 67 of birds, 231 of reptiles and 142 of frog and their relative. The central American nation of Colombia leads the world with 1721 endemic species followed by Indonesia with 1579 and China by 1100 species.

On the Earth summit, June 1992, the majority of the world's nations signed on convention on Biological Diversity, as a commitment to conserve our heritage which remains of the earth's astounding plants and animals diversity the convention reflects many concessions, regional on international conservation measures *in situ* (on site) and *ex-situ* (offsite) protection role of local communities, transfer of technologies and funds and aspects of biotechnology and intellectual property rights.

Key words: Diversity, world distribution, Earth Summit, conservation

SII/O-7 Floristic Composition of Iron Ore Mine Areas of Saranda-Bonai

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Mining is essential for economic and industrial development of a country and minerals are the treasures of the nation. It is a process that can not be carried out without disturbing the "mother earth" beneath which mining shovel has to work for excavating the mineral and causes the ecological degradation and environmental imbalance. Mining operations leave their impacts in the form of landscape alteration, removal of top soil and subsequent physical and biological erosion of resultant strata, qualitative and quantitative changes of rivers, lakes and stream water, air and noise pollution, floral and faunal population and altered socioeconomic status of people.

Saranda-Bonai forest ranges represent one of the most important sal belts in the country. It is also rich iron ore belt (Singhbhum-Keonjhar belt) from which huge reserves are being mined out by Steel Authority of India (SAIL) and Tata Iron and Steel Company (TISCO) and some private mines. The forest has a high density of plant species. The present study was initiated as a part of a project on ecorestoration of iron ore mines of Bolani (Keonjahr). One of the objectives of the study was to gather first hand information of the floristic account of iron ore mine areas of Saranda-Bonai region of Jharkhand and Orissa. Exploration and collection was carried out in the surrounding natural forest areas, degraded areas abandoned recently (1 to 5 yrs.) 10, 20 yrs. ago and areas where plantations have been carried out. The floristic composition of iron ore mine area reveals 168 species belonging to 133 genera and 58 families.

Key words: Floristic composition, iron ore mines, Saranda-Bonai range, Keonjhar

SII/O-8 Changes in Soil Properties, Microbial Population and Plant Diversity during Natural Recovery of Coalmine Spoils in Jaintia Hills of Meghalaya

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The rich deposits of coal are found in several parts of Meghalaya including Jaintia hills. The coal seams occur at a depth ranging from 2-10 metres only, which makes the extraction of coal much easier in Meghalaya compared to the other coal mining areas in India. This has encouraged a large number of private operators to extract coal for generating income for themselves. Thus, the coal extraction is extensively done as a result of which, coalmine spoils abound in the area. During the digging operation, the rock pieces, gravel and soil overlying the coal seams get haphazardly mixed with small coal pieces. These waste materials are taken out and dumped near the mine sites on ground surface forming heaps or mounds of varying sizes, which are referred to as coal mine spoils. These coalmine spoils represent extremely rigorous habitats for plant growth. Colonization and maintenance of vegetation on these spoils is possible only after the soil properties had undergone some changes with the passage of time. This paper presents the salient findings of a comprehensive study that was carried out to monitor the changes in soil characteristics, microbial population and plant diversity on the mine spoils of different ages that were undergoing natural recovery after their abandonment. Three coal mine spoils of varying ages, *viz.* 0-2 years, 6-8 years and 12-14 years, and an un-mined site in the vicinity (the 'control') were chosen in Bapung coalmine area of Jaintia hills for a detailed study. The study revealed that the contents of soil moisture, soil organic matter, NPK concentration and cation exchange capacity (CEC) increased with increasing age of the mine spoils, which shows that a recovery has occurred. The bacterial and fungal populations were maximum in the soils of the un-mined control site whereas the youngest mine spoil had an extremely low microbial population, which increased with the age of the spoils. The plant diversity on the mine spoils was also very much related to their age. The maximum number (39) of plant species was recorded from the control site, whereas on 0-2 yr-old spoil only 2 plant species were observed to grow. With the increase in age of the mine spoils the number of plant species growing on them increased (for example, in the 6-8 yr-old spoil the number of species was 13 and on the 12-14 yr-old spoil the number was 28). Some plant species were found to be well adapted to grow on mine spoils. The study revealed that the coalmine spoils gradually and steadily recovered and in about 14 years time the soil regained many of their vital attributes. The process of eco-restoration, however, can be hastened by suitable intervention by way of planting some leguminous species that may be well adapted to grow on these coalmine spoils.

Key words: Coal mine spoil, microbial population, plant diversity

SII/P-1 Importance of Foliicolous Lichens and their Diversity in Meghalaya, India

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Foliicolous lichens constitute an interesting group of lichens that strictly grow on live leaves. They have the potential to be used as indicators of environmental conditions of the region where they thrive, and evidences prove that they also act as indicators of species diversity and some species are even regarded as indicators of anthropogenic disturbances. Better understanding of this group of epiphytes will be useful in the ecosystem management and development in tropics as they essentially form tropical element. India harbours rich foliicolous lichen diversity represented by 130 sp., of which 106 sp. occur in North eastern states of India. Our recent studies revealed that among the states of Northeast India, Meghalaya stands 2nd in position after Arunachal Pradesh as far as foliicolous lichen diversity is concerned. It comprises 46 sp. distributed under 9 families and 19 genera. The paper also reports 1 sp. *viz*. *Asterothyrium decipiens* (Müll. Arg.) R. Sant. as new to Indian lichen flora and 45 sp. as new records for the state of Meghalaya. Dominant families are represented by Trichotheliaceae (21 sp.), Strigulaceae (11 sp.), Ectolechiaceae (6 sp.), Pilocarpaceae (5 sp.) etc. while dominant genera include *Strigula* (11 sp.), *Porina* (10 sp.) and all the other remaining genera has 2 sp. or 1 sp. only. Foliicolous lichen flora of Meghalaya shows wide range of distribution. The rich sites of distribution of foliicolous lichens in Meghalaya are mainly Garo and Khasi hills. All the species identified are enumerated along with their localities.

Key words: Foliicolous lichens, indicators, diversity, Meghalaya

SII/P-2 Plant diversity and composition in the Regenerating Sal (*Shorea robusta* Gaertn. f.) forests of Eastern Ghats of India

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The Kandhamal hills in the Kandhamal district of Orissa forms the northern extreme of Eastern Ghats and extends up to Nilgiri in the south. The forests of Kandhamal district mainly consists of tropical dry deciduous and tropical moist deciduous. These forests are mostly dominated by sal (*Shorea robusta*), up to 70-80%. Pure stands of *Shorea robusta* result from the exploration of mixed natural stands. As sal is a vigorous coppicer and generates profusely in the openings, it gives dominance over the other miscellaneous species.

In the study area the disturbances are removal of biomass by clear felling for timber to be used for commercial and domestic purposes by the local people, in the form of grazing, looping, and surface burning. Another type of disturbance is shifting cultivation, in which natural forest trees are slashed and burnt and used for shifting cultivation for 2-3 years, thereafter left for regeneration.

The present study highlights the floristic, biodiversity and structure of the regenerating sal forests of different age series of succession in the Kandhamal district of Orissa. Four stands which were protected for 2 year, 4 year, 6 year and 10 year were studied for plant regeneration during 2001 to 2002. The floristic analysis revealed interesting results regarding the diversity of species in the four forest stands of different years of regeneration. Maximum diversity of 69 species was observed in the 2 year regenerating stand while 4 year and 6 year stand exhibited 55 species each. Ten year regenerating stand exhibited 51 species. This diversity pattern shows that, the diversity of species decreased with increase in the stand age. Similarly the number of genus was maximum (59) in 2 year stand, while it remained nearly similar in the other three stands i.e. 49, 50, 48 in 4 year, 6 year and 10 year stands respectively. The similarity indices calculated between the forest stands showed that, the 2 year and 6 year stand showed the highest similarity of 77.4 followed by 2 year and 4 year stand i.e. 74.2. Four year and 10 year stand exhibited the lowest similarity index (62.3) among the stands. The present study helps us to understand the floristic composition and successional patterns of four stands of regenerating sal forests of Eastern Ghats of Orissa.

Key words: Eastern Ghats, plant diversity, regenerating forest, *Shorea robusta*, similarity index

SII/P-3 Distribution, Composition and Seasonal Abundance of Phytoplankton Community in a Subtropical Lake of Kumaun Himalaya (Lake Naukuchiyatal, India)

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Forty-seven taxa of phytoplankton, belonging to 6 taxonomic groups, were collected from the lake during two years of the study from January, 2000 to December, 2001. *Synedra ulna, Synedra* sp., *Peridinium* sp., *Microcystis aeruginosa, Navicula* sp., *Amphora ovalis, Tabellaria fenestrata, Chlorococcum humicola, Ankistrodesmus falcatus* were important with regard to their frequency of occurrence. The biannual mean community abundance of phytoplankton was $5.5x10^5$ cells per litre. The group bacillariophyceae was most prominent followed by cyanophyceae and chlorophyceae in terms of numbers. The biannual average gross production (across months and depths) was 113 gC m^{-2} y^{-1}. The Shannon-Wiener diversity index ranged from 1.16 to 3.48. The concentration of dominance showed a reverse trend to species diversity and varied from 0.03 to 0.61.

Key words: Himalayan lake, Naukuchiyatal, phytoplankton, community abundance, eutrophication

SII/P-4 Preliminary Studies on Taxonomy, Ecology and Diversity of *Oxytropis* DC. (Fabaceae) in the Himalaya in India

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Oxytropis, a member of subtribe Astragalinae of tribe Galegeae, consists of *ca.* 300 species throughout the world. The closest relative of the genus is *Astragalus*, which grows together in the same habitat. The two genera are very similar in their gross morphology and differ chiefly in the shape of keel petals. The study of literature, herbarium specimens and our own field survey reveal that in India the genus has more than 20 species, occurring at high reaches of the Himalaya. The maximum diversity of the genus with about 18 species lies in the N. W. Himalaya, mainly in the cold deserts of Lahul-Spiti and Leh and Ladhakh, while the N. E. Himalaya harbours only about 5 species. The majority of the species shows affinity either with European or Sino Himalayan elements and only three species (*viz*., *O. collettii, O. shivai* and *O. rautii*) are found endemic to India. The present study has also observed some new species and records from India in the genus. *Oxytropis* is widely distributed in the temperate to alpine zones of the Himalaya up to 6,000 meter altitudes. Since *Oxytropis* grows in very cold climate in dry and hard soil, it develops perennial thick woody root-stock and herbaceous and profusely caespitose habit to counter the environmental stress. As the habitats of *Oxytropis* are covered by heavy snow during most part of the year, the life cycle (flowering and fruiting) of the species is completed within short span of time during July to September. The species grow on mountain slopes, along riverbeds and agriculture lands in open among grasses and boulders. Although it is a preliminary study, however it has been observed that *Oxytropis* is a very complex genus and shows great morphological plasticity that causes much difficulty in identification and natural grouping of the species. It has been further realized that the morphology alone is not sufficient to solve the taxonomic complexities existing in *Oxytropis* and therefore, molecular study of the entire group is recommended to understand the basis of variations in the genus.

Key words: *Oxytropis*, diversity, India, Himalaya

SII/P-5 Occurrence and Distribution of Exotic Weed *Limnocharis flava* (L.) Buchenau in Kerala and its Ecological Implications

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Exotic weed invasion has been identified as one of the serious environmental problems impact the structure, composition and function of biological diversity. Weeds are aggressive colonizers, which have flexible habitat requirement and ability to outcompete native species. They are spreading like 'bio-fire' ranging out of control. These weeds pose a serious challenge to the sustainable management of natural and manmade ecosystems. Recent studies reveal that tropical ecological systems are adversely affected by these biological invasions. Ecologically congenial habitats provide adequate and favourable conditions for growth of these weedy exotics since there are few natural enemies. It results in ecosystem pollution.

The present paper describes the autecology of an exotic weed

Limnocharis flava (L.) Buchenau, an emergent exotic aquatic weed of 'Limnocharitaceae'. It is a native of tropical and subtropical America and has introduced in Eastern and South Eastern Asia. The growth and distribution pattern of *L. flava* were studied quantitatively. Data on distribution, abundance, biomass, ecological associations and root zone nutrient quality of water and sediment samples were collected from different wetland systems of Kerala for a period of two years. The current global invasion status of *L. flava* is also discussed. The study reflected that nutrients, water depth and land use patterns were the major factors responsible for the growth and proliferation of this exotic weed. If early steps are not taken to eradicate this weed, it will become a problematic weed in the same way as other noxious aquatic weeds like *Salvinia molesta* D. Mitch and *Eichhornia crassipes* (C. Martius) Solms-Laub.

Key words: *Limnocharis flava* (L.) Buchenau, exotic weeds, biological invasion, sustainable management, wetlands, ecosystem

SII/P-6 Aerial Pollen Incidence of Entemophilous Taxa in Lucknow Atmosphere

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The general presumption is that the airborne pollens belong to anemophilous plants. Records of aerobiological surveys conducted from time to time at different sites of Lucknow during the last 50 years reveal that pollen of at least 40 entemophilous and amphiphilous plants remain suspended in the atmosphere of the city. Though aerial incidence of many of the entemophilous species are meagre, considerable abundance in aerial frequency had been registrered by a number of plant species and most significant among them are *Ailanthus, Azadirachta, Drypetis, Eucalyptus* and *Syzigium*. While occurrence of *Drypetis* pollen was recorded in three aerial surveys, pollen of rest of the above mentioned plants were encountered in considerable frequencies in all of the surveys conducted so far. Other entemo/ amphiphilous pollen recorded in most of the surveys but in relatively lower frequencies are *Callistemon, Pithecellobium, Polyalthia, Prosopis* and *Samalia*. Most of these species are found in parks or road sides introduced by municipal plantings. Pollen of wild plants or weeds of entemophilous category which are recorded in most of the surveys include *Ageratum, Rumex* and *Xanthium*. Incidence of pollen of ornamentals e.g. *Chrysanthemum, Croton*, *Hibiscus* and *Rosa* are represented sporadically while crops like *Brassica* and *Coriandrum* which are cultivated around the city are more frequently present in the atmosphere. High incidence of some airborne entemophilous pollens like *Ailanthus, Azadirachta, Eucalyptus, Moringa, Prosopis* and *Syzigium* had been identified as potential source of allergy.

Key words: Pollen, airborne, entemophilous, aerobiological survey

SII/P-7 Diagnostic Appraisal of Microcystin Variants and their Contrivancial Strategies in Indian Pond

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Pattern of water quality (WQ) is consistent with the toxin producing algal species autecology interpretation. The present study clearly demonstrated the WQ variables and Microcystin content (MC) and their contrivance in eutrophicated pond. The dominant species of *Microcystis* sp.*, i.e. M. protocystis, M. incerta, M. aeruginosa, M. lotoralis* have showed 56.83% and 58.83% of total shared particulate and dissolve form in cyanobacteria bloom seasons and there after tended to decrease. Matrix of pond WQ and its remedies was diagnosed by use of photosynthetic bacteria (*Pseudomonas, Oscillatoria rubescence* DC singly and mixed) and were also utilized for detoxification of MC level. The mixed culture were found to be more efficient in reducing MC level, pH, DO, BOD, Free-CO_2, and Sulphate than single cultured photosynthetic bacteria. *Oscillatoria rubescence* was found in reducing the level of N, P and N/P ratio as compare to *Pseudomonas* singly and also in combination with *Pseudomonas*. MC content was observed as 245.00 and 58.66 ng l^{-1} in particulate and dissolve form respectively in eutrophicated pond. After exposure to photosynthetic bacteria it decreased to 197.00 and 48.73 ng l^{-1}, respectively under laboratory conditions. The detoxification efficiency value was reduced to 50-74%.

Key words: Microcystin, water quality, photosynthetic bacteria

SII/P-8 Climate Effects on High Mountain Ecosystem - Upward Shifting of Alpine Plants along the Glacial Landscape in Central Himalaya (Garhwal)

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The diversity of plants was studied during 1998-2004 in glacial landscape of Chaurabari, situated above Kedarnath (300 44'N - 790 07'E; 3000-7000 m), in Central Himalaya. Glacial plant life is entirely regulated by their climatic condition in addition to geological features. The regional climate is more pronounced than the global at plant niches and its functional level. Thus, the present aim of study is to know how it influences the pattern of plant community and its functional status.

Landscape was identified into different zones on account of vegetational status, glacial feature, geomorphology, climate difference and altitudinal gradients. Cold environment with heavy snowfall, hailstorm and dense frost characterize the study area. The increasing severity of the environment, as we ascend from timberline to snowline, leads to progressive decline in the abundance and diversity of the plant species. The diversity of higher plants decreases while diversity of micro-flora increases from alpine zone to snowline zone. The edge of the melting snow gradually recedes higher and higher as the summer advances till it comes to lie near the equilibrium line altitude (ELA) at the end of the summer. The carpet of specific vegetation (sensitive to temperature oscillation) shifts from the timberline to the snowline with the advent of summer.

Alpine zone occupied opulent and diverse flora but some specialized groups of the plant species, particularly highly fragile and sensitive to climate change, reside in glacial environment. Asteraceae, Ranunculaceae, Primulaceae, Rosaceae, Apiaceae and Ericaceae are the pioneer angiospermic families, while *Anaphalis triplinervis*, *A. royleana, Androsacce sarmentosa, Cotoneaster rotundifolius, Lonicera myrtillus, Cassiope fastigiata, Gaultheria trichophylla*, and *Erigeron multiradiatus* are highly sensitive to temperature change and migrate from lower alpine to glacial environment. Plant substrates are likely to be drastically affected and fragmented by climate change. Through its sensitiveness, the alpine glacial ecotone can be easily seen due to climate difference. Reserves or biodiversity of Garhwal Himalaya are being depleted each day through biotic pressure coupled with haphazard undisciplined damage and destruction. Therefore, mountains need to be conserved and sustainable utilization of natural resources for the human existence.

Key words: Climate, mountain plant diversity, glacial ecosystem, vegetation shifting, conservation

SII/P-9 Hydrobiological Studies on River Ramganga at Bareilly

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An attempt has been made in the present study to correlate the periodicity of algae in the river Ramganga at Bareilly with chemical and

physical factors of the water. Being located in the open country side, the river represents a special type of habitat. It has vast area under cultivation and residential complexes along its course. Observations were made for a period of 12 months accompanied by fortnightly analysis of water and study of different groups of algae occurring in the river. Large amount of biologically important dissolved substances and silt accumulate in this river through drainage mainly from the tilled soil of the agricultural and similar sources. The river is further contaminated to a considerable extent by sewage effluent from bathing and washing of clothes as well wading by cattle. All these factors increase the degree of water pollution of the river by the organic matter of animal origin.

Key words: River Ramganga, algae, agriculture, sewage

SII/P-10 *Teloschistes*, a Lichen Genus New to Iran

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Although, the flowering plants of Iran have been studied in some detail, little is known of its cryptogamic flora. In the case of its lichens, numerous sporadic records and short papers have been published over the past two centuries, but the 2004 checklist by Seaward *et al.* includes 396 species. Undoubtedly, for such a large country with its diverse topography, further investigation will add many more species to this list. As part of an ongoing investigation of lichens of the Khorasan province (NE Iran), more information has been gathered from Irano-Touranian region which contains four different climatic zones and various geological (Jurassic-Cretaceous) areas. Morphological and chemical identification of lichens has been undertaken using standard reagents and microscopical techniques. Of particular interest amongst the collected specimens are: *Teloschistes contortuplicatus* (Ach.) Clauzade & Rondon ex Vîzda and *T. lacunosus* (Rupr.) Savicz, providing important additions to the Iranian lichen flora.

Key words: Biodiversity, lichens, *Teloschistes contortuplicatus*, *Teloschistes lacunosus*, Iran, Khorasan

SII/P-11 Successional Changes in the Occurance of Aquatic Weeds of Mula and Mutha Rivers Around Pune (Maharashtra) in Response to Nutrient Levels

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The megacity like Pune is surrounded by Mula and Mutha rivers. Both the rivers are highly polluted by sewage disposal, industrial effluents, agricultural wastes and human interference. Nutrient levels in these rivers showed changes throughout the year. This is causing significant effect on the occurrence of aquatic weeds like *Eichhornia crassipes, Pistia stratiotes, Azolla pinnata* etc. These macrophytes create dreadful situations in these rivers throughout the year.

In the present investigation water samples from four sampling stations having different pollutant load and nutrient levels were analysed for various physico-chemical parameters during December 2003 to May 2005.

The overall results indicated that comparatively low level of phosphates, potash, sulphate, magnesium and calcium favored the luxuriant growth of *Azolla pinnata* during the month of December and January. It was then replaced by the population *Pistia stratiotes* when nutrient level was medium in the month of February and March. Population of *Pistia* was then replaced by *Eichhornia crassipes* during the month of April and May when the nutrient level was very high.

These studies clearly indicated that the nutrient levels and growth response of aquatic weeds showing very high correlation which can be used further for controlling measures of these weeds. Similarly, occurrence of these weeds may act as the indicators of nutrient levels in the polluted water.

Key words: Aquatic weeds, nutrient level, physicochemical parameters

SII/P-12 Family Leguminosae for Environmentally Sustainable Gum Sources

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Leguminous plants have been used since antiquity as sources of gummy or resinous exudates and from the last four decades, leguminous seeds have assumed importance as the sources of commercial gums. These gums are used in large amounts as thickners, binders, emulsifiers, stabilizing, sizing and water proofing agents, coagulant and as selling or filter aids in such important industries as Textiles, Paper, Food, Petroleum, Paints, Inks, Photography, Cosmetics, Pharmaceuticals, Lithography, Explosives and Tobacco etc. Leguminous seed gums provide vegetable products from renewable resources, raw material is easily available cheap in cost, non-toxic, eco friendly and most important they are non degradable in human body. Existing source of gums from leguminous seeds are *Cyamopsis tetragonoloba*, *Ceretonia siliqua*, *Caesalpinia spinosa*, *Sesbania bispinosa*, *Cassia tora* and many others.

Polysaccharides, gums and mucilages have great value not only in biology but also in industry and economy. India is one of the largest producers of various gums and mucilages, which are being used in various industries for diverse purpose. Although demand for new value added gums is in the increase, we are still largely dependent on imported value added gums with increasing demand there is also a need for search of new gums that may possess better physical and rhelogical properties.

Key words: Gummy, resinous, exudates, coagulants, vegetable gums

SII/P-13 Genetic Diversity in *Cassia fistula* L.

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Morphological diversity is observed in accession of different populations of *Cassia fistula* collected from different / same geographical locations of Uttar Pradesh and Uttranchal, which cover about 9% of the total geographical area of India. It is found that plants were variable in their morphological characters and divided in two distinct group - one has larger leaflets and bright flowers, the other smaller leaflets and paler flowers. Apart of this, one plant was found with white flowered raceme except a portion at the tip, which bears golden yellow flowers with nodulated filament. Random amplified polymorphic DNA (RAPD) technique was applied to detect genetic variation among collected accessions along with *Cassia javanica*.

Most of the primers revealed distinct profile between the accession having nodulated filament and accessions without nodulated filament. Out of 45 primers, 37 generated 5119 bands in all 19 accessions and concluded that *Cassia fistula* (white flower with nodulated filament) should be considered as mutant or hybrid.

Key words: Genetic diversity, RAPD technique, *Cassia fistula*

SII/P-14 Man, Plants and Cultural Ecology of India: A Bird's Eye View

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The land of India is unique in the world in cultural diversity and human civilization, endowed with considerable diversity of flora, fauna, hu-

man caste and customs, traditions, ancient history and myths. The country is a home of heritage of cultural ecology consists varied ecosystems of beautiful grassland, rejoicing scenery of Himalayas, evergreen islands, landscape of sacred river system of Ganga, Yamuna, Narmada etc. The ethnobotanical diversity or variation in relationship between man and plants and dependence of people's communities in plants communities in different biogeography for fulfillment of food, medicine, shelter, socio-religious ceremonies and meeting for other day-to-day needs is based on adaptation, which is a principal aspect of cultural ecology. India is a developing country where plant resources are closely associated as subsistence of people's life, livelihoods and environmental issues. The linkage between man, plants, nature and culture is as a close vicinity of circle in the country. There are about 53,245 botanical species occurring in the country which contribute 16.3% of the world flora. It is estimated that among 18,148 plant species of angiosperms about 3,000 species are essentially utilized in the life and culture of the people's of India. The change in ethnic cultural is directly related to the change of plant biodiversity in specific regions. It has been measured that the loss of knowledge or tradition and change in culture is due to the loss or addition of plant biodiversity. The cultural ecology or the adjustment of man in a given environment and adaptation of plants in life and culture may understood through qualitative as well as quantitative. The living pattern, socio-religious culture of human population of India is directly dependent on plant biodiversity. Therefore, to prevent erosion of human culture, loss of indigenous knowledge, ameliorate gap of tradition and management of cultural diversity the assurance of sustainable occurrence of plants is most important.

Keywords: Ethnic communities, plants, adaptation, cultural ecology

SII/P-15 Germplasm Erosion of Arborescent Elements in Tropical Upper Bari Doab Region of Punjab

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Tropical Upper Bari Doab (31º05'-32º05'N and74º31'-75º32'E) is an area of intensive agriculture. Consequently, the natural vegetation has been reduced to a mere 1.6%. Using a geographic grid comprising sixty-five cells, an assessment of phytodiversity and phytosociology was undertaken from 2002-2005. The results revealed that tree species occupying the canopy level of the vegetation have a poor representation both in terms of total species number (18.52%) as also the importance value (16.67%). What is more, the distribution of tree species is highly skewed. Only four species namely, *Morus alba, Dalbergia sisso, Acacia arabica* and *Zizyphus marutiana* were present in more than half of the grid cells. Most of the species (18 out of 25) are present in less than 10 grid cells and ten species were encountered only at a single location; *Acacia modesta, Aegle marmelos, Cordia myxa* and *Phyllanthus emblica* are some such examples. Phytosociological data revealed a low importance value (IV) of arbores cent members; in 27 of 65 cells they have importance value of less than 10%. This spells extinction of these landraces in the region and an irreparable loss of germplasm. From the ecological and biodiversity point of view, loss of trees has caused disruption in the vertical structure of vegetation. In the absence of over storey, shade-loving shrubs and herbs are also poorly represented.

Key words: Bari Doab, geographic grid, importance value, phytodiversity, phytosociology

SII/P-16 Contribution to the *Cosmarium Species* of Sikkim Himalayas, India

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The tiny Himalayan state of India, Sikkim is located between 27° 46' and 28° 7' 48'' North latitude and between 88°0'5'' and 88°55'25'' East longitude in the Eastern Himalayas, bounded with three international borders of China, Bhutan and Nepal on the north, east and west sides, respectively and southern boundary by Darjeeling district of West Bengal, India. The entire state is a young mountainous terrain spread over 7,298 sq. km. in the Eastern Himalayas and it measures about 112 km in length from East to West, 64 km in breadth in South. With highly folded and faulted rock strata at many places, snow capped mountain peaks, glaciers, transverse river valleys, cascading streams, rivers, lakes make richness of fresh water algal flora of this area. The topography of this pretty Himalayan state is varied with the elevation ranging from 244 m to 8,598 m. The land descends to 240 m a. s. l., which is well known for the rich wealth of floral and faunal aggregation. Climatically, Sikkim experiences varied temperature to the great extent, the maximum temperature is recorded 20-25°C and minimum 0-5°C. Rainfall occurs throughout the year and state as a whole gets 80-90% of the annual rainfall during monsoon (May to September).

In the present investigation, 29 taxa of *Cosmarium* are reported from various altitudinal ranges i.e., sub-tropical to temperate region of Southern and Eastern part of Sikkim. All taxa have been reported for the first time from the study area.

Key words: *Cosmarium*, diversity, Sikkim, Himalayas

SII/P-17 Bamboo: Conservation for Present and Sustainable Future (A Brief Study from Kedarnath Wildlife Sanctuary)

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India is a Country of rich biological diversity supported by ecological and evolutionary factors that is one among the 25-mega-biodiversity hot spots all over the world. The Central Himalayas are biodiversity rich area but due to inaccessible terrains and geographical complexity in depth studies have still not been undertaken in the area of sustainable management and appropriate harnessing of biodiversity. The expansion of biotic activities in natural forest areas, over exploitation of natural resources, has resulted in depletion of various Bamboo (Ringal) species from higher altitudes of Central Himalayas. Excellent bamboo *Arundinaria falcate, Thamnocalamus jaunsaransis, T. falconeri* and *T. spathiflorus* are found above 2400 m, generally in all mountain regions as under storey of *Oak, Rhododendron* and coniferous woody forests. In this region, wherever canopy gaps are formed inside the forests, because of natural (viz. forest fire, wind, rainfall etc.) or anthropogenic reasons (lopping, felling etc.), Ringal culms occupy that land and thus restrict the regeneration of other dominant trees. Unlimited extraction and unauthorized management is the major cause of declining density and quality of Ringal. This situation pertains mainly in the forests that are close to human habitation. Local inhabitants of the area extract Ringal for their personal uses as well as up to certain limits for commercial purpose. Present study deals with economic usage of Bamboo species, its extraction, status and management plans or its conservation in forests of Kedarnath Wildlife Sanctuary in Uttaranchal.

Key words: Biodiversity, canopy gaps, lopping, regeneration, economic usage, management plans

SII/P-18 Useful Plant Species Diversity in the Forests and Environments of Siwalik Hills, Dehra Dun District, Uttaranchal

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Siwalik hills of the study area is stretching in south–eastern direction, between river Yamuna in the northwest and Ganga in the southeast. The area is botanically very rich and rich diversity of the wild plants is the source of food, medicine, fiber, oil, fuels, housing, clothing, contraceptive and other material needs for humankind. The area is inhabited by large number of local tribals, Gujjars who have been living in the forests of the area for centuries. They are well acquainted with the plant species, their uses occurring in different forests ecosystems of the area. Present paper highlights some useful plant species utilized by the local inhabitants, tribals and rural populations. Some important useful plant species of the area are *Acacia catechu, A. nilotica* subsp. *indica*, *Adina cordifolia, Aegle marmelos, Albizia lebbeck, A. procera, Bauhina purpurea, Berberis asiatica, Boerhavia diffusa, Buchanania lanzan, Corchorus capsularis, Curculigo orchioides, Costus speciosus, Dalbergia sissoo, Eulaliopsis binnata, Grewia hirsuta, Helicteres isora, Hemidesmus indicus, Limonia elephantum, Moringa oleifera, Oxalis corniculata, Schleichera oleosa, Spondias pinnata, Withania somnifera* etc.

Plant resources of the area have great potential for establishing small-scale industries, cottage industries, herbal drug industries for the development and welfare of the tribals, gujjars and other rural populations in the state.

Useful plant species diversity in the forests and environments of Siwalik hills, Dehra Dun District, Uttaranchal

Key words: Siwalik hills, plant diversity, tribes, gujjar

SII/P-19 Occurrence and Distribution of Lichens in and Around a Paper Industry (Panchgram) in Southern Assam, North East India

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Lichens are recognised to be the most reliable bioindicators for air quality monitoring. The present investigation deals with occurrence and distribution of lichen communities near a paper mill in Panchgram (Southern Assam) in North East India. The survey revealed 55 lichen species in the area, of which 45 are crustose and 10 foliose. The *Pyrenulaceae* (17 species) dominated the community followed by Arthoniaceae (10 species), Graphidaceae (9 species) and Physciaceae (6 species). Five genera *Pyrenula*, *Arthonia*, *Parmotrema*, *Graphis* and *Pyxine* exhibited their dominance in the community with 14, 8, 6 and 3 species, respectively. The number of species per tree, colonies per species, area covered by species in a tree, largest colony attained by a species per tree and area covered per colony are observed at a distance of 0.5, 5 and 9 km from the pollution source.

Key words: Air pollution, distribution, lichen, paper industry, Assam

SII/P-20 Biodiversity of *Piper* sp. in South India and Application of GIS and Cluster Analysis in Search of its Distribution

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The Western Ghats of south India and the north eastern India are the two hotspots of diversity of the genus *Piper* in India. The Western Ghats of peninsular India presumed to be the centre of origin of black pepper in view of its vast occurrence and diverse distribution in wild. The Indian Institute of Spices Research, Calicut, has made a considerable collection of *Piper nigrum* and its wild relatives from southern India and north eastern India.

Sixteen important qualitative morphological characters of 15 wild species of *Piper* of southern India were studied and plotted for the hierarchical clustering. A dendrogram was drawn using Centroid average linkage between groups, using SPSS software.

Four major clusters and seven sub-clusters were found, whereas species like *P. argyrophyllum*, *P. attenuatum* are found forming first pair between low to medium altitude 50-700 m MSL, while *P. peepuloides* of the first cluster has a wide range 150-1000 m MSL. *P. hymenophyllum* is the only member of second cluster and forming a separate group its relation with all other groups are below 35%. *P. longum* and *P. thomsoni* forming the third cluster with a similarity value of 82% and both occur at low altitude while *P. thomsoni* persists at high range (1000 M) of N.E. Himalayan foot hills. *P. nigrum* and *P. babubudani* which are very close with a correlation value of 0.942 (94%) showed similarity with the member of fourth cluster. *P. nigrum* has a wide range of altitude 100-700 M. Presence of the same group of species in the same location or the nearby location indicates greater degree of geographic relatedness among the species and their origin. Species richness and species diversity index was also studied which shows Wayanad and Palghat district of Kerala, Nilgiri and Tirunelvely of Tamilnadu are the hotspot of species richness.

Key words: Biodiversity, GIS, cluster analysis, species richness

SII/P-21 Lichen Communities of Amarkantak Hills, Madhya Pradesh and their Use in Biomonitoring Studies in the Area

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Amarkantak hills are situated at the southern boarder of Madhya Pradesh in Anooppur district. Being the origin of holy river Narmada, it is a major pilgrim centre in central India and experienced heavy tourist pressure throughout the year. The fast pace of development, urbanization and population pressure is enough to threat the flora and fauna of these hills. Together with other group of plants, the man made assaults leads to massive destruction of lichen habitats too. Lichens are very sensitive to air pollution and microclimatic changes. They exhibit their sensitivity in various ways such as absence of sensitive species, decline in diversity, modification of morphology, anatomy, physiology etc..

The groups of lichens or communities can also be used as a yardstick to assess the impact of human activities across the range of habitats. Amarkantak hills are represented by the occurrence of 71 species of lichens belonging to 37 genera and 21 families. The two major lichen communities of the area are the corticolous communities with 40 species while 21 species falls under saxicolous communities. The epiphytic communities are grouped into 12 alliances and the saxicolous has five alliances.

Among the corticolous communities the Physciaceous alliances dominated the area with 9 species of 3 genera. *Pyxine cocoes* (Swartz) Nyl. and *P. subcinerea* Stirton, are the two most commonly growing lichen species in the area, recorded in five localities surveyed for lichen exploration. Among the saxicolous communities, the Physciaceous, Teloschistaceous and Verrucareous alliances exhibit their dominance in the area.

The good growth of both saxicolous and corticolous lichen communities in the area clearly indicates that the area is still not badly influenced by the human activity. A regular and periodic surveillance of the present lichen communities will be helpful in the assessment of the impact of human activities across the range of habitats in future.

Key words: Amarkantak, Madhya Pradesh, Anooppur district, lichen communities, biomonitoring

SII/P-22 Inter-Generic Relationships among Cyanobacterial Isolates by Random Amplified Polymorphic DNA (RAPD)

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Randomly amplified polymorphic DNA was used to classify and identify 15 cyanobacterial isolates from three different genera namely *Anabaena*, *Nostoc* and *Calothrix* (5 isolates from each genera). This technique is sensitive and specific because the entire genome of an organism is used as the basis for generating a DNA profile. Genomic DNA was subjected to amplification by RAPD technique using different random oligonucleotides primers. Based upon the amplification profile, eight selected informative primers were used in a single PCR to provide specific and repeatable DNA fingerprints. The relationship amongst the isolates was verified using presence/absence of amplified products with random primers and was subjected to phylogenetic analysis. The dendrogram analysis revealed three major cluster. In the first cluster, two different isolates *Anabaena* isolates (CCC 96) and (CCC 163) shared the maximum similarity which accounted for 53.33%, followed by *Calothrix brevissima* (CCC65) and *Calothrix* sp. (CCC261) exhibiting similarity of 47.39%. *Anabaena* ambigua (CCC113) and *Nostoc paludosum* (CCC63) showed least similarity of 22.2%. In the second cluster, two cyanobacterial isolates *Anabaena* sp. (CCC183) and *Calothrix* sp. (CCC124) were related by 22.86%. In the third cluster, *Anabaena azollae* (CCC161) was similar to *Nostoc lickia* (CCC62) by 22.22% and *Anabaena azollae* in turn showed a similarity of only 10% with *Nostoc punctiforme* (CCC168). The dendrogram analysis clearly indicated the potential use of RAPD markers as a rapid method to detect genetic variation/relatedness of the cyanobacterial isolates.

Key words: Cyanobacteria, DNA fingerprinting, genetic relatedness/variations, phylogenetic analysis, RAPD

SII/P-23 An Assessment and Conservation of Biodiversity of Chitrakoot, Madhya Pradesh, India

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Chitrakoot is a very beautiful, peaceful and holy place for the pilgrimage of Hindus, situated in the border of Satna district of Madhya Pradesh and Chitrakoot District of Uttar Pradesh. It has been famous for its rich biodiversity, elegant environment, beautiful hill ranges and perennial streams since times immemorial. According to the epic Ramayana Lord Rama, Sita and Lakshmana stayed for about 12 years on Chitrakoot hill called Kamadgiri, out of their 14-years in exile. Maharishi Valmiki and Goswami Tulsidas described the rich biodiversity of Chitrakoot comprehensively in their texts *Ramayana* and *Ramcharitmanas* respectively.

But at present, the biodiversity of Chitrakoot is under severe pressures emanating from known reasons namely habitat loss by heckles and indiscriminate cutting of forests for timber, fuel wood, expansion of agriculture, construction of roads, querying of stones, grazing, invasion of alien weeds, overexploitation of plants for medicines etc. Therefore, Deendayal Research Institute took initiative to assess and conserve the biodiversity of Chitrakoot region. A detailed taxonomic survey is being carried out for the assessment of biodiversity. For conserving high value medicinal plants of Chitrakoot region, an herbal garden has been developed in Arogyadham campus. There are about 500 medicinal as well as rare and endangered plants are conserved in this garden. As per the latest IUCN Red list Categories (Version 3.1:IUCN (2000), 54 rare and threatened plants are identified for Madhya Pradesh and Chhattisgarh, out of them 48 RET species are conserved in this garden. In the present paper aforesaid work will be highlighted.

Key words: Biodiversity assessment, conservation, Chitrakoot

SII/P-24 *Diospyros melanoxylon* (Linn) -A Boon to Rural Economy

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National forest policy of India envisages the supply of non timber forest produce now known as “non wood forest produce” to the rural people. The leaves of *Diospyros melanoxylon* (Linn) are used in preparation of Indian cigars i.e. bidi which uplifts its socio-economic condition. The tree has a crocodile bark and has a tendency to grow in hot and dry weather. This tree is found in the Vindhyan tracks and Bundal Khand region of U.P., adjacent parts of Madhya Pradesh, West Bengal and Western part of Shivalik hills (Haryana). The leaves of this tree are initially tomantoes in nature, which gradually converts into leathery nature. These leaves have been declared as national product as far as making of Indian cigar (bidi) is concerned. These leaves are plucked, dried, bundled packed and supplied to rural people through middle man where Indian cigar (bidi) is actually manufactured by stuffing tobacco into it. In rural India women, old men and young female children (drop outs) manufacture this Indian cigar (“bidi”). With bottlenecks like exploitation by middlemen, poor availability of raw material, quality material and low earning; people are still preparing Indian cigar (bidi) for their socio economic benefit. A case study was conducted in Uttar Pradesh for a possible policy change for economic gain. This paper deals with the bottlenecks, probable policy changes and methodology for the socioeconomic upliftment of rural people envisaged in national as well as state forest policy and directive principles of state policy of India.

Key words: *Diospyros melanoxylon*, National Forest Policy of India, socioeconomic upliftment

SII/P-25 Screening and Biochemical Analysis of Ethnomedicinal Plants Maximally Utilized by Sahariya Tribes in Shivpuri and Gwalior Districts of Madhya Pradesh

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The present communication deals with the ethnobotanical studies of Sahariya tribes inhabiting in Shivpuri and Gwalior districts of Madhya Pradesh. About 327 species are used for curing various ailments by tribal medicine man. 100 forest plant species maximally utilized for food, fodder and medicine have been collected from remote forests of Gwalior division. Usage of some of the plant species are rare and not recorded anywhere. *Madhuca longifolia, Emblica officinalis* and *Diospyros melanoxylon* are found with various role in their day to day life. These forest plant species are biochemically analysed and results have been discussed in terms of biocomponents.

Key words: Ethnomedicinal, Sahariya Tribes, biocomponents

SII/P-26 Fresh Water Algal Flora of Gangtok (India)

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Gangtok is the capital city of Sikkim state of India, situated in Eastern Himalayas at an altitude of 1,900 meters and has a healthy bracing climate throughout the year. Due to its high altitudinal zones and Himalayan mountain ranges it is one of the major tourist states of India. The region has got unique assemblage of floral and faunal constituents of Himalayan elements. Algal floristic studies of Eastern Himalayas have received very little attention. There are very few cursory reports, which are not giving any systematic account. The present contribution is the result of a survey carried out on the fresh water algal flora of Gangtok city of Sikkim Himalayas, India. Algae growing in many aquatic environments such as brooks, small ponds, submerged plants, rocks, wet walls and associated flora were investigated. This study comprises of 68 taxa belonging to 45 Cyanophycean, 14 Chlorophycean, 8 Bacillariophycean and one Xanthophycean algae. *Anabaena, Nostoc, Oscillatoria, Chroococcus* and *Scytonema* were found to be dominant genera. Detailed taxonomic description of fresh water algal flora of Gangtok city has been discussed in this paper.

Key words: Algae, flora, Gangtok, Sikkim, Himalayas

SII/P-27 Are Small Swamps More Diverse Among Themselves?

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Myristica swamps are one of the unique ecosystems in the wet evergreen forests of the Western Ghats. Members of Myristicaeae dominate the *Myristica* swamps. The swamps occur in small fragments usually ranging in size from a few square meters to few hectares. The swamps are threatened by a variety of factors and it is believed that the smaller swamps may be more vulnerable to threats than are larger swamps. However in a recent study, Ganeshaiah et al., (1997) predicted that contrary to the general belief, a collection of small fragments could be more heterogeneous among themselves compared to a set of larger fragments – and that because of this it might be in fact be more worth while to conserve the small fragments compared to large fragments.

In this study, we examined the above prediction with regard to the *Myristica* swamps in the Uttara Kannada district, Karnataka state. Based on the size we selected 18 swamps, and classified them as small (< 500 m^2), medium (500 – 2000 m^2) and large (> 2000 m^2). The vegetation composition of the swamps was enumerated by laying 100 m^2 quadrates; a total of 204 quadrates were laid in the selected 18 swamps. As a measure of homogeneity, we computed the proportion of species shared and similarity index (based on species frequencies) within a size class of swamps. Both the proportion of species shared and similarity index increased with size class of swamps, indicating that a set of smaller swamps were more unlike each other than did a collection of larger swamps. Indeed the coefficient of variation for the similarity index decreased with size of the swamps. Our results emphasis that few small swamps together are more diverse and thus are more conservation worthy compared to a set of large swamps.

Key word: *Myristica* swamps, predictions, island, species composition, size of the swamps

SII/P-28 Are Swampy Species Threatened?

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Myristica swamps are a unique and highly threatened ecosystem of Western Ghats. Many of the species are obligate to swampy conditions, and possess several physiological and structural modifications to survive the swampy habitat. The swamps form an ideal habitat for areca nut palm and (or) paddy cultivation, thus over the years *Myristica* swamps have been extensively converted to agricultural purposes. Drying up of swamps due to diversion of water is another threat affecting the existence of swamps as well as their endemic species. In this study we address the relative threat to the swampy species and ask if the swampy species are threatened more than are the non-swampy species.

The study was carried out in the swamps of Karnataka, central Western Ghats, India. Swamps ranging in size from 300 m^2 to 10, 000 m^2 were selected and 100 m^2 quadrates were laid to enumerate the vegetation composition. Transects measuring 10 X 50 m were laid adjacent to swamp and the vegetation enumerated. A total of 204 quadrates in 18 swamps and 50 transacts in adjacent non-swampy habitat were laid. Several demographic parameters such as frequency, girth class distribution, density, regeneration, etc were recorded. Further, to identify the obligate swampy species, the swampyness index for each of the species was computed and the species were classified as swampy and non-swampy for the further comparison.

The species richness and diversity increased with the area of the swamps; in disturbed sites, the diversity and richness was much less compared to the undisturbed swamps. Incredibly higher regeneration of swampy species was observed in the smaller swamps compared to large swamps. However the other parameters such as frequency, girth class distribution of stem, density of swampy and non-swampy species did not vary with area of the swamp. Collectively these results indicate that though the habitats per se are under extremely high pressure, the swampy species are not any more threatened than are the other non-swampy species. A counter-intuitive finding of the study that the regeneration of the swampy species is generally better in small compared to large swamps suggests the strong possibility of further increasing the conservation attention to the small swamps.

Key words: Swampy, non-swampy, *Myristica* swamps, threat, quadrate

SII/P-29 Effect of Flowering Synchrony on Progeny Genetic Variability in *Dysoxylum malabaricum* (Bedd.). A Critically Endangered Species of Western Ghats, India

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Asymmetric flowering behaviour has been observed in many tropical species. Such flowering asymmetry generally reduces effective popu-

lation size. Although such temporal isolation due to asynchronous flowering also plays important role in determining population genetic variability, very few studies have addressed this issue. In this study we examined the genetic profile of progeny obtained from synchronously and asynchronously flowering trees in *Dysoxylum malabaricum* one of the endemic, endangered and economically important tree species of Western Ghats.

The study was conducted in the evergreen forests near *Navanagere* hamlets in the Banavasi forest range (14^0 33' N 74^0 56' E), Uttara Kannada district central Western Ghats. The population has more than 200 adult trees that are spread over an area about 15 acres. The population was monitored for variation with respect to flowering phenology. Trees that were found to flower when most (>50 % of individuals) of the population was flowering, classified as "synchronous" while those that flowered when only < 10 % of the population was flowering classified as asynchronous. Seeds from both the classes of trees were collected and further processed to obtain the seedlings. The genetic diversity of the seedlings obtained from synchronously and asynchronously flowered trees was assessed using eight ISSR markers.

Our, analysis indicated that parental behavior with respect to flowering synchrony does not influence the progeny genetic diversity, though the mean genetic diversity was higher for the progenies obtained under synchronous trees. Further, the Dice's dissimilarity (mother to seedling) ranged from 0.04 to 0.17 for progenies from the synchronous individuals compared to 0.05 to 0.18 for asynchronous individuals (KS test – *P<0.05*; Dmax=0.36). Over all progenies pooled together, the Dice's dissimilarity index for the synchronous individuals was 0.098±0.027 compared to asynchronous individuals 0.088±0.029. In other words, it appears that for any potential enrichment program it might be judicious to collect progenies from trees in synchronously flowering populations than from those trees flowering asynchronously.

Key words: Flowering synchrony, progeny, genetic diversity, dissimilarity,

SII/P-30 Biodiversity Studies of Selected Cyanobacterial Genera

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A set of cyanobacterial isolates from three genera namely *Nostoc*, *Calothrix* and *Anabaena* were examined for growth attributes (pigments, sugars, total soluble proteins) and certain biochemical parameters (N-assimilatory enzymes and extracellular ammonia release). Analysis of these parameters exhibited distinct variations among cyanobacterial isolates. The dendrogram generated based upon these parameters showed overlapping of genera. Further, few of the isolates were axenized using optimized protocol (repeated subculturing, streaking and triple antibiotic treatment) for molecular biodiversity analysis. Axenized biomass was used for extraction of DNA and the protocol for restriction digestion of extracted DNA was standardized using endonucleases namely *Eco*R I and *Mse* I for AFLP analysis. After digestion, double stranded adaptors of *Mse* I and *Eco*R I were ligated to the ends of the DNA fragments, generating template DNA for subsequent polymerase chain reaction amplification. The sequences of the adaptors and the restriction site served as primer binding sites for subsequent preselective amplification of restriction fragments using informative primers. The thermal cycling conditions were optimized for preselective amplification of digested/ligated samples. After preselective amplification was carried out, the amplified fragments were subjected to selective amplification of *Eco*R I and *Mse* I modified fragments using *Eco*RI fluorescent dye labeled primers and unlabeled *Mse*I primers to understand the phylogenetic relatedness more precisely.

Key words: Biodiversity, cyanobacteria, physiology, molecular characterisation, AFLP

SII/P-31 Fresh Water Algal Flora of Chitrakoot Water Fall of Bastar District in Chattisgarh State

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The famous Chitrakoot falls are like horse shoe curve, situated at a distance of 38 km from Jagadalpur in Bastar district of Chattisgarh state, at a spot where river Indravati has an abrupt fall of 96 ft. It originates at Mungeri hills of Kalahandi district in Orissa state and flows in south-west direction and enters in Bastar. Average rainfall of this area is 100-130cm, maximum temperature 46.50 ^{o}C and minimum 8.6 ^{o}C. This region is situated between 18^o 41' – 20^o 05' north latitude and 80^o 43' – 82^o 20' east longitude, with an average elevation of 450-750 m to the sea level, comprising an area about 24,350 sq. km. Bastar is abundantly endowed with natural resources and its dense forests cover occupies about 7715.25 sq km that is about 81.09 % land. *Shorea robusta, Tamarindus indica, Emblica officinalis, Woodifordia floribunda, Terminalia belerica, Moduca indica, Bassica latifolia* are the main tree species of this deciduous, monsoon forest.

Fresh water algal samples were collected from near and around the water fall in the month of November, preserved in 10% formaline and deposited at the Algae laboratory of National Botanical Research Institute, Lucknow. pH of water was 6.5–7. A total of 36 taxa of 20 genera were recorded from these lotic waters, out of which eleven genera belong to Chlorophyceae, five to Cyanophyceae and four to Bacillariophyceae. It was found that Chlorophycean members were dominant, Cyanophycean were common and diatoms were rare in their occurrence.

Key words: Algae, freshwater, Chitrakote, Bastar

SII/P-32 Lichen Genus New to Iran

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The word, "lichen", which was employed by Theophrastus, has a Greek origin and means growing on bark of the olive tree. Lichens are an intimate association between two different organisms with notable phylogenetic differences that regularly co-habit.

In the Iranian flora, flowering plants have been identified properly, while our knowledge about cryptogamic plants is too little. In spite of the fact that the first lichen record in Iran passed more than 170 years ago, the progression of lichenology in Iran has been too slow. The first lichen checklist with 396 species for Iran was published in 2004. In continuation of the lichen taxonomic investigation in the Northern Khorasan province in NE Iran, in the Irano-Touranian region with four different climates and Jurassic-Cretaceous geological substrates, more taxa have been added. Morphology and chemistry were studied using standard microscopes and reagents. Among the collected specimens, *Flavopunctelia darrowii* Hale is reported which represents a new genus for the first time in Iran.

Key words: Biodiversity, lichens, Irano-Touranian, Northern Khorasan, *Flavopunctelia darrowii*

SII/P-33 Floristic Diversity and Vegetation Composition of Bhimbetka World Heritage Site in Madhya Pradesh

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The magnificent rock sites of Bhimbetka scattered over the summits of

Vindhyan ranges are located in Raisen District, about 45 km, SE of Bhopal, Madhya Pradesh. Bhimbetka with an area of 12, 172 hectares has always been a center of human activity from the prehistoric times as depicted by rich ancient paintings on its over seven hundred rock shelters. With the inscription of the site in the World Heritage list of UNESCO, there has been further impetus to protect the testimony of Bhimbetka. As the cultural core of Bhimbetka is surrounded by a rich cover of primeval forest, it forms an integral part of environment and biodiversity. The area is also surrounded by dwellings of primitive people, mainly Gond tribes, the true custodians age old traditional knowledge on plants. The site is continuously under tremendous stress due to various natural and anthropogenic imbalances. Thus, the recording of environmental and ethnobotanical data along with critical assessment of biodiversity have become inevitable. Such information are prerequisite for effective management of any protected area. In present study an attempt has been made to have a fresh look on the floristic diversity and vegetation composition of this particular World Heritage Site based on extensive field surveys carried out during 2004-2005. The outcome of this study is highlighted in the present paper.

Key words: Floristic diversity, vegetation, Bhimbetka, ancient paintings

SESSION-III

ENVIRONMENTAL EDUCATION, MASS AWARENESS and LEGISLATIONS

SIII/L-1 Communicating Air Quality - Plant Effects Science to the Public and User Sector

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Successful programs currently educating the public about air pollutant effects on plants usually target students (grade school through college), utilize hands-on activities and visuals, and have a broader objective, such as increasing awareness about the impact of pollutants on the environment while learning how to do scientific research. GLOBE, which stands for Global Learning and Observations to Benefit the Environment, is an international program with more than 100 countries involved that partner schools and scientists. Hands-on activities and visuals, such as plants with injury and pollutant monitoring equipment, are more effective educational tools than written documents. Facilities have been built with visuals that are open for the public to visit on their own as well as to attend educational sessions. Classroom activities, field trips, and teaching workshops are common. While these are successful, teachers are often already overwhelmed today with requirements making it difficult for them to fit in additional activities, further challenged by tightening school budgets. Thus successful programs also target community groups, including church and scouts. Parents are involved with these groups. Summer camps and even birthday parties are being conducted with environmental themes. US national parks provide an ideal opportunity to educate adults as well as children about impact of air quality on plants because pollutants reach high concentrations in many parks and visitors come to experience and learn about the special environment that warranted establishment of these areas as parks. Several parks have air quality specialists on staff. Incentives, such as financial discounts for reducing gasoline use, are an effective enticement for adults to learn how their activities produce pollution, that plants are affected by pollution, and what they can do to reduce their contribute to pollution. Another effective way to communicate air quality-plant effects science to adults is through mass media. Scientists have found reporters to be interested in this topic; likely facilitated by contacting them when pollution has been at an elevated level of concern to people. Through their success, these various types of programs and activities have attracted attention of policy makers, which provides an excellent opportunity for educating this group and obtaining their support.

Key words: Environmental education, GLOBE, mass media

SIII/O-1 Environmental Education: Possible Strategies for India in the Global Village

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Presently, in India there are many groups and individuals in the field, who work to contribute to environmental education. There are also a myriad of organisations providing material available for all ages, groups and learning situations, which can be incorporated in broad-based environmental education efforts to meet diverse needs. The country has no dearth of organisations; governmental or non-governmental. Their aims, objectives and diversity in the styles of functioning could place before us the challenge of a lifetime. However, globalisation of knowledge has its advantages and as scientists, workers and educators in India, we have the opportunity to discover, learn, understand, expand and utilise this complex resource situation, collaborating with like minded individuals and organisations to achieve a common goal.

This paper identifies, some of the current and future challenges that face environmental education in India and offers suggestions on how best they can be addressed keeping the globalisation of education in mind. The way we plan today for public education on the environment will have long term effects for the global village and the quality of life therein. Effective and meaningful environmental education is a challenge to be taken seriously if future generations are to enjoy the benefits of our natural heritage. This paper further identifies specific challenges that face environmental education in the Indian scenario and offers suggestions on how best they can be addressed using the benefits of globalisation and latest knowledge sharing systems.

Key words: Challenges, global village, environmental education, strategies

SIII/P-1 Environmental Education (Mass awareness and Legislation)

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India is definitely better among the developing nations as far as the State's proactive approach towards environment is concerned. Since 1972; changes in educational curricula; mass activities like Bharat Jan Vigyan Jatha's 1987, 1990 and 1992; activities by people; the science movements like KSSP, KPVP, SFS Bihar, SFS Delhi, FSPD, etc. and social movements like CMM, NBA, ATDM etc. along with the pioneering 'Chipko' movement and constitutional amendments to bring environment into directive principles and legislative measures (coupled with proactive judiciary) with regards to forests etc. can be recalled with pride. However, failure to place environment in a proper social prospective, lack of political will in pursuing any legislation, localized mass action failing to match their vast nation, etc. led to a situation of '0' positive result and rather say – further deterioration in environment during the last four decades since 1972. This paper examines all these issues to suggest balanced methods to improve present scenario.

Key words: Environmental education, mass awareness, legislation

SIII/P-2 Analysis of Sustainability of Village Ecosystems of Lucknow District of Uttar Pradesh

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The sustainability of village ecosystems of India is eroding fast. A detailed analysis of these ecosystems from structural and functional point of view and their linkages with other biophysical and socio-economic parameters could pave the way for sustainable utilization of bioresources of the region. The various types of households that are involved in agriculture and other activities and the pattern of utilization of these available bioresources determine the sustainability of a village ecosystem. The different household types differing in size, economic activities, livestock, productivity, food security, education and overall income have varied impact on the natural resource base of the villages. Sustainability of a few selected villages differing in population, education, land holding and socio-economic status was analysed in terms of land-use pattern, crop yield, risk and uncertainties involved in food production livelihood activities of the villagers and maintenance of land fertility. Although crop-yield and economic return were found to be slightly higher in the conventional agriculture than ecologically sound agricultural system, the economic return and value addition per unit of land did not show any difference. The findings suggest that the latter form of agriculture has a tendency towards becoming ecologically, economically and socially more sound than

conventional agriculture, as it requires considerably less agro-chemicals, adds more organic matter to the soil, provides balanced food and relies mostly on local inputs without markedly compromising output and economic benefits.

Key words: Agroecosystem, sustainability, biophysical, ecological agriculture

SESSION-IV

ENVIRONMENTAL IMPACT ASSESSMENT

SIV/L-1 Assessing the Impacts of Air Pollution on Crops in South Asia and Southern Africa

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Current levels of air pollution, and in particular ground level ozone, are contributing to significant yield losses in parts of south Asia (Agrawal, 2001) and may be adversely affecting crop productivity in southern Africa (van Tienhoven et al. in press). Although an impressive number of crop impact studies have been performed in India, such studies have not been replicated in other south Asian countries, making it difficult to develop dose-response relationships that could be used to perform standardised risk assessments for this region. In contrast, in southern Africa very few studies have been performed to assess the impacts of ozone on vegetation *per se* with no studies having been performed investigating the impacts of ozone to key crop species and varieties of the region.

The work presented here describes the establishment of a research programme to address these shortfalls in knowledge. The programme has three main objectives. (i) to perform standardised provisional risk assessments for both south Asia and southern Africa using existing (European and North American) air quality guidelines; here the aim is to identify, at least in relative terms, those areas most at risk from ground level ozone. (ii) To establish a pan south Asian and southern African bio-monitoring campaign. This will employ two methods, the first using a clover clone bio-monitoring method that has been extensively applied in Europe (Mills et al. 2003) and the second using a chemical protectant method to demonstrate yield losses on commonly grown crops of the region. iii) To maintain and expand the Air Pollution Crop Effect Network (APCEN) which comprises a network of air pollution effects practitioners, atmospheric modellers, socio-economic experts and policy makers. This network will provide the scientific and technical support for the other two programme activities and will concentrate on developing standardised observational and experimental protocols that can be used to develop dose-response relationships for local crops and crop varieties and lead to the development of improved risk assessment methodologies for the regions.

Key words: Bio-monitoring, risk assessment, ground-level ozone, crop yields

SIV/O-1 Biodiversity Indicators and Impact Assessment : Sundarban Mangroves, Bangladesh

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To assess the capacity of the biodiversity status and thorough understanding of the given ecosystem, especially with its biodiversity components, a baseline information is required.

Under the above said circumstances it is thought by the authors that the identification of indicators, that indicate the change in the biodiversity, may be an answer to tell about the impacts of interventions from within or outside the given ecosystem. With this understanding, this paper has attempted to describe:

- The process of identifying indicators using the long experiences of all concerned so that these indicators are robust and easily readable by the managerial personnel,
- The establishment process of a baseline and
- The capacity building of the personnel involved in the field.

The paper describes the activities and findings of the IUCN Bangladesh team on the identifications of indicators for monitoring the biodiversity of Sundarban mangroves as an early warning system so that impacts of interventions on the biodiversity of Sundarban can also be read or identified. It has the lists of:

- Indicators identified for the Sundarban ecosystem
- Flora and Fauna

It is expected that these indicators will function as an early warning system towards the biodiversity status of Sundarban. This write-up is an outcome of a large number of field visits by teams of experts, led by the authors, during 2001 to 2003 and inputs from many brain storming sessions, workshops etc.

Key words: Biodiversity, bio-indicator, ecosystem, early warning system, flora, fauna, Sundarban, mangroves

SIV/O-2 Use of Bio-Organic Approach to Combat Desertification and Soil Salinity with Application of ^{15}N Technique

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Several greenhouse and field experiments were conducted using the ^{15}N labeling technique to evaluate the role of different microorganisms as well as labeled plant residues on enhancement of grown plants under poor fertile desert soils.

Nitrogen fixation by asymbiotic bacteria has been observed in greenhouse and field experiments under dry land cropping systems. Biological N_2 fixation, associated with crop residues (legumes or cereals), was investigated in pot experiments with wheat and chickpea cultivars. In these experiments, both residues of wheat and rice were labeled with ^{15}N and used as organic N sources in comparison with either ^{15}N-labelled ammonium sulfate or ammonium nitrate as chemical nitrogen fertilizers. Dual inoculation with *Rhizobium* and mycorrhizae fungi significantly affected nodulation and colonization percentages of chickpea cultivars. *Rhizobium* inoculation extended to be used with wheat gave the best results of growth parameters and N_2 fixation when combined with *Azospirillum brasilense* as heterotrophic diazotrophs. The economical return of *A. brasilense* (as liquid media or commercial product) was estimated with maize crop grown under field conditions. The obtained data showed that inoculation combined with the half dose of recommended N fertilizer rates was the most effective and low cost agricultural inputs. The nitrogen uptake by wheat plants significantly increased by application of soybean residues and inoculation with *A. brasilense*. This field trial concluded that soybean residue as enriched N material, and *A. brasilense* inoculation enhanced the growth, grain and N yields of wheat cultivars grown in poor fertile sandy soil.

Key words: BNF, desert soil, inoculation, ^{15}N technique, organic residues, salinity

SIV/O-3 Short Rotation Bioenergy Programs for Sustainable Utilization and Eco-Development of Sub- Standard Soil Sites

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The Biomass Research Center of NBRI, earlier sponsored by Ministry of Non Conventional Energy Sources, had standardized technology for biomass production and bio-reclamation of sodic soils (pH 8.6 to 10.5) under various plantation models. The major components of management system included: matching species to site, productivity en-

hancement and studying the quantum of litter inputs to enhance soil fertility of degraded soil systems. Field trials of several nitrogen fixing tree species (20) were laid in moderate (2,500 to 4,444 plants ha^{-1}) and high densities (10- to 30,000 plants ha^{-1}) following standard cultural practices except use of chemical fertilizers (gypsum or pyrite). Species like *Prosopis juliflora, Leucaena leucocephala, Acacia nilotica* (*ssp. cupressiformis*) and *Casuarina glauca* were identified as the potential species for short rotation (5 to 8 years) energy plantation programs on degraded soils because of their good plant establishment (75 to 95%), high biomass productivity (7 to 10 ha^{-1} yr^{-1}), quality fuelwood (FVI = 629-1853) and greater efficiency to improve fertility status of soils. Standardization of appropriate silvicultural practices and selection of promising seed sources and genotypes helped in optimizing productivity per unit area. The soil structure, physical and chemical properties of the afforested soil also changed notably in comparison to the barren soils prior to plantation. A marked reduction in pH, bulk density and sodium content; and manifold increase in the status of carbon, nitrogen and calcium were observed in surface layer (0-15 cm) indicating changes in fertility status of these soils. Extent of soil amelioration varied greatly from species to species depending on quantum of litter inputs, its decomposition and mineralization. Mulching practices need to be adopted for incorporation of litter and improvement in deeper layers of soil. The technology developed for raising short rotation fuel wood plantations on sodic soils is eco-friendly, low cost and sustainable without use of any chemical fertilizer. This will lead to increased energy security, environmental protection and boosting the local economy.

Key words: Sodic soils, afforestation, selections, improvement and soil reclamation

SIV/O-4 Evaluation of Genotoxicity of the Leather Industry Waste by *Vicia*-Test

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Chromium, with its great economic importance in industrial grounds, is a major metal pollutant of the environment. Chromium-induced acute and chronic toxicity, genotoxicity and carcinogenicity have been extensively demonstrated. The decline of the leather industry in Eastern and Central Europe in the late 1980's left hundreds of hectares of land contaminated with chromium as a major inorganic contaminant. This study was designed to evaluate the clastogenecity of the sediment samples collected from a post treatment pond system of a leather factory near town Kunszentmárton, Hungary. Water solutions extracted from the sediment samples were used to treat the roots of the *Vicia faba* to determine the degree of genotoxicity by calculating micronuclei frequencies. We also studied the changes of mutagenic effects of the sediment during the four year long investigation period.

Results obtained by statistical tests of micronucleus decrease in frequency in the sediment samples, collected in 2002, were compared to the sediment collected in 1998. Moreover, the total chromium concentration of the sediment was much lower in 2002 than in 1998, and the concentration of Cr(VI) in the sediment was under the detection limit in 2002. The decrease of the mutagenic activity and chromium content of the sediment during the examination period can be explained by leaching of the water soluble chromium forms, especially Cr(VI) from the sediment due to the rain falls, and formation of low-solubility chromium complexes. The results of this study demonstrate that the chromium content in the waste sediment of a leather factory bears a high degree of genetic toxicity.

Key words: Chromium, genotoxicity, leather factory, *Vicia faba*, micronucleus assay

SIV/O-5 Water Hyacinth - Its Impact on Lake Environment and Management

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Water, one of the most abundant compounds on the Earth, is special because all life-forms on the earth are totally water dependent. Water amounts up to 70% of our body and plays diverse chemical roles in humans as well as in flora, fauna, soil, and air. Pollution of water resources is a global problem. Aquatic plants have created havoc all over the world. Unwanted growth of aquatic plants especially some seriously invasive species like water hyacinth and *Salvinia* has caused a loss of billions of US$ all over the world. It affects the supply of drinking water. Water hyacinth *(Eichhornia crassipes)* has proved to be a persistent and expensive aquatic weed problem costing millions of dollars to control and unaccounted millions of dollars more through the damage to the environment, irrigation systems and crops. It has posed ecological and economical problems in several countries. The natural loss of water from the water surface by evaporation is thought to increase through transpiration from the leaves of water hyacinth by at least 40 to 50 percent. The dense growth of water hyacinth obstructs water flow in irrigation channels, interferes with navigation and hydro-electric power generation. It interferes with the seed germination and seedling establishment in paddy, resulting in heavy economic losses to the tune of up to 24 million dollars. The oxygen-depleting load of one hectare of water hyacinth mat is equivalent to that of the sewage created by 80 persons. Over the years, various control methods have been studied and tried including chemical, biological and mechanical means but with no lasting success. Use of chemical methods are not recommended in the drinking water lakes whereas biological control is very slow. The simplest way to manage this weed is to harvest it and utilize it for useful products like use in animal feed, biogas generation, handicrafts, paper industries, etc. In some parts of India it is also used as a medicinal plant. The main problem of utilization and management of water hyacinth is its high cost of transportation to the disposable site or factories. To overcome this problem, a mechanical system was developed at College of Technology and Engineering, Udaipur, India, which chops and crushes water hyacinth simultaneously in a single pass. This solves the problem of the bulk of freshly harvested water hyacinth during transportation. The developed machine is simple in construction and can be installed on the aquatic weed harvester or on the bank of lake or river. It consists of a pair of rollers, shear plate, hopper and conveyors. It can be fabricated by the local artisan in the workshop with very commonly available hardware. The feed material is chopped between a cutting roller and shear plate and then passed between a set of rollers for crushing. The developed chopper-cum-crusher reduced the specific volume of water hyacinth by 73% at recommended 36 No. of blades on cutting cylinder, cutting cylinder speed of 13.33 m s^{-1}, crushing roller speed of 6.66 m s^{-1} and feed rate of 2 t h^{-1}. 65.7 % reduction in cost of transportation can be achieved with the introduction of this mechanical system and only 5 truck trips per day are required against 16 truck trips in conventional system. The system is tested extensively and worked satisfactorily.

Key words: Aquatic weed, mechanical system, chopping, crushing, transportation, utilization

SIV/O-6 Different Experiments on the Wild Plant (*Tamarix nilotica*) and its Soil at the Banks of River Nile, Aswan, Egypt

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In order to better understand the mobility and distribution of metals between *Tamarix* parts and their crystal salts–soil system, in addition to the effect of thermal analysis on the fate of plant metals, different

experiments were conducted with plant rich and plant-free soils at river Nile banks, Aswan, Egypt. For these purposes *Tamarix*, top and sub-soil samples, near and far from the plant, were collected from six different locations at river Nile banks. Elemental analysis of Fe, Mn, Ca, Mg, Cr, Cu, Ni, Zn, Cd and Pb in soil, different parts of *Tamarix* and their crystal salt samples, was carried out by atomic absorption spectrometry while, Na and K were measured by atomic emission spectrophotometry. The bioavailability of metals in the soil samples was evaluated by determining their contents using sequential extraction single-step, providing higher metal concentrations in occluded Fe / Mn oxide fraction. The ratio of heavy metal concentrations in top-soil to that in sub-soil enhancement (RTE) ranged from 0.67 to 4.4 and 0.22 to 4.61 for soil near and far from *Tamarix*, respectively for all measured total element concentrations. Up scaling, calculations indicate that the mobility expressed as transfer factor (TF) was obtained as Fe > Mg > Cr > Mn > Ca > K > Na, to *Tamarix* leaves. The major part of accumulated Na is retained in the plant leaves while roots accumulated high concentration of Co. Differences were found in the element concentrations in *Tamarix* parts and, in general comparison of these values with the corresponding element concentrations in their crystal salts give us a model of *T. nilotica* capacity to leach such elements from soil and the ability of these metals to recycle back affecting soil properties.

Concentration of heavy metals (Fe, Mn, Cu, Co, Ni, Mg, Ca, Cr and Na) in the thermally treated samples increased considerably in rising temperature till 500°C and decreased at 700 and 900°C. Potassium concentration exhibited a significant increase at 105 and 500°C while the amount of lead increased at 300 and 700°C. The treatment at 500°C may be more suitable where it gave significant metal concentrations, but this result needs further examination.

Key words: *Tamarix nilotica*, soil, heavy metals, bioaccumulation factors

SIV/O-7 Ecorestoration Concepts and Strategies for Degraded Lands

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Degradation of land to a larger extent is directly linked to our developmental activities. The nature of degradation and extent of ecological disturbances may, however, vary accordingly. Where ecological impacts are slight and reversible, ecological health can be restored over time by natural recovery but where the impacts to ecosystem components viz., land, water, air and habitat are strong and irreversible, ecological restoration is necessary. Because of the lack of ecosystem based holistic approach, the ecological environment of many areas has been seriously harmed and unable to carry on ecological processes normally. The results may be serious, such as soil erosion, water quality and quantity deterioration, decline of cycle capacity of nitrogen and nutrition, dramatic change of regional climate, and acceleration of the extinction rate of species in many cases. In turn, these results may negatively affect the productive development of industry and agriculture, and diminish the living level of inhabitants. Obviously, it is important to develop regional or micro level watershed planning by the ecological principles combined with sustainable use.

Present paper discusses the ecorestoration strategies practiced in mined land restoration and degraded urban landscapes in detail and success of these approaches in terms of initiation of ecological succession, amelioration of soil, restoration of ecological processes and socioeconomic returns to stakeholders.

Key words: Land degradation, ecological disturbance, ecological restoration, mined lands, soil amelioration

SIV/O-8 Eco-Friendly Approach for Rehabilitation of Difficult and Degraded Sites through Forestation

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The land and water resources being finite, our ability to feed the increasing population will depend on how efficiently we use these resources without reducing their potential to meet the growing demands of the future. Vast stretches of land, in our country, have become ecologically and economically unproductive due to chronic degradation and denudation. These lands, called as wastelands or degraded lands, are lying unutilized due to one reason or another. It has been estimated that out of 329 million ha of total geographic area of the country, wastelands show a sizeable area of 175 million ha which is about 57.55% of this area. About 2.1 million ha of land is getting degraded and deforested annually. The major types of soil degradation are caused by erosion, accumulation of salts, brackish water infestation, water logging, nutrient depletion, destruction of vegetative cover, indiscriminate disposal of industrial wastes/effluents and mine overburdens, etc.

According to an estimate, about 6.65 million ha area in U.P. is categorized as degraded land. The extent of salt affected (saline-alkali) soils in the state is about 1.8 million hectares, which comes to about 4% of its geographical area. About 1.23 million ha of land is affected by gully erosion (ravines). Thousands of hectares of land in the state are infested by industrial effluents/wastes (e.g. tannery, sewage, dairy, distillery, refinery, etc.). Hundreds of hectares of land have been converted into wastelands due to continuous disposal of fly-ash near thermal power stations.

Several suitable packages of eco-friendly technologies for rehabilitation and eco-restoration of difficult and degraded lands e.g., salt affected soils, ravines, dry tracts of Vindhyan region, industrial wastelands, fly-ash dumps through afforestation have been developed by the Forest Research Institute, U.P., Kanpur. In the present paper, certain site-specific successful afforestation techniques have been described. These techniques have been tested over years on an operational basis and need to be extended widely in the field for conservation of fast degrading land resources.

Key words: Degraded lands, afforestation techniques, salt affected areas, ravines, industrial wastelands

SIV/P-1 Environmental Impact of Leaf Cure Disease of Guar (*Cymopsis tetragonoloba* L. Taub.)

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Guar *Cyamopsis tetragonoloba* (L.) Taub. is cultivated as vegetable, fodder and green manuring crop. It is an economically important crop and its seeds flour is the commercial source of gum. The guar gum is used extensively throughout the world in food, paper and textile industries. Some sparse data is available on viruses infecting guar and two RNA viruses have been documented. Division of Field Gene Bank, National Botanical Research Institute (NBRI), Lucknow, maintains a large collection of guar genotypes. During the last couple of years, in rainy season, a disease showing curling, shortening and chlorosis of leaves with stunted growth of plants was observed in different cultivars of guar grown at the NBRI experimental plot. Attempts were made to transmit the causal virus by *Bemisia tabaci* (whitefly), geminiviruses are usually transmitted by whiteflies. Based on the symptoms the virus cause in guar and its transmission through whiteflies, it is assumed that the leaf curl disease of guar is caused by a geminivirus. This is the first report of any geminivirus infecting guar.

The casual virus remains to be identified at biological and molecular level. Once the virus is characterized, the molecular probes will help in identifying new unknown host of guar leaf curl disease, thus they will help in studying the environmental impact of guar leaf curl virus.

Key words: Guar, environmental impact, leaf curl virus, geminivirus

SIV/P-2 Water Quality in a Floating National Park (Keibul Lamjao National Park) of Manipur

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Keibul Lamjao National Park (KLNP), latitude 23º83' N to 25º85' N and longitude 93º03' E to 94º78' E is the only floating National Park in the world and is the only natural habitat for the endangered brow-antlered deer (Cervus eldi eldi), locally known as Sangai. The park is characterised by a floating mat of about 40 sq. Km. locally called as phumdi which is heterogeneous mass of soil, vegetation and organic matter in different stages of decay. Before the construction of Ithai Barrage, the floating mat experiences the annual draw down cycle. However, after Ithai Barrage construction in 1983, the phumdi has ceased its function of annual draw-down cycle leading to poor nourishment and thinning of phumdis as the nutrients are no longer procured from the sediments. In order to ascertain the nutrient quality of the habitat, the water quality of the KLNP was assessed from four sites at monthly intervals for the year 2000 to 2001. The variables analysed were Nitrogen, Phosphorous, Potassium, Calcium, Magnesium and Sodium by using standard methods.

The annual range of nutrients varied as below, nitrogen 0.01 to 0.32%, phosphorous from 0.0 to 0.006 mg l^{-1}, potassium from 0.0 to 7.0 mg l^{-1}, calcium between 4.81 - 12.21 mg l^{-1}, magnesium between 3.41-25.65 mg l^{-1} and that of Sodium 8 - 23 mg l^{-1}. The nutrient status of park water is discussed in the light of above findings.

Key words: Water quality, national park, nutrient, habitat

SIV/P-3 Wetlands of Assam

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Wetlands are important and productive ecosystems. The value of the world's wetland is increasingly receiving due attention as wetlands contribute to a healthy environment in many ways. Wetlands provide tremendous benefits to mankind by way of attenuation of floods, maintain stream flow, recharge ground water, recycle nutrients, purify water, provide drinking water, fish, fuel and fodder, offer recreation to the society, etc. In addition it also serves as a habitat for native and migratory birds and aquatic flora and fauna. However, the interaction of man with wetlands during the last few decades has been of concern largely due to the rapid population growth accompanied by intensified industrial, commercial and residential development that leads to pollution of wetlands by domestic and industrial waste and agricultural runoff such as chemical fertilizers, insecticides, pesticides etc.

Assam state of India, a truly riverine state amidst the hilly areas of the North–Eastern Region, is drained mainly by two river systems – the Brahmaputra and the Barak. In the flood plains of these rivers, a large number of natural lakes and swampy areas are found. There are 3513 wetlands in Assam, covering an area of 101,231.60 ha. Many of these wetlands are undergoing degeneration due to natural and man made activities.

In this paper an attempt is made to present an overview of the wetlands in Assam. The basic causes of degeneration and measures to conserve these wetlands are also presented.

Key words: Conservation, degeneration, ecology, mitigation of flood, water logging, wetland

SIV/P-4 Soil Sickness and Autotoxicity during Ratooning of Sugarcane in the State of Maharashtra

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Soil sickness is a loss or a strong decrease of soil fertility as a consequence of growing some agricultural plants or a monoculture of the same plant species. The most serious soil sickness is induced by sugarbeet, flax, pea, clover, alfalfa, fruit plant cultures, but in principle any cultivated plant can make soil sick.

In the state of Maharashtra which is the 'sugarbowl' of India ratooning of sugarcane is preferred by growers, but due to monoculture and autotoxicity the number of millable canes per hectare. Cane yield and CCS percentage decrease constantly as the number of ratoon increases. The stagnancy and reduction in cane yield and sugar recovery is due to soil sickness. However, this problem is not yet fully worked out even in India. The work on soil sickness has been carried out for different crops mainly in countries like Canada, California, Taiwan, Scotland, Germany, England, Italy, France, Australia, Japan etc.

In the present study soil analysis for various physico-chemical parameters and nutrient level under ratoon crops indicated drastic changes in the above parameters. Not only this but the soil microflora was also changed and various allelochemicals like phenols showed very high accumulation. The overall factors lead to autotoxicity in sugarcane ratoon, which might be the reason for decreased cane population and yield.

Key words: Autotoxicity, sugar cane, soil sickness, population, yield

SIV/P-5 Heavy Metals Estimation in Mosses Growing Around National Thermal Power Corporation (NTPC) Unchahar, Raebareli

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Thermal power plants are the major contributors of air pollution. Along with noxious gases like SO_2 and NO_x, they also release quantities of suspended particulate matter (SPM) out in the air. Among the particulate pollutants heavy metals are most important and they settle down on the surface of plants and soils. Mosses are incapable in avoiding the heavy metals uptake as they imbibe them directly from the atmosphere through the leaves due to simple organization of the tissues and absence of cuticle and also through the rhizoids from the soil surface. With this aim, an attempt was made to estimate the concentration of selected heavy metals (Cd, Cr, Fe, Pb, Ni and Zn) in mosses namely *Barbula consanguinea* (Thw. *et.* Mitt.) Jaeg., *Ceratodon stenocarpus* B.S.G. and *Physcomitrium japonicum* (Hedw.) Mitt. growing in pollution stressed environment created by the National Thermal Power Corporation (NTPC) Unchahar, RaeBareli. The soil samples of the above mentioned mosses were also estimated for the same metals to make a comparative assessment of the uptake of metals from atmosphere and soil. The results revealed higher concentrations of heavy metals in plants than in soil samples. Pb although not traceable in soil samples was detected in plants in high concentrations. All the mosses accumulated very high concentration of Fe (149-279.1 ppm). *B. consanguinea* was found to have maximum concentration of Fe (279.1 ppm), Cr (26.61 ppm) and Ni (20.14 ppm) whereas Pb (44.78 ppm) and Cd (0.56 ppm) were found maximum in *C. stenocarpus*. Zn (80.5 ppm) had maximum concentration in *P. japonicum*.

Key words: Heavy metals, mosses, NTPC Unchahar

SIV/P-6 Study on Production of a Wetland, Dominated by *Scirpus littoralis* both in Natural and Experimental Condition

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This study is on the estimation of production of a wetland species, *Scirpus littoralis* in a sub-tropical ecosystem, growing in the flood plain of Yamuna river **(**naturally) as well as in experimental conditions. The effects on variation, in the production, are studied under different water and nutrient levels that are - three water levels (10, 25, 52 cm) and two nutrient conditions, i.e., low and high organic amended soil.

In a natural wetland dominated by *S. littoralis,* three zones were identified in the area near Bhalsawa Lake, New Delhi which differed in their hydroperiods. Zone A is an area, which was identified at the outermost fringe of the wetland and had the lowest hydroperiod. The intermediate zone B had a relatively longer hydroperiod than zone A and the innermost zone C had the maximum hydroperiod.

In the present study, maximum total biomass was recorded in zone A. Three peaks of total biomass in all the three zones were observed during the entire study period. The average peak (g m^{-2}) of *S. littoralis*, in zone A was 3384.8 during January 2002, 2116.1 in zone B during January 2002 and 1287.1 in zone C during May 2001. Other species such as *Cyperus* sp. was found to grow abundantly in zone A. The species density in zone A and B was also observed to be highest during the month of March and April.

An attempt was also made to study experimentally the total production of *S. littoralis* under interaction of two factors i.e. water level and substrate organic content. The total production declined with increase in water depth in plants grown on both types of soil. No significant difference was observed between the total production from plants grown on soil with low and high organic content. Density of *S. littoralis* shoots decreased with an increase in the water level along with increase in shoot length of the plant.

Overall, it was observed that production from the natural wetland site was higher compared to peak biomass of *S. littoralis* grown under experimental conditions for four months.

Key words : *Scirpus littorali,* wetlands, production, water level, organic amended soil

SIV/P-7 Bio-Aesthetic Planning and Greenbelt : Effective Tools for Bioremediation

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Environmental pollution is a global problem and a growing concern for all. Considering present scenario, the importance of planting trees, either in bio-aesthetic planning or as a greenbelt, has increased in manifold. Bioremediation by planting trees-plants is considered as most sustainable method, having long lasting impact on amelioration of environment. Earlier, the sole purpose of bio-aesthetic planning was beautification and ornamental trees were planted considering only aesthetic importance. However, the incessant increase of pollution has necessitated reconsidering the whole approach of bio-aesthetic planning. Little reorientation in the approach and proper planning by incorporating pollution tolerant ornamental trees will greatly help in attenuating environmental pollution particularly in urban and industrial areas. Performance of the ornamental trees has been adjudged on site and symptoms of pollution exposure studied. A comprehensive list of ornamental trees has been drawn up on that basis. These can safely be recommended to the civic bodies in urban and industrial areas for using in bio-aesthetic planning.

Greenbelt, a systematic mass plantation of trees (evergreen and deciduous) in any vacant place for the purpose of minimizing air pollution by filtering, intercepting and absorbing pollutants, is a very good tool for bioremediation of environmental pollution. Designing greenbelt is a specialized task as many factors like source of pollution, type of pollutants, intensity of pollution, agro-climatic factors and finally selection of trees are involved. Three tier system of plantation keeping dwarf trees in the front rows followed by medium and tall, leaves no way for polluted air to pass through without interception of pollutants. Therefore, little manoeuvre of the bio-aesthetic planning and greenbelt may act as effective tools for bioremediation.

Key words: Bio-aesthetic, greenbelt, trees, bioremediation, environment.

SIV/P-8 Suspended Matter and Particulate Zinc Speciation in the Nozha Hydrodrome, An Artificial Lake Feeding with Contaminated Nile Water

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The Hydrodrome, covering area of 5.04 km^2 and average depth of 2.11 m, is fed by contaminated Nile water and used as fish and duck farms, which possibly affect human health. Surface water samples were collected monthly from the lake for investigating the distribution of particulate zinc (PZn) species and suspended matter (SM), as the latter is essential for interpretation of the metal speciation.

The regional distribution of SM was limited. The feeding canal was not the main source of SM, as shown from the minimum SM average value near its discharges. Differences in composition of SM in locality and season indicate its different sources; bioorganic, hydrogenise and allochthonous. The peaks of SM in spring and summer confirm its bioorganic origin from the flourishing plant life in those seasons.

A five-step sequential extraction scheme was applied to the SM to illustrate the contribution shared by each individual species in the total zinc concentration of the SM. By studying the distribution of metal different species, its risk can be ascertained, as more mobile (more dangerous) species introduced by man's activities are adsorptive, bound to carbonate and bound to reducible form.

As expected, the exchangeable fraction (Fl) was the least among the other zinc species, giving a poor negative correlation with pH and a significant positive correlation with chlorosity. The Fl percentage did not pass 15% of the PZn. The bound to carbonate fraction (F2) showed a high significant correlation with the organic matter/sulfide fraction (F4), indicating that the metal carbonate had two origins; organic and inorganic. The peak of F2 in April could be attributed to spring blooms of the plant life, which consumed most of the carbon dioxide facilitating carbonate precipitation. The high dissolved oxygen and chlorosity affected the release of F2, as confirmed from its correlation with these variables. The highest monthly average value of Fe/Mn oxides fraction (F3) in February and June resulted from its highest amounts in the feeding canal in those months. The part shared by F3 in building up the PZn was monitored via its positive correlation with PZn. The correlation coefficient, similar to F2, indicates more contribution of F3 in building up the PZn in the lake. F4 was the second smallest fraction in the open locations in the lake, where the water was well oxygenated from the effective prevailing winds facilitating the oxidation of organic matter. The dominance of the residual fraction (F5) in the feeding canal water, except in February, April, May and June, explains the abundance of this inert fraction in the lake water, except in those months. Similar to F4, a significant negative correlation existed between F5 and SM.

Key words: Nile water, suspended matter, zinc species, pollution

SIV/P-9 Evaluation of Toxic Components of Ash Pond to Ground Water by Toxicity Characteristics Leaching Procedure

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In many countries throughout the world, fly and bottom ashes originating from coal-fired thermal power plants are declared as wastes requiring special care during reuse and disposal. In this regard, a number of toxicity tests have been developed to assess the metal leaching potential of ash residues. This study paper deals with the leaching of trace elements present in fly ash due to ash water interaction at ash ponds. The release of contaminations from ash and their subsequent influence on ground water quality is governed by several factors including quality of coal, source of water, pH, time, release mechanisms etc. A connectivity has to be established between the seepage water and ground water for the pollutants to reach the ground water. Trace elements present on the surface of ash particles are in constant contact with water, resulting in an enhanced leaching of toxic metals and eventual contamination of ground water.

A study has been carried out at fly ash disposal site of a coal based thermal power plant of Singrauli area in Uttar Pradesh, India to monitor the ground water quality in order to determine the potential impact of ash ponds. By Toxicity Characteristics Leaching Procedure (TCLP) it has been found that ground water quality is deteriorated due to presence of some trace elements. The effect of different parameters like pH, leaching time, temperature, bulk density etc. in leaching of trace elements from fly ash to ground water will be discussed.

Key words: Ground water, ash pond, trace elements, toxicity characteristics, leaching procedure

SIV/P-10 Revegetation of Overburden Dumps : A Case Study

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The present study deals with the dump slope stabilization through revegetation of coal mine overburden dump in Dhanbad Coalfield in India with a broad objective to minimise the impact on the landscape, maximize plant productivity and long term protection of the environment. The study was performed in the Mugma area of Mandaman collieries of the Eastern Coalfield Limited with selected plant species, viz. *Dalbergia sisoo* (Shisham), *Azadirachta indica* (Neem), *Albizia procera* (Siris), *Delonix regia* (Gulmohar), *Acacia nilotica*, *Acacia auriculiformis*, *Leucena leucocephala* (Subabool), *Samnea saman* (Rain tree), *Ficus religiosa* (Pipal), *Lagerstoemia parviflora,* etc. The results obtained after five years revealed that the growth performance in terms of diameter was highest for Rain tree, being 36.33 cm followed by Shisham (33 cm), *A. auriculiformis* (22.25 cm) and Gulmohar (21.66 cm). After ten years, Subabool exhibited highest diameter (127 cm) followed by Pipal (95 cm), Rain tree (83 cm), Shisham (76 cm) and *A. auriculiformis* (70 cm). Therefore, among the selected tree species, Rain tree, Shisham and Subabool were observed to be the fastest growing species after ten years of the revegetation programme. However, Neem, Babool, Gulmohar and *Lagerstoemia* are the other most-suited tree species for the plantation on mine spoils.

Thus, revegetation of mine-out areas is a way to solve the twin problems of waste land restoration and checking environmental pollution. The results of these studies will help in selecting the appropriate plant species for the bioreclamation of huge overburden dumps with similar conditions.

Key words: Coal mine, overburden dump, mine spoils, bioreclamation, revegetation

SIV/P-11 Screening of Potential Tree and Shrub Species for Their Tolerance in Contaminated Industrial Waste Land

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Phytoremediation is an emerging cost-effective, non-intrusive, esthetically pleasing, and low cost technology using the remarkable ability of plants to concentrate metals from the soil into the harvestable parts of roots and above ground shoot, which is usually called phytoextraction. In this paper different tree and shrub species have been screened for their tolerance in the industrial site. These plants belong to different families, majority of them are fuel wood species viz., *Acacia. auriculiformis, Acacia nilotica, Albizzia lebbeck, Albizzia procera, Dalbergia sissoo, Leucaena leucocephala, Prosopis juliflora, Sesbania gradiflora, Jatropha curcas* and *Terminalia arjuna.* These plants were grown in nursery medium (control), 100% flyash and fly ash amended with soil and mycorrhiza. Various parameters were studied with respect to plant survival, growth performance (shoot height and diameter), biomass production and elemental composition in different plant parts and remaining pot medium. The result revealed that amending fly ash with soil and mycorrhiza enhances plant growth as well as increased heavy metal absorption. Significant linear correlations were found between plant and soil metal concentrations. Patterns of metal distribution in plant parts varied with different tree species and metals.

Key word: Phytoremediation, fly ash, tree species, mycorrhiza, metal accumulator

SIV/P-12 Waste Minimization Techniques of Environmental Auditing: Emergence of a New Concept

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Since the beginning of environmental conservation and sustainable development movement, both government regulatory agencies and the industries have now focussed their environmental protection efforts on controlling the pollution by abatement and prevention techniques. The method, called Waste Minimization originally, and more recently pollution prevention, now pervades in environmental programmes used to protect air, water, land and other natural resources. Environmental Auditing is a tool to practice Waste Minimization. It is the first step in management hierarchy that emphasizes on reduction of waste at source, reuse and recycling of generated waste.

Waste minimization can be done by environmental auditing of industrial processes with respect to optimal use (and reuse) of resources, improved inventory management, more optimum process operation, substitution of raw materials, recycling of waste products, etc. For processes, waste minimization involves conserving raw materials and energy, eliminating the use of toxic substances as much as possible, reducing quantity and toxicity of emissions and wastes which would have entered a waste stream or emission. For products, it means reducing their environmental impacts and less waste to be produced during its entire life cycle from raw material extraction till ultimate disposal.

Waste Minimization is, thus, an integrated approach and not an “add on” as in the waste treatment approach. By using this preventive approach of waste minimization, the costs of waste treatment systems can get substantially reduced and the overall resource utilization factor improves, leading to improved profitability and competitive ad-

vantages.

Key words: Waste minimization, environmental auditing, industrial processes, management, reuse and recycling

SIV/P-13 Role of Organic Detritus in Reclamation of Sodic Soils

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Sodic wastelands of Gangetic alluvial plains are being developed under agriculture and forest ecosystems. Chemical (Gypsum) treatment of soil followed by cultivation, although reclaims the soils successively in due course of time, but it could not built-up sufficient organic matter in the soil. As a consequence, problems of resodification are often noticed particularly when the cultivation is dropped for few years. Afforestation on such soils makes the stable changes towards the reclamation process, in which role of organic detritus contributes mainly in soil amelioration. Dynamics of the two main components of organic detritus i.e. litter and fine roots, were evaluated in this study along with their impact on soil reclamation. Annual contribution of litter was about 8.5 Mg ha^{-1} whereas accumulated litter mass on the forest floor was measured as 12 Mg ha^{-1} in a 40-yr-old rehabilitated forest on sodic wasteland. Fine root biomass was estimated as 5.33 Mg ha^{-1} with the fine root production of 2.33 Mg ha^{-1} yr ha^{-1}. Litter and fine roots decomposed to 76 and 72% of their initial weight in a year. Such pools and fluxes have altered the once sodic soil to significant extent. Various soil properties changed to different degrees, but on comparison to their reference sites, it could not offset the degraded conditions completely even in 40 years. Microbial biomass carbon in forested soil (340 µg g^{-1}) was four times greater than barren sodic soil (89 µg g^{-1}) to a depth of 15 cm, and it was nearly half to that of reference site. As a result of increase in soil organic matter (7 times) and biological activity, soil pH reduced to 8.6 from 10.4 of an adjacent barren land. Bulk density decreased in forested soil and water holding capacity increased by 15% of the barren soil. There was a significant reduction in exchangeable sodium percent ESPP (7 times), whereas exchangeable Ca and K increased in forested soil. Total, available and mineralized N increased 3-6 times in forested soil in comparison to barren soil, whereas available P did not show any significant change between the forested and barren soils. Seasonal and depth wise variations in soil properties were also monitored. If C and N are considered as the reclamation indices to examine the status of the restoration of degraded lands, the surface 15 cm of soil depth, in the present forest, has almost approached the status of the natural dry tropical forests found in this region. However, soil organic matter in lower depth below 30 cm was relatively less indicating that in-depth reclamation is a slow process.

Key words: Sodic soil, organic detritus, microbial biomass carbon, nitrogen mineralization, reclamation

SIV/P-14 Bioreclamation of Saline Soil under *Salicornia brachiata* Roxb., A Halophyte

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The coastal land in India remains barren and uncultivable because of bad soil affected by sodium chloride. Efforts have been made by scientists to reclaim the saline soil through several means and render it suitable for cultivation of crop plants. The objective of the present study was to examine the exogenous addition of NaCl ranging from 100 to 1000 mM in *Salicornia brachiata* during the early stages of the development of the seedlings. The upper limit was 700 mM NaCl for the survival of this species and the favourable growth response was observed 400 mM NaCl. The accumulation of proline and quaternary ammonium compound glycinebetaine increased significantly upto the extreme salinity of 700 mM. The two compounds are suggested to function as compatible solutes and to act as intercellular osmoticum. The pH and EC of the soil (before and after salt treated) were observed at various time intervals.

Sodium chloride salinity stimulated the chlorophyll and carotenoid contents and they were increased upto 400 mM NaCl concentration. The net photosynthesis increased with increasing salinity upto the optimal level and the CO_2 uptake rate was identical in this species at various salt concentrations. Even at the extreme salinity, the CO_2 uptake was comparable to that of non-saline control plants and CO_2 uptake could be correlated with the chlorophyll content. The photochemical activities such as PSI, PSII and WCET of the isolated cells increased upto the optimal salinity of 400 mM. The results of the chlorophyll '*a*' fluorescence kinetics provided with additional proof to the findings of CO_2 exchange rate and photochemical activities.

Enzyme such as catalase, peroxidase, polyphenoloxidase and amylases exhibited enhanced activity upto the optimal level of 400 mM beyond this level, these activities were inhibited. ATPase and NRase activity also steadily increased with increasing NaCl concentration upto the extreme level of 700 mM, and these two enzymes might play a role in the salt tolerance. So, it is concluded that this species could be recommended for cultivation in salt affected soils to reduce the soil salinity level and the redamated soil can be utilized for cultivation of crop.

Key words: *Salicornia brachiata*, salinity, saline soil

SESSION-V

ENVIRONMENTAL BIOTECHNOLOGY

SV/L-1 Biochemical and Molecular Basis for Plant Response to Ozone : A Role for Ascorbate

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Ozone (O_3) exposure causes a variety of foliar symptoms on plants that are manifested as necrotic lesions, red/purple/brown stippling, chlorosis and development of early fall coloration. Ozone can also accelerate leaf senescence, impair photosynthesis and reduce plant growth and yield. The biochemical and molecular mechanisms responsible for localized tissue death have been extensively studied and are most similar to the hypersensitive response of foliar cells elicited by pathogen attack. In this process, an oxidative burst is initiated resulting in the production of reactive oxygen species (ROS) that kill cells. Cell death is propagated and eventually terminated through a complex of hormonal interactions and signaling pathways.

The biochemical basis for symptom development that does not result in necrosis is less well understood. Foliar application of ascorbate (AsA, vitamin C) has long been know as an O_3 protectant. The biosynthesis of AsA in plants, however, has only recently been characterized and consists of a complex network with mannose, *myo*-inositol and glacturonate as principle entry points into the pathways. Through genetic manipulation, numerous mutants now exist that contain either reduced or elevated levels of foliar AsA. Low AsA results in O_3 sensitivity whereas high AsA produces O_3 tolerance in the few plant species that have been examined. A new gene, *VCF*1, appears to developmentally control foliar AsA levels resulting in O_3 tolerance in young leaves and progressive sensitivity as a leaf ages. Genetic enhancement of AsA levels may produce plants that are more resistant to oxidative stress and more nutritious for human consumption.

Key words: Ozone, plant response, foliar cell, ascorbate, oxidative stress

SV/L-2 Carbon Concentration Mechanism(s) in Plants and Algae : Biotechnology for Improved Photosynthesis

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Carbon concentration mechanism in algae plays an important role in controlling levels of carbon dioxide and oxygen, primary productivity of aquatic bodies thus contributing to the aquatic ecosystems. An unsolved problem in photosynthesis is how plants and algae concentrate dissolved inorganic carbon (DIC) into the cells and chloroplasts. Algae contribute to more than 70% of global photosynthesis, but some of the components of the dissolved inorganic carbon concentrating mechanism (DIC-pump) have not been characterized. A general working model for the dissolved inorganic carbon concentrating mechanism in unicellular green algae includes isoforms of carbonic anhydrase (CA), membrane associated active transporter(s) and P-type ATPase (both in the plasmalemma and the inner chloroplast envelope). Isoforms of CA have been well characterized, but the components of active DIC transporters are not. A novel approach for identifying and characterizing inducible membrane inorganic carbon transporters and feasibility of transferring these components to C_3 plants of economic importance will be presented. A genetically engineered active inorganic carbon transport system may reduce photorespiration, an energetically wasteful process in plants, thus yielding higher plant productivity.

Key words: Carbon concentration mechanism, green algae, photosynthesis, primary productivity

SV/L-3 Insect Resistant Transgenic Plants: A Major Contribution of Plant Biotechnology to Pollution Abatement

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Genetic engineering is poised to offer some of the most powerful approaches to develop novel life forms aimed at keeping the environment cleaner and sustainable. Plant biotechnology has already given an outstanding example in this direction in global commercialization of insect resistant transgenic crop plants – the Bt-cotton, maize and soybean. This has reduced the use of chemical pesticides to a large extent.

In India, pesticides worth Rs. 10 billion are used on cotton crop alone, which is more than half of the total pesticide usage in the country. The development of transgenic cotton and paddy for resistance to insect pests is a major need in responsible applications of recombinant DNA techniques and transgenic crops in the country. Some of the areas full of inventive opportunities are: need to discover new genes targeted against locally relevant insect pests, pyramiding genes to guard against the evolution of resistance in insects, economical evaluation of biosafety and environmental risks following the release of the pesticidal proteins and transgenic crops, designing proteins against specific pests, expressing the pesticidal proteins specifically at the site of infestation by insect pests etc. Several of these issues have been innovatively pursued at NBRI for the development of transgenic cotton, pigeon pea, chickpea, castor, groundnut and tomato, jointly with laboratories at other institutes in India. A variety of novel genes and promoters have been designed to develop transgenic lines for resistance to locally prevalent insect pests. Some of our researches in this area will be discussed. The possibilities in discovering new genes and organisms and engineering those for the abatement of pollution through agricultural chemicals are endless.

Key words: Transgenic plants, insect resistant, plant biotechnology

SV/O-1 Variability of Kenaf (*Hibiscus cannabinus* L.) Treated by Ethyl Methanesulfonate (EMS) base on RAPDs

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Fibre-source-plant kenaf (*Hibiscus cannabinus* L.) var. KR11 that was treated by a chemical mutagen ethyl methanesulfonate (EMS) has given rise to some new phenotypic character i.e non branching to profusely branching plants. In this research RAPD analysis was employed to determine the relative distance of the branching phenotypes to the initial line. A profusely branching M2 plant was grown to seek the mode of inheritance of the branching phenotype.

The fenogram base on RAPDs was built using Clad97 program, showing that the M1 plants with a high number of branches have a low similarity coefficient (0.46) compared to the initial line whereas the M1 plants with medium number of branches had small similarity coefficient values, ranging from 0.59 to 0.70. M1 plants with small number of branches locate close to the initial line KR11, with similarity cofficient ranging from 0.73 to 0.89. These suggest that RAPDs is capable to differentiate the branching plants from non branching plants. The M2 plant of the most-profuse-branching-M1 plant segregate many types of branching plants ranging from very small number to high number of branches, but none of them exactly resemble the M1 plant. It is suggested that the branching habit of kenaf may be controlled by many genes (polygene).

Key words: Variability, kenaf, EMS, branching, RAPDs

SV/O-2 Effects of Environmental Factors on Transplant Survival Rate of Grape Vessel Plant

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The transplant technique of the young plantlet of grape 'Red Globe' *in vitro* was investigated in two different regions of China, Northern Xingjing, and Lanzhou, Gansu, which differ in climate and soil types. The main factor affecting transplant survival rate and its applications for high-efficiency transplant of grape vessel were proposed.

Key words: Environmental factors, grape, micropropagation, transplant survival rate

SV/O-3 The Utilization of *in vitro* Selection Technique for Enhancing Salinity Tolerance in Wheat

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Salinity is an environmental stress which seriously affects plant growth and productivity, especially in arid and semiarid climate regions. To solve this worldwide problem, scientists have made great efforts to produce new varieties with enhanced tolerance to salinity. One of the plant biotechnical approaches, i.e. *in vitro* mutant selection, offers a feasibility for developing salt tolerant variant of crop species. Wheat is an important crop in the world. In our experiment, a salt-tolerant cell line of wheat (*Triticum aestivum* L. Baofeng 7228r) was screened from immature embryo-derived callus cultures on the MS medium containing NaCl. A few number of colonies which were tolerant to 1.2% NaCl were obtained through multistep selection procedures. The resistant colonies had proliferated for several passages on the NaCl-containing medium and formed calluses. The resistant calluses were induced to regenerate plantlets on the MS medium added with 0.8% NaCl and appropriate plant growth regulators. On the MS medium added with same concentrations of NaCl, both variant calluses and their regenerated plants showed higher relative growth rates, accumulated higher content of free proline, exhibited higher K+/Na+ rate and a relative high level of superoxide dismutase (SOD) activity as compared to the control's (non-selected calli and their regenerated plants). SDS-PAGE patterns of soluble proteins in the salt-tolerant variant were quite different from that in the control's. In the variant, some new bands of soluble proteins appeared, and some bands became stronger, but the other's weaken or even disappeared. When cultured in the medium added with same concentration of polyethyleneglycol (PEG 6000), the tolerant variant calluses expressed higher resistance to PEG (water stress) than the control cell line. The regenerated plants were transplanted into soil to set seeds. When the progeny seeds of salt-resistant variant were cultivated in the saline soils containing about 0.7% salinity, the plants grew normally, and expressed stable adaptability. The SDS-PAGE patterns of gliadin in the seeds of progeny of salt-tolerant variant were quite different from that in the control's. The characteristics of free proline accumulation still existed which is proposed as one of the physiological markers for the osmotic components of salinity stress. RAPD analysis revealed the diversity of genome DNA in the progeny seedlings of the salt-tolerant variant and the control seedlings.

Key words: Wheat, *In vitro* selection, salt stress, salt-tolerant variant, characterization

SV/O-4 Effect of Transgenic Plants on Soil Biodiversity and Processes

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Transgenic crops are products of agriculture biotechnology. These transgenic crops will play important role in future for world agriculture, when we will need more from lesser resources to feed the increasing population. Transgenic crops have potential to resist biotic, abiotic stresses, to use marginalized land (saline land) and to increase yield along with being a source of better nutritional quality. Several studies have reported economic as well as ecological benefits of transgenic crops such as increase in yield, phytoremediation, soil conservation and reduced environmental impacts from pesticides. Because of these benefits, during the last eight years (1996 – 2004) the total area cultivated by GM crops, in 22 developed and developing countries around the world, increased by more than 47 fold, from 1.7 million hectares in 1996 to 81 million hectares in 2004, reaching a cumulative total of around 385 million hectares (almost 600 million acres).

Beside benefits of transgenic crops, several studies also reported ecological risks associated with transgenics such as risk of invasiveness, gene flow, evolution of super weeds, the development of resistance in the target pests and threat to selected beneficial insects and pests etc. Most of these risk assessment studies on transgenic plants have reported their impact on aboveground environment and its biota. However, only very few reports are available on the impacts of transgenic plants or their products (that they release in soil) on soil biota (both invertebrates and microorganisms) and processes. Though both in vitro and *in situ* studies have shown that transgenic plants are releasing products through root exudates, as well as from their biomass, which adsorbs and bind rapidly on surface active soil particles (clay and humic substances) and remain active for a significant duration. If production and release of these transgene products from transgenic plants through different routes in soil exceed to its consumption (through various processes such as ingestion by earthworm and insect larvae, degradation by the microbiota etc), it may lead to their accumulation, and may acutely or chronically affect the soil biodiversity and various ecological services mediated by soil biodiversity in soil ecosystem. As soil biodiversity play an important role in mineralization and immobilization of nutrients, physical and biochemical degradation of organic matter, biological control of plant pests, and as food sources for other organisms, it is crucial to evaluate the potential impacts of transgenic plants on soil ecosystems.

Key words: Transgenic, genetically modified, transgene, ecosystem

SV/O-5 RT-PCR Studies of Metallothionein 3-Like Protein Reveals mRNA Level Expression in Sorghum Seedlings under Hexavalent Chromium Stress

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RT-PCR has been evaluated as an alternative to Northern blot analysis in quantifying levels of MT mRNA. It has been reported that sensitivities of both techniques were similar in detecting induced levels of MT mRNA. This suggests that RT-PCR may provide a sensitive and quantitative method to evaluate MT gene expression. Many MT genes are expressed at high levels in plant tissues, at least in terms of transcript abundance. The *MT3* gene expression in roots after imposition of 100 ìM Cr(VI) for 5 days in 15-day-old seedlings of two sorghum cultivars,

viz. K 10 and CO 27 (susceptible and tolerant respectively, based on earlier studies on growth and antioxidant response to Cr(VI)) was studied by enzymatic amplification of DNA by polymerase chain reaction (RT–PCR). Along with the plant samples, the cDNA of *Arabidopsis thaliana* MT3-like protein gene inserted in plasmid vector pZL1 was also run as an external control. Gene-specific primers were designed for *A. thaliana* MT3-like protein on the basis of the cDNA sequence of the gene obtained. The products were analysed by electrophoresis in agarose gel by choosing the gel matrix for 320 size of the amplification product. RT-PCR products were seen in all the samples, which suggests that RNA expression of this gene is present in sorghum. From the results obtained it was seen that sorghum cultivar CO 27 treated with Cr(VI) had high-intensity band matching that of the gene of interest. This suggests that there could be higher transcription rates of the MT under Cr stress, particularly in the tolerant variety. It is possible that reactive oxygen species and H_2O_2 produced under Cr stress acted as a signal to induce MT mRNA transcription. Phytochelatin functions in the regulation of essential metals and in the detoxification of most toxic metals. The distinct absence of phytochelatin has been reported in plants under Cr(VI) stress. This suggests that there could be an enhanced role for MTs in plants under Cr stress. There is a possibility that MTs could confer tolerance to plants against metal stress by binding Cr ions and rendering them non-toxic. A clear role for MTs is yet to be established, although they certainly are thought to play a role in metal metabolism. MTs may function as antioxidants and a role in plasma membrane repair is another possibility. Although MTs are expressed ubiquitously and conserved in plants, determining their function remains a future challenge.

Key words: Chromium, metallothionein, sorghum, RT-PCR, oxidative stress

SV/O-6 Slow Release Fertilizers : An Eco-friendly Approach to Reduce Nutrient Losses and Enhance Plant Productivity

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Slow (controlled) release fertilizers, are new generation eco-friendly plant nutrients, which minimize losses of nutrients like NO_3^-, PO_4^- etc. in the environment on one hand, and enhance plant productivity and the quality of yields by sustained availability of the nutrients on the other hand. We have developed organic matrix based, cost effective, eco-friendly slow release fertilizers which give a very encouraging performance in wheat, rice, mungbean, Indian mustard, sesame spinach, garlic etc. These fertilizers release the nutrients especially nitrogen in form of NH_4^+ up to 45 days after application. Attempts are in process to make it cost effective and for the large scale trials in fields under non-stressed and stressed agro-climatic conditions.

Key words: Ammonium, eco-friendly, Indian mustard, garlic, mungbean, rice, slow release fertilizers

SV/O-7 Enhanced Production of Glucose Oxidase through Mutagenesis of *Aspergillus niger* by UV Rays

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Glucose oxidase is the chief enzyme used in clinical diagnosis of glucose in body fluids. UV rays were used to induce mutagenesis in the wild type strain of *Aspergillus niger* for hyper production of glucose oxidase. *Aspergillus niger* mutant strains resistant to 2-deoxy D-glucose were obtained which showed 16 fold increase in enzyme activity as compared to parent type. Glucose oxidase was then purified by ammonium sulfate precipitation, ion exchange and gel filtration chromatographic techniques and it achieved 285 fold purification. Purified enzyme was subjected to various kinetic and thermodynamic parameters. It was found that K_m, V_{max}, K_{cat} and T_m were 25 mM, 125 m ml^{-1}, 3676.47, and 55 ^{0}C respectively. Half life, enthalpy, entropy, Gibb's Free energy parameters were also observed to seek the nature of the enzyme.

Key words: Glucose oxidase, UV, mutagenesis, *Aspergillus niger,* production

SV/O-8 Management of Postharvest Diseases Through Eco-friendly Yeasts

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Development of resistance of pathogens to fungicides, and public demand to reduce synthetic chemicals use has provided the impetus to develop alternative and effective natural methods of controlling postharvest diseases. Non-antibiotic producing microorganisms were found to be viable option against *Penicillium expansum* the causal agent of blue mold on apples. *Debaryomyces* sp. was very effective against *Botrytis cinerea* and *P. expansum*. Complete control at three tested concentrations (2×10^7, 8×10^8 and 1×10^9 CFU ml^{-1}) was obtained on wounded apples inoculated with 10^3 conidia ml^{-1} of *P. expansum*. *Debaryomyces* reduced *B. cinerea* decay by more than 80% at the above-mentioned three concentrations. Equal control was obtained with the bioagent at 8×10^7 CFU ml^{-1} as with fungicide imazalil at commercial doses against both the pathogens.

Key words: Bioagents, eco-friendly, pathogens

SV/P-1 *In vitro* Multiplication of *Salacia beddomei* Gamble - An Endemic, Rare, Woody Climber from Stem Explants

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Biodiversity is not an entity, but a property, a characteristic of nature. This enormous diversity is disappearing at an alarming and accelerating rate. The habitat loss and fragmentation, over-exploitation of plants, animals, pollution and Global climatic changes contribute much to the loss of biodiversity. The number and size of relatively undisturbed ecosystem in the world have shrunk dramatically as global population and resource consumption increases enormously. Pollutants put pressure on ecosystem and may reduce to eliminate population of sensitive species.

India is one of the twelve mega-Biodiversity nations of the world. Among the 23 mega-hotspots of the world, the Western Ghats and Himalayas deserve special mention. Western Ghats harbors a large number of rare, endangered and endemic species. Endemics are plants which have a special mention in the native systems of medicine. With vast variations in geography, climate and vegetation, India harbors a rich flora, with fairly high degree of endemism. Among the 17,000 flowering species of India, 5,725 are broadly considered as endemics, representing 33.5% of the flora. Endemics are plants which need priority in conservation efforts, as these are in small isolated populations under the risk of extinction. Recognition of the world's shrinking biological heritage has prompted numerous reactions both at international and national levels as well as within local communities. Based on the principle of totipotency, these valuable economically important plants can be propagated using tissue culture.

Salacia beddomei Gamble is one such important medicinal plant which is endemic to Western Ghats. The plant is rare and restricted in distribution to rocky areas. In the present study, an efficient protocol for large-scale multiplication of this rare, woody medicinal plant from stem explants. Induction of multiple shoots was achieved directly from cultured stem explants. The highest regeneration rate was obtained on half strength MS medium supplemented with BAP (1 mg l^{-1}) and IAA (1.5 mg l^{-1}). Successful rooting of the microshoots was obtained following a two step procedure. A pretreatment with IBA (10 mg l^{-1}) and NAA (10 mg l^{-1}) and an initial incubation in dark for about 72 hours was essential for initiation of roots. The roots elongated only when transferred to hormone free half strength MS medium. The plants regenerated from stem explants were morphologically normal.

Key words: Endemics, *Salacia beddomei*, propagation, medicinal plant

SV/P-2 Horizontal Transfer of Multiple Drug Resistant Plasmid among Enteric Bacteria Isolated from the Runoff of the Gangotri Glacier, Western Himalaya, India

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Gangotri glacier is situated in the Uttaranchal, India between 30°56' N and 79°15'E. The Gangotri glacier is around 30 km in length covering an area of 143 km^2, flowing north-west. It is the largest valley type glacier. Glacier store enormous water wealth, but with increasing anthropogenic activities around glacier area, deterioration of glacier run off is expected. The incidence of antibiotic resistant bacteria in aquatic environments has increased world wide as a consequence of the widespread use of antibiotics. This increase has resulted from a variety of factors, perhaps the most important of which is the selection for resistant strains and the ability of such strains to exchange plasmids encoding resistance. Plasmids are frequently conjugative important agents of horizontal gene transfer and often encoding antibiotic resistance, pathogenecity, virulence determinants and ecologically important factors. The aim of this work is to assess R-plasmid presence and their transfer in enterobacterial species of different sites and altitudes of runoff of the Gangotri glacier. Sixty four coliforms and 64 faecal coliforms were isolated from different sites of Gangotri glacier and their plasmid characterization and resistance pattern were studied and discussed in the paper.

Kew words: Gangotri glacier, plasmid, bacteria

SV/P-3 Rapid *In vitro* Clonal Propagation of *Lavendula officinalis* Chaix: A Multipurpose Plant of Industrial Importance

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An efficient regeneration protocol has been developed for rapid and mass scale clonal propagation of *Lavendula officinalis* from shoot tip explants. For the induction of multiple shoot formation, the explants were cultured on Murashige and Skoog's (MS) basal medium supplemented with different concentrations of cytokinins viz; BAP (0.5-2.0 mgl^{-1}), Kn (0.5-2.0 mgl^{-1}) and on different cytokinin plus auxin combinations viz; BAP (1.0-2.0 mgl^{-1} + IAA (0.5-1.0 mgl^{-1}) and Kn (1.0-2.0 mgl^{-1}) + IAA(0.5-1.0 mgl^{-1}). These shoot tips produced multiple shoots, with the best result in BAP (2.0 mgl^{-1}) whereby (45±6.40) shoots were produced/explant in 80% cultures in 4 weeks time. The regenerated shoots were subcultured on the best induction medium (BAP 2.0 mgl^{-1}) after every 4 weeks so as to increase their number. These shoots rooted best in half strength MS basal medium fortified with IBA (1.0 mgl^{-1}) with 7-18 roots per shoot (Avg.16±6.89) roots in 80% cultures in 4 weeks time. Rooted plantlets were shifted to the plastic pots containing mixture of sand: clay: vermiculite (1:1:1) and kept for two weeks under controlled conditions of temperature (25±2°C) and relative humidity 60%. Afterwards these plantlets were hardened in green house environment (Vista Biocell Limited) for one month and finally shifted to field conditions were 70% plants survived.

Key words: *Lavendula officinalis*, aromatic, clonal, shoot tips, organogenesis, *in vitro*

SV/P-4 Significance of Bacteriophage Sensitivity in Rhizosphere Ecology of Growth Promoting Bacteria of *Dichanthium annulatum* (Willem.)

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Biotic stresses present in the soil have been suggested as important driving force for selection and evolution of bacterial population in the rhizosphere. Bacteriophages present in the soils have been recognized as one of the important biotic stresses, which determine the population size; structure and function of inoculated strains and thereby affect the efficacies of inoculation technology. Development of range of rhizobacterial mutant differing in phage sensitivities and evolution of their functional properties is a prerequisite to understand the bacterial community dynamics in rhizosphere. Such studies will help in development of predictable ecological model for inoculation technologies in ecological restoration programmes. Therefore, a plant growth promoting rhizobacterial strain of *Dichanthium annulatum* was selected and phages were isolated using broth enrichment method. Plaque assay was carried out using double agar overlay method and bacterial mutant developed on the plaque region were selected. Morphological and cultural properties of wild type strains and their mutants were recorded. Both the groups of bacterial isolates were studied for their differences in their selected plant growth promoting traits (such as phosphate solubilization, siderophore production, IAA production etc.) using chemical and biological assays. Sensitivities to plaque isolates was also evaluated in terms of differences in plaque type, time taken for appearance of plaque, number of plaque developed etc. The results obtained were also correlated with phage sensitivities pattern of bacterial isolates. It is suggested that soil-born rhizobacteria serve as one of the important biotic stresses, which not only contribute in generation of bacterial diversity but also lead to development 'biased rhizosphere' characterized by specific composition of rhizobacteria. Therefore, bacteriophages are considered as an important component of microbial ecology in rhizosphere.

Key words: *Dichanthium annulatum*, rhizobacteria, functional type, mutants, bacteriophage sensitivity, rhizosphere ecology

SV/P-5 Ethylmethane Sulphonate Induced Tall Mutants in Jute (*Corchorus olitorius* L.)

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Presoaked seeds of jute (*Corchorus olitorius* L. var. JRO-632) were treated with 1% Ethylmethane Sulphonate (EMS) for 6 hours. Tall mutants were screened in M_3 in contrast to the normal looking flowering plants. A number of yield component parameters were recorded including plant height, basal diameter, plant spread, root length, pod per plant, seeds per pod, pod length/breadth ratio, number of primary branches, number of secondary branches, leaf angle, branching angle, first flowering date, 100% flowering date, total duration, % of pollen

sterility, and weight of 100 seedss which were found to vary from the control plant. Chromosome analysis revealed aberrations like stickiness, fragmentation, polyploidy, clumping, laggard and bridge formation, etc.

Key words: Jute, ethylmethane sulphonate, tall mutants, chromosome

SV/P-6 Regeneration of Plants from Hypocotyl Derived Callus Tissue of Jute (*Corchorus olitorius* L. var. JRO-632)

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The present paper deals with the induction and regeneration of callus tissue from *in vitro* system of jute (*Corchorus olitorius* L. var. JRO-632). Hypocotyl of *in vitro* germinated seedlings was taken as explants. Hypocotyl explants were cultured in both Murashige and Skoog's (1962) (MS) and Schenk and Hildebrandt's (1972) (SH) basal media supplemented with different growth regulators in definite concentrations. Callus growth was found better in MS basal medium than SH medium. For morphogenetic study, the hypocotyl callus tissues were grown in the medium containing different combinations and concentrations of auxins (IAA, NAA, IBA and 2,4-D used separately @ 0.020 mg l^{-1} to 0.3500 mg l^{-1}) and cytokinins (BA and Kn used separately @ 0.150 mg l^{-1} to 3.2000 mg l^{-1}, coconut milk 10-35% volume/ volume). A simplified method for morphogenesis of calli was standardized. Cytological studies of the regenerated roots from calli as well as from regenerated plants revealed diploid chromosome number while the calli were mixoploid in nature. It was observed that the balance in the concentration of auxin-cytokinin (in initial culture) as well as ploidy level in the cells were the important factors in controlling differentiation.

Key words: Jute, callus growth, auxins, cytokinins

SV/P-7 Generation of Single PCR Product from Random Amplification of Total Genomic DNA of *Tricosanthes dioica*

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Single band PCR product from random amplification of total genomic DNA of *Tricosanthes dioica* (male and female plants) was obtained with operon primer OPAB- 19. This primer did not yield any amplification product with DNAs from *Luffa cylindrica, Momordica charantia* (all Cucurbitaceae), *Piper betle, Citrus limon* and *Cassia fistula*. The amplified DNA product when used as probe hybridized only with *T. dioica* under high stringency. Derived protein sequence analysis of the PCR product from total genomic DNA showed similarity to a number of plant gene products. Highest homology was observed with transpoases and some hypothetical proteins of *Arabidopsis thaliana* showing two distinct conserved regions.

Key words: *Tricosanthes dioica*, RAPD, Dioecy

SV/P-8 Properties and Cloning of Chlorophyllase in the Leaves of *Piper betle* Landrace, Kapoori Vellaikodi

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Betel vine (*Piper betle* L.) commonly known as Pan, is an important commercial crop widely cultivated in India for its leaf which is used as masticator. The plant is known to have explicit dioecy and landraces Kapoori and Bangla represent, male and female plants, respectively. Due to regional organoleptic preferences and adaptability, Kapoori landraces are largely cultivated in humid and warmer peninsular region. It has been observed that the plants have less chlorophyll content, are prone to low temperature stress and also have shorter shelf life compared to Bangla (?).

Chlorophyllase (chlorophyll - chlorophyllido hydrolase EC 3.1.1.14, Chlase) is the first enzyme that is involved in the chlorophyll breakdown pathway. It is membrane bound hydrophobic enzyme whose action yields water soluble chlorophyllides, by hydrolyzing the ester bond linking porphyrin moiety to its hydrophobic tail, phytol. Chlorophyllase is a constitutive enzyme and its activity has been observed in presenescent leaves during the period of chlorophyll biosynthesis suggesting a role in turnover and also during senescence. Chlase activity also responds to ethylene and jasmonic acid during fruit ripening and leaf senescence as loss in chlorophyll is taken as an index of senescence and ripening. Our data show that constitutive Chlase activity is high in Kapoori leaves (?) as compared to Bangla (?) and low temperature stress caused four fold rise in chlase in Kapoori leaves (?). In the present study we report the properties of Chlase such as pH, and temperature optima and Km and Vmax .The gene was cloned from *P. betle* Kapoori Vellaikodi using degenerate primers and gene specific primers designed for 5'- and 3'- RACE PCR. (Accession no.-AY327108).

Key words: ***Piper betle*, Kapoori, dioecy, low temperature stress, chlorophyllase**

SV/P-9 A Novel System for Conducting Biosorption Studies with Microorganisms

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We have constructed equipment to serve a variety of experimental procedures for biosorption involving the formation of alginate beads that encapsulate microorganisms, and flow cylinders designed to hold beads in a confined region that may have a continuous flow of growth media, an exchange of fluids, a flow of nitrogen to simulate microaerophyllic conditions, and an access for sampling fluid and/or alginate beads as desired.

The alginate bead maker is designed to produce uniform size (1.5 ´ 2.0 mm diameter) beads with encapsulated cells. Each bead can be made to incorporate a uniform amount of microorganism cells, thus making cell sampling by weight or volume unnecessary. Furthermore, the beads encapsulate the cells so that they are not lost in filtration, or mechanically damaged in transfer from one medium to another. The bead maker is designed for gravity flow of sodium alginate and concentrations of cells fully mixed, through a plate of numerous beveled pores. Encapsulated cells can be embedded in various embedding media including LR-White for sectioning and microscopic observation at both light and electron microscope levels. Encapsulated cells may be checked for viability through the use of staining with fluorescein diacetate and observation in a UV-fluorescent microscope. In our experiment more than 50% on average of the beads with encapsulated cells of *Plectonema boryanum* (a cyanobacterium) showed evidence of viability.

The flow cells were constructed to allow for a variety of experimental conditions. The system also allows for the monitoring of elements and heavy metals through an access port that does not interrupt the normal flow conditions of nutrients or microaerophyllic levels.

Key words: Alginate beads, biosorption, experimental equipment, microaerophyllic, phosphorous

SV/P-10 Evaluation of Genetic Diversity in a Mangrove Species, *Xylocarpus granatum* Koen. (Meliaceae) as Revealed by RAPD Markers

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Random Amplified Polymorphic DNA (RAPD) analysis was employed to determine the genetic diversity in eight different populations of a minor mangrove species, *Xylocarpus granatum* Koen., sampled and screened from the East coast of India. Ten primers, out of 40 initially screened decamers generated a total of 444 amplification products, of which 364 were polymorphic. Inter-population polymorphism among eight populations of *X. granatum* varied between 36.25% to 72.5%, while intra-population polymorphism was found relatively very low. Some unique population-specific RAPD profiles were detected, which are being examined further to correlate these findings with their respective physio-environmental factors. Cluster analysis based on Jaccard's similarity coefficient was done following UPGMA method and a dendrogram was constructed. In the dendrogram, seven populations clustered together in one group containing four sub-groups, the remaining one (Kalibhanjdia Forest, Dhamara, Orissa) in another. The RAPD data indicate a high degree of divergence among the eight populations studied.

Key words: Genetic diversity, polymorphism, RAPD, *Xylocarpus granatum*

SV/P-11 Conditioning of Temperate Climate Crop of Asiatic Hybrid Lily into Subtropical Climate of Lucknow using Tissue Culture

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Due to increasing global temperature, it is imperative to develop the crops hardier towards high temperature. Asiatic hybrid lily, a temperate climate crop, is one such crop which has been grown under subtropical climate of Lucknow due to its high lucrative value in floriculture trade, as individual flower spike. A protocol for mass multiplication of this crop has been developed through *in vitro* methods. After hardening, tissue-raised plants have been transferred in the open field conditions from the very beginning. Flowering occurred at 43°C in the month of April-May, when there was no flower in the gardens of Lucknow. The acclimatized plants not only grew and flowered but regenerated a new bulb at their base after flowering. The biochemical studies of different antioxidant enzymes like, SOD, POX, CAT, APX and their isoenzymes patterns showed differential up and down regulation of these enzymes in control and *in vitro* raised plants and in their different parts. Characterization of both high and low molecular mass heat-shock proteins was done using HSP70 and HSP18.1 antibodies. The level of high molecular mass proteins did not change much and were found to be of constitutive nature whereas a new small molecular mass of 21 kDa was induced only in tissue culture-raised flowering plants (TF), indicating the possible role of this stress protein in acclimatization and flowering of Asiatic hybrid lily plants flowering at 43°C under subtropical conditions. The amount of this protein was much higher in petals as compared to stem and leaf. The technology is being tested for other temperate crops.

Key words: Asiatic hybrid lily, acclimatization, heat shock proteins, antioxidant enzymes

SV/P-12 Soil-Borne Bacteriophages of Rhizobacteria of *Dicanthium annulatum* (Willem.) Inhabiting Mined out Area and their Significance in Inoculation Technologies

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Soil-based productivity has been taken as one of the indices for economic prosperity and ecological security of any nation. Therefore, soil degradation has become one of the major concerns both for ecologists and economists. Restoration ecologists have suggested the use of native grasses and their associated plant growth promoting rhizobacteria (PGPR) as the key biological inputs for the development of ecological restoration technologies to restore the extremely degraded lands and stressed habitats. However, the PGPR inoculum failure is common rather than exception in the tropics. The soil borne phages present in the rhizosphere have been proposed as one of important biotic factors, which affect the efficacy of inoculation technologies. An extremely degraded site was selected at the Bhatti mines areas of Delhi region. *Dicanthium annulatum* and its rhizosphere soils were sampled. To identify the stresses, present organic matter content, pH, and nutrient analyses of the soil were carried out. PGPR were isolated from the rhizosphere soil using standard microbiological techniques. Ecological significant properties (phosphate solubilization, siderophore production, IAA production etc.) of the bacterial isolates were determined using specific chemical and biological assays. One of the PGPR strain was used as an indicator strain and soil-borne phages were isolates using broth-enrichment method. Diversity in phage isolates was assessed in terms of their plaque characteristics observed under culture conditions and morphological traits using electron microscopy. Some of the phage isolates had icosahedral symmetry and a long tail with helical symmetry and belong to family *Myoviridae* and *Siphoviridae.* Host range of the phage isolates was assessed using selected PGPR strains of *Dichanthium annuluatum.* PGPR strains were found to be phage susceptible however degree of infectivity varied. It is proposed that evaluation of phage susceptibility of PGPR and selection of phage-resistant effective PGPR is essential to improve the efficacy of inoculation technologies.

Key words: Bacteriophage, rhizobacteria, *Dicanthium annulatum*, PGPR, *Myoviridae*, *Siphoviridae*

SV/P-13 Eco-Friendly Approaches for Management of Plant Virus Diseases

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Plant viruses are intracellular parasites that have a small genome made up of RNA or DNA. Virus diseases cause serious losses worldwide in horticultural and agricultural crops. In nature, plant once infected by viruses can not be controlled by any chemical means and there is no cure of infected plants is known till date. However, viral diseases may be managed based on strategies that prevent infection of plants in the field. We have worked out on some eco-friendly approaches of virus disease management practices which neither have adverse effect on neither human health nor posses any hazard to the environments.

ELISA, Western immuno assay, RT-PCR and nucleic acid probe based diagnostic system has been developed for sensitive and reliable diagnosis of *Cucumber mosaic virus* (CMV) in Amaranths, Banana, To-

mato, Tobacco, Gladiolus and Chrysanthemum plant species. A unique PCR diagnostic kit has been developed for sensitive detection of *Tomato leaf curl virus* (TLCV) in Tomato, Capsicum, Chilli, Bitter guard, Luffa, Pumpkin, Papaya, Guar, Pigeon pea, Mung bean, Soybean and several weed plants. A leaf disc of 100mg is required for total DNA isolation and a minimum 5-10ng of DNA is needed as template for PCR to detect the virus infection. This technique is more reliable, quick and sensitive as compared to ELISA. Moreover, the coat protein (CP) genes of TLCV and CMV have been utilized for development of transgenic lines of tobacco and tomato. The transgenic lines expressing high copy number of the CP have been found resistant to these viruses (TLCV and CMV) under glass house conditions. Further, the findings on theses approaches would be discussed in the conference.

Biological control of aphids (the virus vector) capable of transmitting various types of viruses especially the Cucumo (CMV) and Poty viruses (Bean yellow mosaic virus, BYMV) in several plant species has also been attempted to control of aphid population. The feeding behavior of Ladybird (*Coceinella transversalis*) predator of green and black aphids has been observed on Chrysanthemum plants. Different larval stages as well as adult ladybird predator have been exploited for minimizing the aphid population.

Key words: Plant viruses, ELISA, RT-PCR, IC-PCR

SV/P-14 Variations in Functional Properties among Rhizosphere Bacteria of *Saccharum munja* (L.) Inhabiting Heavy Metal Contaminated Fly Ash Dumps

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Fly ash has been considered as one of the important source of metal contamination in the biosphere. About 95 million ton of fly ash is produced every year in India and of these 88 % is being dumped on land. Sixty five thousand acres of land have already been used up for its disposal. These sites represent man made extremely stressed habitats and characterized by high concentration of toxic metals with poor organic matter and other essential nutrients. Selected group of living organisms particularly plants and their associated rhizosphere bacteria belonging to different ecological functional groups having ability to overcome such stresses may serve as biological inputs for the development of biotechnologies for remediation of metal contaminated habitats and their conversion into biologically productive lands. Fly ash dump in Delhi region was selected as the experimental site. Ecological surveys were made for identification of vegetation type. Contents of selected toxic metals in the fly ash were estimated and magnitude of their contamination was assessed. Biological productivity of the areas was assessed in terms of vegetation cover, species types present, organic matter content, concentration of essential nutrients particularly NO_3-N, PO_4-P, K and cation exchange capacity and the pH. Rhizosphere bacteria from the most abundant plant species were isolated and based on the chemical and biological assays, the bacterial isolates were categorized into different functional groups such as siderophore producers, IAA producers, ACC-deaminase producers etc. The tolerance level of these bacterial isolates to the selected metal types was also assessed in vitro conditions. These rhizosphere bacterial isolates of different functional types have tremendous potential for the development of microbial consortium useful in the remediation of metal contaminated sites.

Key words: *Saccharum munja*, rhizosphere bacteria, heavy metal remediation, fly ash, functional types

SV/P-15 Biochemical and Molecular Studies Related to Cadmium Accumulation in Aquatic Plant, *Certophyllum demersum*

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Plants respond to heavy metal toxicity in a variety of different ways. Such responses include immobilization, exclusion, chelation and compartmentalization of the metal ions. One general mechanism for heavy metal detoxification in plants is the chelation of the metal by cysteine-rich peptides such as phytochelatins (PCs) and metallothioneins (MTs) and subsequently compartmentalization of the ligand metal complex. These peptides are rapidly synthesized in plants in response to exposure of heavy metals exposure. In land plants, gene responsible for synthesis of phytochelatins, the PC synthase, has been cloned and utilized to develop transgenic plants. Though aquatic plants are known to phytoremediate toxic metals but studies related to biochemical and molecular aspects of phytoremediation are very limited. Understanding the biochemical and molecular mechanisms of metal toxicity in aquatic plants will lead to develop better technologies for phytoremediation of contaminated water. We present here, data related to cloning of PC synthase gene from an aquatic plant, *Certophyllum demersum* and its expression after Cd exposure. To isolate PC synthase from *Certophyllum,* a set of degenerate primers were employed to carryout RTPCR using total RNA from 1 µM Cd exposed plants. An amplified product of 715 bp was amplified and cloned in PCRÒ 2.1-TOPO vector. The nucleotide and deduced amino acid sequences show approximately 70% homology to PC synthase gene known from other plants. Transcript accumulation of PC synthase was observed in plants exposed to Cd. This result is in accordance with biochemical data, which suggest an increase in non-protein thiols and PCs levels to a concentration of 10µM. Plants exposed to more than 50µM Cd did not show transcript accumulation whereas decrease in non-protein thiol content and DNA fragmentation were observed in these plants. In conclusion, moderate concentration of heavy metal may transcriptionally regulate phytochelatin synthesis whereas high concentration may lead to cell death.

Key words: Phytoremediation, phytochelatins, PC synthase, *Certophyllum demersum,* DNA fragmentation

SV/P-16 Effect of Nitrogen Sources on Hydrogen Production by *Rhodopseudomonas palustris CGA009*

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Hydrogen is a well known clean and efficient energy carrier. Biological hydrogen production by using photosynthetic bacteria has been studied extensively. Photosynthetic bacteria are known as the most powerful hydrogen producer. Two enzymes are especially critical for hydrogen production namely nitrogenase and hydrogenase. Nitrogenase promotes hydrogen production and hydrogenase enzyme involve for both hydrogen production and consumption. Both enzymes are inactive in aerobic condition.

A photosynthetic bacteria *Rhodopseudonomas palustris CGA009* was studied for its capability of hydrogen production in batch cultivations. The effect of different nitrogen sources on hydrogen production by bacteria was observed. Ethanolamine, L-glutamate and Ammonium sulphate were used as nitrogen source showing 29.5 mM malate in an argon gas atmosphere for hydrogen production. Nitrogen gas was also used as a nitrogen source with 29.5 mM malate in the

absence of argon gas. The results showed that Ethanolamine was a good nitrogen source, which permit a large amount of hydrogen to be evolved. 78, 74, 60 and 56% hydrogen yield was obtained by bacteria with 3.0 mM Ethanolamine, 6.5 mM L-glutamate, 3.0 mM Ammonium sulphate and nitrogen gas, respectively. Moreover, it was also observed that the suppression of hydrogen evolution occurred at high concentration of all nitrogen sources, probably due to an accumulation of ammonium ions in the cells.

Key words: *Rhodopseudonomas palustris CGA009*, hydrogen production, nitrogenase, hydrogenase, ethanolamine

SV/P-17 *In Vitro* Mass Multiplication of Medicinal Plants

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Bacopa monieri and *Ocimum gratissimum* are important medicinal plants and widely used in many traditional medicines. Their many properties are being used to prepare herbal formulations to cure different diseases. *O. gratissimum* is commonly called as Ban Tulsi and *Bacopa monieri* as Brahmi. Mosquito repellant property of *O. gratissimum* can be exploited as a herbal preparation. It would be a better than synthetic repellants to protect human health from undesirable side effects. An efficient protocol for *in vitro* shoot multiplication of *O. gratissimum* and *B. monieri* has been developed. Explants for callus culture were taken in the form of nodal segments, from young plants of *O. gratissimum*. Calli were induced on slightly modified Murashige and Skoog's (MS) medium supplemented with BAP (0.6 ppm) and NAA (0.9 ppm). Shoot proliferation is better induced in different combinations of BAP, IAA and Kinetin. Shoots were multiplied further through reculture of nodal segments of aseptic shoots. Micropropagated shoots were rooted in basal agar medium supplemented with IAA (0.3 ppm) and BAP (0.1 ppm). In *B. monieri* calli was best induced in a combination of NAA (0.5 ppm) + IAA (1 ppm). Best shoot development was seen in BAP and NAA in different combinations. *In vitro* grown plantlets showed a growth rate of 84% after 2 months of transplantation in the pots containing sand and top soil in equal ratio. Effect of UV-C was observed in both plants grown in vitro under fields conditions. Both plants showed different impacts of UV on proline, ascorbate, phenolics and flavonoids contents.

Key words: *Ocimum gratissimum*, *Bacopa monieri*, MS media, auxins, cytokinins

SV/P-18 *In vitro* Antioxidant Activities of Essential Oil and Methanol Extract of *Piper betle* L. Landraces

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Piper betle (L.) is one of the important plants of Indian subcontinent and Indo China, which is known to have several ethnomedicinal uses. Five major landraces *viz*. Desi Bangla, Bangla Mahoba, Khasi Shillong, Kapoori Vellaikodi and Madras Pan Kapoori were evaluated for essential oil yield, antioxidant activity and total phenol content in the leaf. The landraces showed major differences in the essential oil yield and total chlorophyll. Antioxidant activity and total phenol content in essential oil and methanolic leaf extract was more in Desi Bangla, Bangla Mahoba, Khasi Shillong and low in Kapoori Vellaikodi and Madras Pan Kapoori. This may be one of the reasons for greater use of Bangla landraces for ethnomedicinal purposes.

Key words: *Piper betle* L., landrace, essential oil, phenol, antioxidant activity, hydroxyl radicals

SV/P-19 Non-chemical Methods to Manage Postharvest Pathogens

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In the present study an effort was made to compare the efficacy of UV-C light and hot water treatment alone and in combination with each other to control postharvest pathogens *Aspergillus niger* Van Teigh. and *Penicillium expansum* isolated from mango and apple fruit respectively. Under *in vitro* conditions UV-C treatment at 10 cm distance, all the doses *viz*.1.3 KJ m^{-2} for 1.75 min, 3.6 KJ m^{-2} for 4.83 min, 7.5 KJ m^{-2} for 10.10 min, 11.2 KJ m^{-2} for 15 min, 14.9 KJ m^{-2} for 20 min were highly effective in inactivation of *A. niger* and *P. expansum* spores while hot water at 60ºC was found most effective against the two pathogens at all duration of exposure ranging from 20 sec to 20 min. Efficacy of hot water treatment at 50ºC increases with increase in exposure time. However 40ºC treatment irrespective of time duration did not significantly reduced spore germination of *A. niger* and *P. expansum*. All combination treatments of hot water at 40ºC and 50ºC followed by UV-C irradiation (at 10 cm distance) was effective in inhibiting spore germination of *A. niger* and *P. expansum* equivalent to hot water treatment at 60ºC or UV-C irradiation with exposure time of more than 5 min.

Key words: Hot water treatment, UV-C, pathogens

SV/P-20 Ecofriendly Approach in Controlling Diseases of Gladiolus by Using Essential Oil of *Hyptis suaveolens*

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The protection of crops and pest control in the public health sector continues to place heavy reliance upon the use of chemicals. The history of pesticide development has been instructive to us in terms of benefits derived as well as the hazards, which accompany indiscriminate use of these poisons. The volatile substances obtained from higher plants have proved their usefulness in controlling diseases as they are vast cornucopia of defense chemicals, toxicant and antimicrobial agents. In this communication, bioactivity of essential oil extracted from *Hyptis suaveolens* was tested against pathogens of *Gladiolus* sp. cultivar 'Friendship Pink', *Fusarium oxysporum* f. sp. *gladioli*, *Alternaria* sp. causing diseases in field and *Aspergillus niger* causing disease during storage of corms. Nature of the toxicity was studied by poisoned food technique and it was observed that the oil was fungicidal for these pathogens between 700 ppm to 1100 ppm range. The oil was extremely toxic for the spore germination and it was found that at 500 ppm the spore germination was inhibited in these test fungi. The toxicity of the oil did not change even during storage periods of 250 days, at its exposure to 100ºC and on autoclaving. The chemical composition of essential oil of the *H. suaveolens* was elucidated, employing GC-MS, consisted of 24 components with 1, 8-Cineole accounting for 44.4% of the total constituents.

Key words: Essential oil, pathogen, *Gladiolus*

SV/P-21 Exploitation of Bioagents as an Alternative Strategy to Control Post Harvest Fungal Rotting of Fruits and Vegetables

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Biological control offers an effective, suitable and safe alternative to synthetic chemicals. Bacterial species have been widely studied for their biocontrol property. *Bacillus subtilis* was tested against *As-*

pergillus niger, *Alternaria alternata* and *Botryodiplodia* sp. the post harvest pathogens of potato, tomato and mango respectively. *Bacillus subtilis* was effective in *in vitro* studies in reducing fungal radial growth as well as mycelium weight of the pathogens. Spore germination of all the three fungi was also inhibited by the culture and the extract of the antagonist. In lab fruit trails *Bacillus subtilis* was found to be non-pathogenic to all the fruits. It also reduced the disease severity in all the three cases.

Key words: Bioagents, bacteria

SV/P-22 Comparative Performance of *Trichoderma* Formulations Applied Individually and in Combination for Plant Growth Promotion and Suppression of Important Diseases of Sunflower and Mustard

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Due to environmental concerns there is considerable interest in finding alternatives to chemical pesticides for suppression of soilborne plant pathogens. In addition to it, these beneficial rhizosphere microorganisms play a key role in assuring satisfactory plant growth and development in microbe-rich and nutrient-poor environments. Therefore, by creating a beneficial rhizosphere in plants at an early stage, the plants could be better protected against biotic and abiotic stresses that occur in greenhouse or field conditions. In recent years, *Trichoderma* sp. are widely used in agriculture as biological control agents and inoculants to provide plant growth promotion. The majority of strategies for biocontrol of soil borne plant pathogens by using *Trichoderma* sp. rely only on use of single isolates of *Trichoderma* sp. Unfortunately, biocontrol agents applied individually are not likely to perform consistently against all pathogens of the crop or under diverse rhizosphere and soil environmental conditions. An approach to overcoming this inconsistent performance, combination of two isolates of *Trichoderma* was formulated to check their efficacy to suppress important diseases of mustard and sunflower. Compatibility of *Trichoderma* isolates was carried out. Compatible isolates were mass multiplied on different agri based substrates such as rice bran, wheat bran, rice husk maize cob, maize grain, bajra grain, sandalwood waste and press mud etc. In comparison to non-treated control and individual formulation of *Trichoderma* sp. consortium formulation significantly reduces the disease incidence as well as enhanced, the seed germination. Treatments of *Trichoderma* formulation also led to increase of 15-18% in total phenolic content of seedling. The total increase in seed yield in consortia formulation was also recorded in sunflower and in mustard in comparison to uninoculated control and individual formulations.

Key Words: *Trichoderma*, consortium, sunflower, mustard, plant growth promotion

SV/P-23 Studies on Biological Control of Soilborne Diseases of Soybean

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With above 7.0 million hectares area under cultivation and production of over 7.0 million tones; soybean has occupied important place in agricultural and oil economy of country. There are several constraints in successful cultivation of soybean plantation, among them soil borne diseases affects the productivity of the soybean. Among several soil borne diseases; wilt caused by *Fusarium* sp., collor rot caused by *Sclerotium rolfsii* and charcoal rot caused by *Rhizoctonia bataticola* (*Macrophomina phaseolina*) causes substantial losses to soybean cultivation. Therefore consistent, economical and ecofriendly management strategies to control soybean diseases is an important aspect of modern agriculture. The use of microorganisms to suppress soil borne diseases is an attractive alternative that has gained attention and has shown significant potential. Among them several strains of *Trichoderma* are found to be effective biocontrol agents of soil borne plant pathogenic fungi under glasshouse and field conditions. Therefore with this view the influence of microbial inoculants consisting of *Trichoderma* sp. to control important soil borne diseases of soybean in glasshouse as well as in field was studied. *In vitro* screening of several isolates of *Trichoderma* against the pathogen was carried out. The potential isolate of *Trichoderma* was mass multiplied on suitable solid substrate and the final formulation of *Trichoderma* were evaluated in comparison to uninoculated control to control the soil borne diseases as well as their efficacy to promote plant growth. In general all the *Trichoderma* isolates reduces the disease severity of important soil borne pathogens significantly in comparison to uninoculated control. Likewise, *Trichoderma* inoculation also improves the overall growth of plant in term of height, no. of pods per plant, no. of seed per plant and total yield of the crop.

Key Words: Soybean, Soil borne disease, Biological control, *Trichoderma*

SESSION-VI

CONTEMPORARY ENVIRONMENTAL ISSUES

SVI/L-1 The Plant Populations under Condition of Chemical and Radioactive Contamination

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The dandelion coenopopulations, grown up in a gradient of radiation or chemical loading were studied (background, buffer and impact populations in the Eastern Ural radioactive trace, and similar samples from the impact area of an iron-and-steel works). The seed posterity from all investigated coenopopulations was subjected to additional impact (heavy metals in soil and ã-radiation). The assumption that the stronger is the pressure of the factor in habitats, the more rigid selection takes place in populations and the greater is the share of plants resistant against the given factor, does not confirm. In impact coenopopulations under the existing conditions the seeds were initially weakened. Additional stress both from habitual and new factors resulted in high death rate of sprouts. High viability of descendants in the background sample has provided their high radioresistance, however chemical influence has resulted in practically full destruction of sprouts. Only in buffer coenopopulation from industrial area it is possible to assume some prospective adaptation to chemical pollution. Hence, mechanisms of resistance to factors different in nature are not universal.

Key words: Dandelion coenopopulations, adaptation, eastern ural radioactive trace, heavy metals, ã-radiation

SIV/L-2 Sustainability in Agriculture and Forestery

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Why our current agriculture and food production is not sustainable? Indiscriminate application of fertilizers, pesticides, weedicides renders the soil lifeless and passive partner in plant growth. Loss of biodiversity, including microbial diversity, is a silent but serious impediment in sustainability. Monocultures imposed by industrialized farming, GM crops cause the biggest threat. There is an increasingly dependence on mechanized agriculture that depends largely on oil. Supply of oil is beginning to run out and its demand from developing countries like India is increasing. Production cannot keep up with demand. The price of crude oil will escalate to $100-$200 per barrel, and oil-driven food production will sharply decline. There is a growing shortage of water and that will rise 5-6 fold effecting half the world population by 2025. The current use of water in agriculture is extravagant and utterly unsustainable. With flood irrigations, 1,000 tonnes of water is consumed to produce 1 tonne of grain. 1,000 energy units are used for every 1 energy unit of processed food. Greenhouse gas emissions have to be reduced by 60 per cent by 2050, however, long distance transportation of food, storage under artificial conditions renders the current situation incompatible with the environmental targets. Intensification of climate change has led to an increase in the incidence and ferocity of climatic catastrophes in the past years. Tsunami, Catalina and Rita remind us of increasing incidence of hurricanes, cyclones, floods, as well as increasing drought, desertification, inextinguishable forest fires, which render more and more croplands unusable or infertile.

So what should be done? There has to be a paradigm shift in tilling land, harvesting and consuming food by the modern societies rich in resources, poor in oil, versatile in knowledge and enthusiastic about environment. There has to be a massive switch from highly mechanized, pesticide and weedicide-driven agriculture to low-input, organic system with a massive reduction in energy inputs. Microbial and organic fertilizers have to replace synthetic inputs. Environment is not capable to absorb unlimited non-degradable waste. There is a limit to overload fields with fly ash, dumps of plastic, heaps of unused machinery etc. Deep tilling, application of quick release fertilizers and pesticides have to be replaced with least tilling, organic cultivation, building soil health and localized agriculture systems. It will render the food production system as circular and not linear. Least movement of food by local consumption and processing is an ideal situation for developing countries, lesson is to be learnt from developed nations who produce major component of CO_2 emissions by transporting food. All food production systems should be accounted for energy consumed, impact on biodiversity, and CO_2 produced and the same is incorporated into pricing of food, subsidies and incentives. Increase in food production requires additional land to be brought under cultivation and this results in further loss of diversity and additional land poisoned by pesticides. Excessive irrigation dries up croplands, increasing aridity and enhancing climate change. Massive switch from fossil to renewables in every sector is mandatory and not a choice. Lastly, the producers, traders and consumers of food have to be educated and made accountable for energy consumed, diversity eroded, environmental damage caused, challenging health of animals and humans and retarding soil productivity. These can be regulated by taxes and incentives, policy changes and education of various target groups.

Key words: Agriculture, sustainability, CO_2 emission

SVI/O-1 Some Mathematical Models in Mathematical Ecology

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Mathematical Models are playing important role in ecology. Early examples are population growth models such as exponential growth by Thomas Malthes and Logistic growth which was developed by Verhulst to model density dependent pollution growth Reed used it in 1920's to predict the future population size of U.S. In recent decades, the modeling procedure, have been used by mathematicians which resulted in a more productive and specific stage structure models. This presentation deals with models for various interactions of species.

Key words: Mathematical model, ecology

SVI/O-2 Fertigation as an Engineering System to Improve Nitrogen Fertilizer Effectiveness

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Fertigation is the application of a commercial fertilizer, soil amendment, or reclaimed water from food processing and wastewater treatment facilities with irrigation water. Minimization of leaching below the rooting volume and maximization of crop yield and quality may be achieved by managing ferilizers concentrations in measured quantities of irrigation water, according to crop requirements. Fertigation has increased dramaically in the past 15 years, particularly for sprinkler and drip systems due to higher efficiency which is being gained by pressurized irrigation systems. Drip irrigation generates a restricted root system requiring frequent nutrient supply that may be satisfied by applying ferilizers in irrigation water. For drip systems, the expansion is mostly in horticultural and high value crops. In agricultural areas with declining water supplies, drip systems have also increased. With increased irrigation, a corresponding increase in fertigation has taken place. It will continue to grow since such systems result in less water usage and better uniformity and lend themselves to the technique much more readily than the less water-efficient and non-uniform furrow and flood systems being replaced. Effective fertigation requires

knowledge of certain plant characteristics (optimum daily nutrient consumption rate and root distribution in the soil), nutrient characteristics (solubility and mobility) and irrigation water quality factors (pH, mineral content, salinity and nutrient solubility) must be considered. This paper will address fertigation method as a tools of precision agriculture which can be used either to protect human environment or increse farm profitability. Some case studies are being illustrated as well.

Key words: Fertilizer, fertigation, irrigation, nitrogen

SVI/O-3 Pest Management With Eco-Friendly Techniques : Options to Combat Environmental Pollution

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Man has been interfering with nature since the dawn of civilization. Increasing population has resulted urbanization, rapid growth of industries and several fold elevated use of chemicals. Several types of chemicals have been used in agriculture by the human in order to raise standard of living on one hand and boost agricultural productivity on the other. Pesticides and fertilizers are being used indiscriminately in order to increase per hectare yield to cope with the growing need of ever increasing population. The indiscriminate pesticide use for various vegetables, fruits and cash crops is at peak and hence the dangers to biodiversity are maximum. The pesticides are dangerous to human beings on one hand but these are disturbing biological equilibrium on the other, by eliminating the beneficial organisms. Scientists have been working to develop methods to solve these problems. Integrated Pest Management (IPM) is one of the successful methods being undertaken. The biological control is an important tool of IPM which can reduce the indiscriminate use of pesticides and help the people to minimize environmental pollution. Predators and parasitoids are important components of biological control. These are being eliminated by the use of pesticides. Very simple, economical and commercial technologies for mass rearing and mass releasing of the bio-control agents *viz*., *Chrysoperla carnea* (predator) and *Bracon hebetor* (Say) (larval ecto-parasitoid) have been developed in Bio-control Labs at the University of Agriculture, Faisalabad, Pakistan. These technologies will be helpful in conserving the natural fauna by minimizing the use of pesticides.

Key words: Environmental pollution, pesticides, integrated pest management, biological control, *Chrysoperla carnea*, *Bracon hebetor*

SVI/O-4 Invasion Biology of *Cyperus brevifolius* (Rottb.) Hassk.

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Cyperus brevifolius (Rottb.) Hassk. is pantropic sedge reported to be a weed and an invasive species in large range of area. This plant has high potential to establish in human-managed lands. Due to the difficulty and inefficiency of eradicating this species using bio-herbicides, studies on the biology of this species is particularly significant to understand the biological characteristic to avoid further establishment. This study focussed on three assessments: life history and phenotypic variability of *C. brevifolius* in temperate and tropical regions, and its responses to soil water contents. The records of annual development, biomass and flowering of *C. brevifolius* in Hiroshima, Japan (represented a temperate region) were observed from April 2000 to April 2001. Comparatively, data of biomass and flowering in Malang, Indonesia (represented a tropical region) was provided four times/year during that period. According to phenotypic variability, *C. brevifolius* has numerous variations among particular populations upon different geographical distribution. The findings of these assessments resulted that this species has adaptability to establish across regions and has the potential to naturalize at various habitats. Considering its responses to soil water content, growth, productivity and reproduction of this species were highly favoured by sufficient water availability; in contrast, these traits are greatly diminished by drought condition. Therefore, the implication of our findings for the management of this species is the preventive action for its infection into new area, also more attention might have to be paid to moist fields and flooding grounds.

Key words: *Kyllinga brevifolia* (syn.), invasive species, weed, life history, phenotypic diversity

SVI/O-5 Identification of Radioactively Contaminated Water Sources – Airborne Spectrometric Data Application

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The present study discusses about the implications of radiometric data, acquired using GSI aircraft in various part of central and southern India. Three distinct river courses exhibiting high radiometric zones are observed at different locations and geological environments: (1) Mahanadi River: in its NE-SW course (Thorium rich) and E-W course (Uranium rich) along with some of its tributaries, (2) Pedda Vanku river (N-S course): in Mahbubnagar district (AP) and (3) Malattar river (NW-SE course) in Mulbagal district Karnataka. These features raises the issue of environmental concern, as the river basin is inhabited and cultivated area and long exposure to radioactive concentration may cause health hazards. Some forest covered zones were also identified to be radioactive in the airborne survey data.

Key words: Airborne spectrometry, exposure rate, radioactive contamination

SVI/O-6 Assessment Criteria of the Surface Vegetation Conditions in Areas Subjected to the Chronic Anthropogenic Stress in Urban Agglomerations

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Two basic approaches to the assessment of the combined impact of the mining enterprise and chemical plant emissions on the surface vegetation in areas subjected to the chronic anthropogenic stress have been developed in this study.

The first approach consists of studying the changes in physiological and biochemical parameters in various vegetative stages under the influence of air pollutants both in the absence of visible damage and in the presence of the same. At the same time it is necessary to take into account weather and soil conditions, as well as the level of air, soil, and water contamination.

The second approach to the assessment of the impact of combined emissions of a mining and smelting plant and a chemical plant (sulfur- and fluorine-containing compounds, heavy metals) on the surface vegetation consists of obtaining quantitative and qualitative accumulation characteristics of phytotoxic compounds in various vegetation parts, mainly in leaves and roots.

The choice of plant parts is conditioned by the fact that leaves mostly suffer from the air pollution impact, and roots- from the soil contamination.

Conducted systematic studies of the vegetation conditions in the areas chronically affected by the mining enterprise and chemical plant allowed to develop an investigation methodology, determine the area of the emission impacts and apply ecological standards developed at NIGMI on atmospheric emissions for vegetations. Horticultural crops (pomegranate, plum, nut, apricot, apple, cherry, mulberry, wheat and grapes) and industrial crops (cotton) were taken as a subject of enquiry.

Analyses were carried out in accordance with the standard management directives and techniques developed at NIGMI. The findings indicate that industrial pollutants have a negative influence upon the photosynthetic activity in plants. It was found that acid gases (nitrogen and sulfur oxides, hydrogen fluoride) and ammonia possess the most oppressive activity. The accumulation dynamics of polluting compounds in different plant parts, soils and bottom sediments were found. Multiple exceeding of fluoride ion and heavy metals concentrations in plants (4-12 times) in comparison with the reference point was found. Conducted research revealed the necessity of systematic complex monitoring in the area liable to industrial pollutant emissions.

Key words: Surface vegetation, pollutant, emissions, accumulation, assessment

SVI/O-7 Urban Agriculture in Matara City of Sri Lanka: The Household Perspective

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Urban Agriculture (UA) is a growing field that refers to the practice of farming in a city environment. Although the UA was viewed as solely for subsistence purposes, it has many additional social, economic and ecological benefits. UA practices in small areas such as vacant plots, gardens, balconies and containers and grows crops and raises livestock for self-consumption or sale in neighboring market. The main objectives of the study were to ascertain the impact of livelihood conditions of urban households on involving UA; to identify their UA production systems; and to examine their environmental and other concerns with regard to the UA. The primary data were collected through a field survey conducted in Matara Municipality area by interviewing randomly selected 85 households.

It has been revealed that 65% of the households are involved in some kind of UA. Their involvement is significantly influenced by the family size of the households (Kruskal-Wallis test: H (1, N= 85) = 5.657451 p =.0174). However, there are no significant relations of the household involvement in the UA with size of land holding (Kruskal-Wallis test: H (1, N= 85) = .0530899 p = .8178), their occupation ($\div^2$=0.2995, P =0.8609**)** and their monthly income (Kruskal-Wallis test: H (1, N= 85) = .7494120 p =.3867). The majority (51%) of the households who are involving in UA are the middle-income group (Rs. 10,000 = 20,000). Many households mainly grow floriculture (71%), Coconut (65%) and fruits (42%) as the common components. Almost all the households (91%) who are involved in floriculture do it as a hobby while many vegetable growing households (75%) produce vegetable only for domestic consumption. Only commercial floriculture and vegetable producers apply fertilizer and agro-chemicals for their plants. Pleasant surrounding (85%), protect the environment from sun burn heat, dust, smoke, noise and heavy rain (69%), and safe-food (51%) are the common interest of the urban households. Among the main limitations most of the households are facing the problems of lack of quality planting materials (87%) and difficulties in finding organic fertilizer (80%). They are expecting method for convenient compost making (87%), improved UA technology (76%) and urban nurseries (71%) in order to promote their UA.

Key words: Urban households, urban environment, agriculture

SVI/O-8 Effects of Gamma Radiation on Morphological Characters of Ornamental Plants and their Commercial Exploitation

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The down of the 'atomic age', following world war II, saw a boom of interest in utilizing radiation for peaceful purposes. Different radiations affect different crop plants differentially. Changes in different morphological characters are immediate effect after treatment of plant parts with radiations. Morphological changes are manifested in the growth and development of roots, stems, leaves and flowers. Changes may be both towards deleterious and economic importance. Deleterious effect of radiation in the form of abnormal growth is found up to certain period of growth. But radiation can create changes in genetic make up of plant materials through mutation and induced mutagenesis, is now an established method of crop improvement. A wide range of mutant varieties has been developed in different crops and commercialized world wide. Gamma rays have been most successfully used to produce quite a large number of new promising varieties in different ornamental (*Bougainvillea* – 4, Perennial *Portulaca* – 6, *Chrysanthemum* – 43, *Hibiscus* – 1, Rose – 16, Tuberose – 2, *Lantana depressa* – 3 etc.) plants by bringing about genetic changes at Floriculture Section, National Botanical Research Institute, Lucknow, India. Research carried out valuable informations on radio sensitivity, selection of materials, methods of exposure to gamma rays, suitable dose of gamma rays, detection of mutants, isolation of mutants and commercial exploitation of the mutants. A good number of mutant varieties have been well accepted in the floriculture industry. Studies have clearly proved that nuclear radiation can be exploited for the creation of new and novel ornamental varieties of commercial importance.

Key words: Radiation, crop plants, genetics, mutation, ornamentals, new variety

SVI/O-9 An Ecological Survey of Sand Dunes with Reference to their Role as Natural Barriers against Tsunami, in the Hambantota District of Sri Lanka

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A variety of rich coastal habitats including headland-bay-beaches with mangroves, salt marshes, sand dunes, estuaries and lagoons, sea-grass beds and coral reefs occur in the coastal zone of Sri Lanka. Prominent among them, are the sand dune ecosystems. Some of the largest sand dunes in the equatorial region of the world are known to occur along the southeastern coast of Sri Lanka. Of a total of nearly 7600 ha. of sand dunes, nearly 6% occur within the Hambantota district in the southeastern coastal belt. The factors which contribute to sand dune development in Sri Lanka are considered to be climatic, biotic and geomorphic. Wind transported sediments are stabilized by salt tolerant plants which colonize them once they grow above the level of most high tides. These plants act as efficient sediment traps. The initially formed incipient dunes then coalesce to form fore dunes which with further accretion result in large dune ridges that run parallel to the shoreline. Several dune ridges can develop the troughs which provide damp environments supporting a rich biodiversity as seen in the dune environs at Hambantota. The coastal dunes have been known to act as important natural barriers against coastal erosion and thus to protect life and property within the coastal zone by absorbing the energy of the waves. The dunes furthermore provide a reservoir of sand to replace that carried off by the severe coastal storms and also provide an important habitat for a number of plants and animals, some of which are unique to these environs.

The tsunami on 26th Dec. 2004, induced by a powerful submarine earthquake off the north-western coast of Sumatra caused devastation in the northern, northeastern, eastern, southeastern and southern coastal belts of Sri Lanka. It claimed the lives of over 38,000 people in Sri Lanka, left almost a million people homeless, destroyed many settlements and much infrastructure, affected the livelihoods of half a million people, destroyed vegetation, changed landform, created vast amounts of debris, released pollutants and contaminated

soils and fresh water supplies. A rapid environmental survey carried out soon after the tsunami, indicated beyond doubt that sand dunes, wherever they had been left undisturbed from anthropogenic interventions, formed the best natural barrier against the tsunami. The dune system which is highly stabilized under natural conditions can yet be fragile and sensitive to environmental changes, and can be easily subjected to irreversible damages due to its improper exploitation. In the recent past, several dunes in the district had been exploited for sand mining and hotel constructions. The paper describes the ecological importance of the sand dunes with special reference to their role against the tsunami.

Key words: Dunes, coastal ecosystems, natural barriers, tsunami, anthropogenic activities

SVI/O-10 Present Concern of Nitrogen Management in Rice Cultivation on Environmental Degradation - Its Impact Assessment and Risk Management

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Present state of the art of nitrogen management in rice cultivation becomes a serious concern to the environmental safety and security, likely to cause a severe disaster in near future. Such an apprehension may not be an exaggeration unless immediate consciousness has to be focused assessing risks encountered in present practice of N management *vis-à-vis* addressing appropriate alleviative measures. Coping with the burgeoning population, enhancing rice production is our prime concern; but certainly not at the cost of environment. In view of achieving apparent yield enhancement, N has been applied indiscriminately, in excess to the plant requirement. Obviously its deleterious impact disrupts the dynamic equilibrium in soil-plant-environment continuum, posing severe threat to the environmental sustainability, even damaging the biodiversity too. Excessively applied N begets excessive use of pesticides, a follow-up action to prevent unusual pest incidences. Amount of toxic substances, phytoalexins and also cellulose and pectinase in plant cells were noticed to be declining considerably following luxurious growth due to excessive N application rendering easy cell permeability of pests into plant body. Nonetheless, soil applied non-bio-degradable pesticides remain persistent therein for a considerable period of time, which restricts the growth and perpetuation of soil microbes deteriorating soil quality. Furthermore, this can pollute the water bodies either through surface runoff and/or leaching to the ground water table. In one way it affects biodiversity causing irrevocable damage to the flora and fauna; while health hazards occur due to drinking water taping out of this polluted ground water. Keeping the above views into account, a paradigm shift in future researchable issues on N management in rice appears to be imperative for better awareness of environmental security. To alleviate such crisis our future strategy should address; (1)'Need - based N management' for increasing N use efficiency to reduce N application; (2)'Improve crop management' restricting excessive use of either N or pesticides to conserve bio-diversity and to protect from health hazards; and (3)'Organic rice farming' ascertaining sustainable wholesome environment and crop produces. Advance technique using **'**Plant-based Tools**'** for 'Real- Time N management (RTNM)' and 'Site-Specific N management (SSNM)' like chlorophyll/SPAD meter and LCC could enhance N use efficiency. In addition, N management through 'Soil test crop response' based 'Target yield equation' is also an improved technique estimating appropriate N to be applied for a specified yield. Concurrently environmental security following improved crop management deserves due emphasis. It includes judicious water management like aerobic rice cultivation, irrigation based on 'crop water stress index', biological pest management using botanicals and biopesticides, integrated nutrient and pest management (INPM), use of biodynamic compost/culture and vermi-compost, autotrophic and phyllospheric bacteria, and other rhizosphere micro-flora, etc. 'Organic rice farming' has got considerable momentum since recent past. It is believed, besides quality produce, organic rice farming deserves versatile merits offering several advantages to ensure safe and secured environment along with its creatures. However, its study needs to be furthered more convergently awakening farmer's awareness for its wide adoption in a holistic manner.

Perhaps today's commitment can ensure future conviction of restructuring a better world for safe and secured life. Thus, our efforts for increasing rice production should consider N management in right perspective for the great cause of our environment in general, our life in particular.

Key words: Rice, nitrogen management, environmental hazards, risk management

SVI/O-11 Salinization Prevention and Sustainable Agriculture by Biological Method in Inland Region

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Soil salinization is a non-ignorable environment degradation which influences agriculture industry and ecological environment, deeply. According to statistics, there are 970 000 000 hm^2 salinized land all over the world.

Among the 970 000 000 hm^2 salinized soil, 10% is in China, mainly distributing in north-west inland region such as Gansu Hexi Area, Xinjiang province, Ninxia Yinchuan and west part of Neimenggu province. All these areas are far away from the sea, with dry climate, composing a special salinization system. In order to make use of this large amount of degraded land resource, to improve the ecological environment, to prevent desertification and to develop sustainable agriculture, we have taken biological prevention method and engaged in this field for 20 years.

The reasons for salinization are variable. Because saline soil characteristics, such as high degree of salinity, complicated salt contents, low rain fall, salt-washing off, obvious salt surface concentration, second salinity distributed more often and water movement unable to take away the salinity in the soil, so it is very hard to prevent salinization in inland than in areas near sea. After 20 years of studies, we have taken a biological approach by planting special salt tolerant crops, which take away salt, increase green-cover areas and prevent salts reaching up to the subsoil, therefore to improve soil production efficiently. Meanwhile, we studied the mechanics of plant salt-resistant and methods to use these plants for desalinization. Models of "grass industry in salinized areas" and "medicinal plants industry in salinized areas" are presented, this will lead to obvious ecological, social and ecological efficiency of sustained agriculture in salinized areas in north-west China.

Saline grass industry: For instance, the Hexi Corridor of Gansu has 277 000 hm^2 of land, of which only 10 400 hm^2 is arable land, 81 800 hm^2 is grassland, 170 000 hm^2 is virgin. If 2% grassland and 1% virgin (equal to 500 000 acres), are planted with *Medicago sativa,* then from the next year the land can yield fresh grass 2 500 kg per acre, with a total yield of 1 250 000 t in 500 000 acres and a value of more than 200 000 yuan. Because fresh grass is delicious, with high nutrient value, it can be pastured, or made into dry grass. Saline grass industry can be an economical and sustainable agriculture.

Saline medicine industry: With people more concerned about environment protection, Chinese medicinal materials are favoured more. *Glycyrrhiza uralemis, Epheara intermedis, Lycium barbarum, Lycium ruthenium, Poacymum venetum, Carthamus tinctorous, Cistache deserticola* and *Cynomoriun songaricum* are grown in special eco-

logical environment of inland saline soil. *Glycyrrhiza uralemis* and *Epheara intermedis* are adaptable to saline soil. Pure income from only *Epheara intermedis* per acres is beyond 1 800 yuan.

Key words: Salinization, biological prevention, sustainable agriculture, saline grass industry, saline medicine industry

SVI/O-12 Analytical Methods for Forest Soil and Plant Analysis : A Canadian Perspective

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Many of the studies at the Northern Forestry Centre require high quality analysis of soil and plant samples in order to meet their objectives. In some cases analytical techniques must be modified or developed for specific requirements of the users. The Analytical Laboratory performs a broad range of routine analyses and develops analytical techniques. This presentation reviews some of the methods used for environmental research

The microwave digestion technique developed by this laboratory in late 1980s for the determination of Ca, Mg, K, P, S, etc. in tree foliage is used around the world. Our laboratory coordinated the first soil analysis methods validation study conducted by the AOAC International and the Soil Science Society of America in early 1990s. Procedures have been developed for the determination of exchangeable cations especially for low pH soil including organic horizons.

During the last three decades the laboratory has participated in collaborative studies conducted by several organizations, e.g. Acid Rain Direct/Delayed Response Project (Environmental Protection Agency, USA), Canada Soil Survey Committee, International Soil Exchange (Wageningen, The Netherlands), Long Range Transport of Air Pollutants (Canada), and Western Enviro-Agricultural Laboratory Association (Canada). These studies have enabled the laboratory to produce high quality analytical results. Generation of high quality data has always been and remains the top priority.

Key words: Methods development, methods validation, collaborative studies, microwave digestion, AOAC

SVI/O-13 Natural Dyes : Eco-Friendly Chemicals for Textile Dyeing

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Now a days, there is trend through out the world towards the revival of natural dyes because their usage is more relevant in the context of increasing environmental consciousness. The non-toxic, biodegradable and eco-friendly properties make them exceedingly popular amongst nature loving and heath cared people. All this happened due to the excessive use of synthetic chemicals / colours / derived products in the last one and a half century, the production and application of these cause human health hazard and environmental pollution and also disturb our eco-system. Consequently, some of the countries like Germany, Netherlands and other EU countries have banned the use of specific azo-dyes even for colouring textile. India has also banned the use of these azo-dyes for colouring textile and other consumer goods. In the present scenario of work culture, new concept of eco-friendly processing, ecological controls, effluent treatment compulsion, and ISO 9000 and 14000 have emerged in global market.

Natural dyes may be defined as chemicals, which are obtained from vegetable and animal sources, without chemical processing. Dyes are not confined to a particular chemical class of organic compound, they belong to a wide range of chemical class of compounds e.g. tetraterpenoids (carotenoids, xanthophylls), O-heterocyclic compounds (anthocyanins, flavones), tetrapyrroles (chlorophylls), quinones (naphthaquinones, anthraquinones), N-heterocyclic compounds (indigoid) etc. Plants are the main source of dyes and there exist about 300 plants which yield colours. Twigs of certain insects are also good source of colours.

During studies on natural dyes at the NBRI, special emphasis was laid to tackle these constraints using modern techniques with incorporation of traditional knowledge. Standard extraction and dyeing profiles have been developed for several dyes. Numerous colour shades with fast washing properties have been developed on silk, wool and cotton under eco-friendly dyeing using safe chemicals and natural mordants. No heavy metal salts e.g. Cr, Pb, Ni, Mn, Co, As etc were used as mordant.

Key words: Eco-friendly, natural dyes, synthetic dyes, pollution, extraction, dyeing

SVI/O-14 Eco-Friendly Tillage Management for Reducing Soil, Water and Environmental Pollution

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The intensive use of chemical herbicides and pesticides raised a serious concern about their effect on non-target organisms, human bodies, plants, soil, ground water, and environment. Weeds, insect-pest and diseases in plants damage the crop yield and agriculturists are compelled to control it through chemical herbicides. Heavy doses or overuse of herbicides to save the high - yielding crops are increasing water pollution, contamination of food grains and food articles with toxic residue and causing other environmental hazards. Recently, Indian media has widely reported that even costly mineral water and soft drinks in India were found contaminated with highly toxic pesticides and herbicides like Gamma-HCH, DDT, Chlorpyrifos, Malathion etc. more than the critical limits. It is reported that bottled mineral waters and soft drinks are contaminated due to poor quality of ground water and aforesaid herbicide substances were available in mineral water and soft drink due to their presence in ground water. This compelled the policy makers and the government to give a serious concern and save the million lives through fresh water. It was observed by the farmers that diseases, insect–pest and weeds were successfully controlled through the use of deep summer ploughing (DSP) and they rarely use herbicide for such control.

Deep summer ploughing (DSP), followed by secondary tillage operations for rice and wheat cropping system, was undertaken at farmers' demonstration fields at different reaches (head, middle and tail sections) of Patna canal of India's oldest Sone Canal Command during wet and winter seasons. The DSP plots were large in each canal reaches at the interactions between villages to ensure wide exposure with the farmers and enabling them and researchers to see and assess a new practice at the farming scale. Farmers (around 200) in participatory mode assessed the practice from a range of view points relative to their usual practices, including land preparation, fertilizer, sowing and herbicide costs, quality of crop establishment, weed growth, pest and disease incidences.

The incidence of disease, insect-pest, and presence of predators/ parasite in rice and wheat fields were studied in a participatory mode. The growth of the crop was much better and there were fewer incidences of insect-pest in DSP fields than non–DSP fields. Leaf folder in rice crop was found in all conditions but its severity under DSP was much less. Sheath blight disease incidence was comparatively severed in non-DSP than DSP fields. It was observed that diseases and insect-pest never crossed the threshhold limit in DSP whereas non-DSP fields were infested badly. Farmers didn't use herbicide to control the disease, insect and pest in DSP field, which

reduced the cost of cultivation and gave them a better economic benefit/return. Due to non-application of herbicides in DSP field, the ground water contamination is not possible and it will improve the availability of fresh ground water and reduce the chances of soil-water-environment pollution.

Key words: Herbicides, pesticides, weeds, insect-pest, ground water, deep summer ploughing

SVI/O-15 Effect of Industrial Wastes, Press Mud and Biocompost on Growth in Cyanobacterium *Anabaena*

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Cyanobacteria, which are also called blue-green algae, are the primordial organisms evolving more than three billion years ago. These organisms form one of the main eubacterial phyla and one of the largest groups of gram-negative bacteria. Today more than 2000 cyanobacterial species are known with a variety of physiological, morphological and developmental properties and colonizing a wide range of habitats. The presence or absence of nitrogen in the growth medium affects the growth of blue green algae significantly. Therefore, the work was done to see the effect of Industrial waste products like press mud (PM) and biocompost (BC) on the growth and related physiological and biochemical changes in *Anabaena*. The results have shown that the growth of *Anabaena* increased initially over control with 1% PM and growth decreased with 0.01 and 0.1% PM when the nitrate was present in the culture medium. However, the growth of anabaena increased by 17.5% with 0.1% PM and it further increased to 34% with 1% PM in nitrate free culture medium. Similarly the growth of *Anabaena* was inhibited by all concentration (0.01%, 0.1% and 1.0%) of BC when the nitrate was present in the culture medium but the growth increased by 17.5 and 36% respectively with 0.01 and 0.1% BC when the nitrate was absent in the culture medium. The results indicate the compensation of nitrate by Industrial recycled waste like PM and BC.

Key words: Cyanobacteria, *Anabaena*, industrial waste, press mud, biocompost

SVI/O-16 Evolution of Fully Protected Cultivation: Case of Betel Vine (*Piper betle*) Cultivation in Subtropical India

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In historical terms reliable information on climate can also be gathered following the accounts on vegetation and cropping patterns during a given period. Crop raising was solely dependent on climate and there was no exception to this rule in history before the advent of industrial revolution and more precisely after invention of refrigeration. The only exception to this was the cultivation of betel vine (*Piper betle)* in subtropical India almost 2000 years back. This also represents first fully protected cultivation developed anywhere in the world in terms of antiquity.

P. betle is a plant of tropical origin, which can be cultivated without any anthropogenic intervention except planting the cutting. However, in the subtropical regions the plant has to be protected from dry summer and cold winter warranting temperature and humidity regulation. How this has been achieved over the years in harmony with the nature can be very well grasped following cropping patterns of this plant, which shows three types such as unprotected, partially protected and fully protected mode depending on the region. The intricacies of fully protected cultivation will be described.

Key words: *Piper betle*, tropical origin, subtropical cultivation, first fully protected cultivation

SVI/O-17 Monitoring of Pesticide Residues in Butter From Hisar, India

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Pesticides are being used in large scale in agriculture throughout the world to control pests and to increase production but their activities reduce the quantity and quality of food produced. In recent years, the political and public concern about possible adverse effects has increased. Besides the environmental components, food commodities also get contaminated with pesticide residues, and due to their injudicious use, residues exceed the MRL values also, which can be hazardous to human beings. Contamination of agricultural crops is due to continuous use of pesticides whereas possibilities of contamination of milk and milk products are mainly due to consumption of contaminated feed and fodder.

During 2002-03, butter samples (24) were monitored for pesticidal contamination with organochlorines (OC), synthetic pyrethroids (SP), organophosphates (OP) and carbamates. Samples were extracted with 1% acetonitrile using liquid-liquid partitioning (LLP). Diluted the acetonitrile phase with 10% NaCl solution and further subjected to LLP first with hexane followed by dichloromethane. Combined both phases and concentrated to near dryness on rotary flash / gas manifold evaporator. Complete removal of dichloromethane traces was ensured. Made final volume to 2ml in n- hexane for OC and SP and in ethyl acetate for OP and carbamates. Estimated the residues on GC-ECD/NPD capillary systems.

Among OC, HCH and DDT residues were detected in traces in almost all the samples whereas residues of endosulfan and chlordane exceeded the MRL values in 6 and 4 samples, respectively. Cypermethrin, fenvalerate and deltamethrin among the SP insecticides were detected frequently with residues of cypermethrin and deltamethrin each exceeding the MRL values in 4 samples. Among OP, only chlorpyriphos was detected in safe limits. Residues of carbamates were not detected in any of the samples. Additionally, dicofol and pendimethlin herbicides were also detected in a few samples.

Key words: Monitoring, residues, gas liquid chromatograph, capillary column, maximum residue limit (MRL)

SVI/O-18 The Groups of the Péczely's Large Scale Weather Situations for Szeged, Hungary with Special Attention to Plants' Pollen Levels

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This paper discusses the six groups of a subjectively defined system of air mass types; namely, the six groups of the thirteen Péczely's large-scale weather situations over the Carpathian Basin in relation to the plants' pollen levels. Based on the ECMWF data set, daily sea-level pressure fields analysed at 00 UTC were prepared for the six groups of the thirteen Péczely-types in order to relate their sea-level pressure patterns with the pollen levels in Szeged. The data basis comprises daily values of twelve meteorological parameters and daily pollen concentrations of twenty four species for their pollination term in the five-year period 1997-2001. It was found that groups III and V are favourable,

while groups II, IV and VI are negligible in classification of pollen concentrations. Role of group V in accumulation and group VI in dilution of pollen levels is in agreement of our expectations. However, role of group III in accumulation and groups II and IV in dilution of pollen concentrations is complex. Nevertheless, winds speed seems to be an important factor. On the other hand, the cyclonic and anticyclonic components of groups II and III as well as the ambivalent role of the anticyclonic ridge situations (group IV) make it difficult, using groups of Péczely-types in classification of pollen levels. Hence, the groups of Péczely's large-scale weather situations cannot be considered as an overall system in categorization of pollen concentrations.

Key words: Péczely's large-scale weather situations, groups of Péczely-types, plants' pollen levels, ANOVA weather classification

SVI/O-19 The Hidden Impacts of Air Pollution on the Poor: A Case Study of Heavy Metal Contamination of Vegetables in Indian Cities

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Vegetable crops are often grown in polluted and degraded environmental conditions in the peri-urban (or urban fringe) zone and are subject to further pollution from vehicles and industries during marketing. There is therefore significant cause for concern regarding the potential impacts of air pollution on crop yield and quality.

Levels of contamination of Cu, Zn, Cd and Pb were measured in spinach beet (palak), cauliflower and okra at market and field sites in Varanasi, and in palak in Delhi, and were compared with national (Indian) and International permissible limits. In Varanasi markets, the mean heavy metal contamination levels significantly exceeded the Indian prevention of food adulteration act (PFA) limits for Cd, Cu and Zn for much of the year for all three crops. Pb did not exceed the PFA limits, but the majority of samples did exceed the more stringent EU or CODEX permissible limits. In Delhi markets the majority of palak samples contained Pb concentrations that exceeded the Indian PFA limit. The considerably lower contamination levels measured in crops at field production sites indicates that a significant proportion of the contamination occurs during transport to market or at the point of sale. Heavy metal contamination could be reduced, often to below PFA permissible limits, by twice washing in clean water.

This paper is one of a series of outputs from a major interdisciplinary research project carried out to assess the nature and significance of aerial deposition of heavy metals on the safety of vegetables consumed in urban India (with particular emphasis on impacts on the poor); to explore appropriate technical and institutional measures to address the issue, and to draw lessons for policy approaches to improve food safety in India. The study brought together a cross-sectoral team to develop new types of partnerships and new ways of working, in order to understand and address the impacts of newly emerging environmental threats to the food system on the livelihoods of the poor. The study is a pointer to the inefficacy of current policy approaches towards ensuring safety of food to the consumer. Current policy relates to food standards, environmental standards, industrial siting, peri-urban agriculture and consumer rights separately and is inadequate to tackle the issue comprehensively. Whilst progress is being made with the proposed new integrated food safety bill, there is still no emphasis on fresh produce rather than processed food, or recognition of environmental pollution as a threat to food safety.

Key words: Heavy metals, food safety, livelihoods, air pollution

SVI/O-20 Performance Improvement of a Diesel Engine Fueled by Cottonseed Oil Blended with Orange Oil

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To meet the twin problems of fuel scarcity and air pollution, caused by the growing use of fossil fuels, many countries are using alternative renewable fuels in motor vehicles. Blending vegetable oil with light oil is one of the methods to improve its performance as an alternate fuel. An attempt has been made to use vegetable oil as a CI engine fuel by adopting a simple method of blending it with orange oil.

The problem, encountered by using vegetable oils in a diesel engine as a fuel, is smoky exhaust due to the higher carbon residue of vegetable oils, high viscosity and poor volatility. In order to improve the combustion characteristics of vegetable oils, several different methods are followed. In this paper the performance, combustion and emission characteristics of a single cylinder, CI engine using cottonseed oil and its blend with orange oil as fuel is compared with that of diesel operation.

Brake thermal and volumetric efficiencies, smoke, HC and CO emissions, exhaust gas temperature, peak cylinder pressure and maximum rate of pressure rise are analyzed and blend containing 5, 10 and 15% of orange oil are compared with diesel and cottonseed oil graphically for better clarity.

Addition of small quantities of orange oil with high octane number and volatility with the high viscous cottonseed oil improves the atomization, mixture formation and combustion. The brake thermal and volumetric efficiency increases with reduction in HC and CO emissions. The cylinder peak pressure and maximum rate of pressure rise of the blends also increases when compared to raw cottonseed oil. Results show that addition of up to 15% of orange peel oil by volume improves the performance of the cottonseed oil in the diesel engine largely. The effect of adding more than 15% is also discussed in the paper.

Key words: Cottonseed oil, orange oil, viscosity, emission, blends

SVI/O-21 Neotectonic Uplifting of Hyderabad Granitic Region and Environmental Pollution

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Environmental pollution and current climatic changes are usually linked with the natural variability or anthropogenic inputs to the atmosphere. However, there appears to be a case for significant contribution from earth's internal and external forcings also, but how much, is still not well understood.

Hyderabad granitic region (HGR) situated in the south central Indian shield and covering nearly 150 km x 150 km area, is one such active terrain which is neotectonically uplifting at a very high rate of~12 mm/yr as revealed by recently acquired IGS-GPS data. This has resulted into a removal of almost a major part of the upper granitic crust leaving behind a thin veneer (~2 km only) of granites at the surface. HGR now corresponds to a circular morphostructural region where drainage patterns follow the concentric elements of topography. Uplifting has also resulted into the alteration of the river courses for example, Manjeera river, which is presently situated northwest of Hyderabad, takes a sudden U turn after reaching close to Hyderabad. The same river was originally flowing into Musi river, which still runs across this city.

Radioactive measurements on the Hyderabad granitic rocks reveal

anomalously high concentration of radioactive elements with average U, Th, and K concentrations of ~8 ppm, 43 ppm and 3.4 % respectively. Neotectonic upliftment seems to have enormously accelerated the weathering and erosion of these radiogenicaly rich granitic bodies, which are seen deposited in the nearby lakes. These lake bottom sediments exhibit even higher concentration of these elements than the exposed granites. For example, Nacharam lake situated in the heart of city where concentrations of U, Th, K average around 16 ppm, 78 ppm and 3% respectively. Still higher concentrations (spot values of U and Th exceeding 30 ppm and 200 ppm respectively) are recorded in far away areas like Wailpalli watershed, situated ~80 km from Hyderabad, where there is no anthropogenic activity.

Our study thus highlights the role of underlying geo- processes like neotectonic uplifting towards severely contaminating water bodies in and around Hyderabad and impending danger it can create for environmental and human life.

Key words: Neotectonic uplifting, radiogenic elements, climate, Environmental pollution, Hyderabad, lake sediments

SVI/O-22 Protective Role of Sodium Dithionite and Sodium Chloride against UV-B Induced Damage in *Chlorella vulgaris*

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Increasing UV-B incidence on earth due to ozone depletion results global climatic change and deleterious impacts on human, plants, materials and environment. Highly useful and economic algae especially protein-rich microalgae are highly affected.

The protein, carbohydrate and pigments are highly damaged by increased UV-B exposure in a highly protein-rich (45%), green, freshwater microalga *Chlorella vulgaris*. Sodium dithionite (1 mM) partially protected survival and growth against UV-B induced damage but NaCl (0.5M) became lethal in supplemented condition.

Key words: Sodium dithionite, sodium chloride, UV-B, *Chlorella vulgaris*

SVI/O-23 Distribution of Persistent Organic Pollutants in the Sediments from Industrialized Urban Ganga Estuary, India

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Detailed analyses of persistent organic pollutants (POPs) such as HCH (hexachlorocyclohexane) isomers (HCHs), DDT (dichlorodiphenyltrichloro ethane) and its metabolites (DDTs), HCB (hexachlorobenzene) and congeners of PCBs (polychlorinated biphenyls) and PAH (polycyclic aromatic hydrocarbons) in surface sediments (top 0.5 cm) from Ganga estuary, West Bengal, India allowed the evaluation of the contamination status, distribution and possible pollution sources. HCH, DDT, HCB, PCB and PAH were identified compounds in all the samples, whereas the concentrations of chlorinated pesticides (trans-eptachloroepoxide, dieldrin, endrin, metaoxychlor and mirex) were below the detection limits and were not of great concern. The pesticides demonstrate markedly different distributions reflecting continuous agricultural and domestic usage and washed into the estuary from sources within the catchment areas. The range of concentrations of HCH, HCB, DDT and PCBs in the sediments were 0.11- 0.40, <0.05-0.98, 0.18-1.93 and 0.18-2.33 ng/g dw, respectively. Overall elevated levels of HCB, DDT and PCB were recorded at the site proximal to metropolitan mega city Calcutta with severe urban and industrial impacts. The sequence of mean contents of nine dominant congeners is as follows: fluoranthene> pyrene> chrysene> 1,2benzo(a)anthracene> benzo(a)pyrene> anthracene>perylene> roanthene> napthalene. Fluoranthene and Pyrene, the dominant 4-ring PAHs, also showed an abrupt elevated concentrations at Outramghat with values of 324 and 444 ng/g dw, respectively. Thus suffers from a huge load of untreated municipal and industrial effluents, atmospheric deposition, automobile exhausts, slum sewage and street runoff, that play a significant role in PAH contamination. The congener 7, 12-dimethylbenzo(a) anthracene was below the detection limits (<10) in all sediment samples. To substantiate the origin of PAHs in sediments, the ratio of fluoranthene/pyrene was used in the studied matrices. The ratios were always >1 and compatible with a pyrolytic pollution for all 8 sediment samples. Fluoranthene (flu) is less thermodynamically stable than pyrene (py) and a predominance of flu over py is characteristic of pyrolytic products. The large amount of fossil fuels burnt for domestic heating within this area could contribute to a local atmospheric source of PAHs along with urban run-off and automotive sources which have been shown to be major sources of PAHs to this coastal environment

Among the isomers and metabolites of HCH, DDT and PCB, a- HCH, pp¢-DDT and PCB $_{101}$, PCB $_{118}$, PCB$_{153}$ and PCB$_{138}$ were found to be dominant. High ratios of metabolites of DDT to S DDTs reveal recent use of DDT in this coastal environment. The baseline data can be used for regular ecological monitoring considering the industrial and agricultural growth around this important estuarine ecosystem.

Key words: Organic pollutants, pesticides, sediments, coastal pollution, Ganga estuary

SVI/O-24 Qualitative and Quantitative Assessment of Industrial Effluent *vis–a–vis* Technological Upgradation

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Industrial pollutants and their constant discharge in large volumes to air, water and soil media are known to alter the flora and fauna. One may have to incur more capital investments while selecting the environment friendly technologies. The pay off from such technologies is certainly better to address the social and environmental concerns compared to the conventional techniques. The methodology involves to compare the results of two effluent treatment techniques for qualitative parameters like TDS, TSS, BOD, COD, TOG, DO and quantitative parameters such as solid sludge generation. The commitment from top management at TATA Motors, Lucknow (a leading automobile company with global presence) and EMS initiatives like ISO 14001 helped to achieve the treated effluent parameters far below the ones set by State Pollution Control Board. This paper is aimed to compare the physico-chemical properties of treated effluent *vis-à-vis* two different technologies.

Key words: TDS, TSS, BOD, COD, TOG, DO, solid sludge, industrial effluent

SVI/O-25 Effect of Organic Matters on the Growth of Arbuscular Mycorrhizal Fungi and their Impact on Human Activities and Environment

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Organic matter is a grouping of carbon containing compounds which originated from living beings and deposited on or within the earth's structural components. A fertile soil should contain 2-8 percent organic matter; most soil contain less than 2%. So, it is necessary to add organic matter to the soil for growth of the plant.

Effect of using organic matter has been shown to adversely affect the diversity and activity of microbial population in soil. The aim of this work was to determine how the diversity of mycorrhizal (AM) fungi is affected by the addition of locally available organic matter such as *Lantana camera, E. adenophorum, Thitonia diversifolia,* farmers compost and tri-superphosphate in the eroded soil through mesh bag experiment in the Baluwa forest, Kavre district, central Nepal. We have seen that growth of AM in degraded soil is highly stimulated by the presence of organic matter. Different types of organic matter had similar positive influence on AM growth. Addition of rock phosphate on the other hand had no effect on AM growth. Added leaves of *L. camera* and *T. diversifolia* had a stronger positive influence on AM spore formation than other organic materials.

Eight AMF ecotypes such as *Acaulospora scobitulata, A. spinosa, Acaulospora* sp., *Glomus macrcarpon, G. constrictum*, *G. clarum, Glomus* sp. and *Scutellospora* sp. were found in the rainy season experimental soils, showing consistent differences with regard to their tolerance to the presence of different organic matter. The authors conclude, based on the results of this study, that diversity of AMF population were modified in eroded soils. It shows that increasing AM spores in the soil use the organic matter and maintain clean water, good air and soil quality, stabilize climate by using carbon dioxide of the atmosphere for photosynthesis. So, biological diversity is one of the major challenges that human beings have to deal in the next millennium.

Key words: Organic matter, arbuscular mycorrhizae, environment, Baluwa forest, eroded place

SVI/O-26 Study of Genetic Diversity Based on Specific Alkaloids in Opium Poppy (*Papaver somniferum* L.)

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Papaver somniferum is a chief source of diverse, physiologically active alkaloids and known to mankind since antiquity. Among the opium producing countries, India is one of the largest producers of licit opium, which meets national and international demand. In recent years, global trends show that the consumption of opium alkaloids and its derivatives are growing drastically. Despite this, the international trend shows, it is likely that there will be a new domestic and international demand for thebaine based drugs. Its utilization has increased from 5-8 MTs from 1981-1994 to 46 MTs in 2000. Since thebaine is used as base component for the manufacture of semi-synthetic morphine analogous i.e. oxycodone, oxymorphine, buprenorphine etc. and having no narcotic effect, which increases its global demand. Keeping in view, the drastically increasing demand of opium alkaloids and its derivatives, India being a main producer should trap this demand and increase its share of export. To capture this increasing demand, only way is to increase the production of thebaine, which can be achieved by the development of high opium yielding varieties with high specific alkaloids. These varieties can be developed through hybridization involving promising parents with specific alkaloids followed by rigorous selection. So, the selection of divergent parents is most important, as the greater genetic divergence among the parents for the characters, better would be the chances of releasing the variability. To study the genetic divergence, multivariate analysis is a powerful tool for determining the degree of divergence between populations, the relative contribution of different components to the total divergence and the nature of forces operating at different levels. Several studies on genetic diversity based on morphological traits have been carried out in past but no attempt has been made for alkaloidal diversity. In the present investigation 122 accessions of poppy were assessed to study the genetic divergence among them. These accessions were grouped into 11 clusters. The clustering pattern indicated that majority of the accessions i.e. 88 (72%) were grouped in five clusters and the rest of the accessions distributed over six clusters. Intra and inter cluster distance ranged from 60.96 to 485.06 and from 155.39 to 2676.09 respectively. Papaverine content (42.37%) followed by narcotine content (30.42%) was found to be main contributors towards total divergence. First three principal components accounted more than 78% of total variance. The accessions with low morphine and high papaverine content were accumulated in one cluster and the accessions with low papaverine and high morphine content accumulated in other cluster which suggested that there could be one or more genetic block(s) in the normal biosynthetic pathway of major alkaloids.

Key words: Genetic diversity, *Papaver somniferum*, alkaloids, multivariate analysis

SVI/O-27 Urban Air Pollution Modeling for Chennai City

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Air pollution constitutes a serious environmental concern particularly in urban areas like Chennai. In that, traffic is the predominant source of air pollution in urban areas. The impact of transportation system on air quality is such that mitigation measures are mandatory to ensure the safety of the environment for the future generation. Modeling of air quality is a useful technique to determine the air quality impacts of the environment or new transportation projects.

The objective of the present study was to predict the pollutant concentration using Mobile 6 and Caline 4 models and to ascertain the validity of such models in Indian scenario. The most crucial parameter of the models was emission factor that can be estimated using Mobile 6. The emission factors of vehicle can be obtained from the values as published by the Indian Institute of Petroleum (IIP) for Indian conditions and also by using the Mobile 6 model. The Mobile 6 model predicts the emission factors of vehicles of different types. In this study the emission factors have been determined by Mobile 6 and compared with the Indian Institute of Petroleum estimated values. However the emission factor that helped in predicting the concentration of CO and NO_2 accurately has been considered accurate. Caline 4 model was used to predict the pollutant concentration of pollutants in the ambient air due to emissions from automobile. The model predicted the concentration of Carbon monoxide (CO) and Nitrogen dioxide (NO_2) for different wind speed and stability conditions.

Four sampling points were selected for this study in Grand South Trunk road (GST) and Inner Ring Road (IIR) Chennai and are (i) near Vijay Park at Vadapalani, (ii) near Kasi Theater Bridge at Ekkaduthangal,

(iii) Shanthi petrol bunk at Pzhavanthangal, (iv) near Madras Institute of Technology (MIT) at Chromepet. The traffic density data and metrological data were collected in the field and were used in the model. For the purpose of validation of the model CO and NO_2 for various sampling stations were measured for different time periods. Mobile 6 predicted emission factor used in Caline 4 model, all CO concentration predictions fall within the range of 56% to 153% with the observed values and all NO_2 concentration predictions fall within the range of 50% to 153% with the observed values. Indian Institute of Petroleum (IIP) estimated emission factor used in Caline 4 model, all CO concentrations predictions fall within the range of 58% to 155% with the observed values and all NO_2 concentration predictions fall within the range of 58% to 158% with the observed values.

The detailed statistical analysis between the measured and predicted concentration was done using the statistical parameter to assess the accuracy of the model. For CO concentration, it is therefore concluded that the Indian Institute of Petroleum (IIP) estimated emission factor used in Caline 4 model is suitable for Indian road condition, when compared with that of Mobile 6 model. For NO_2 concentration, it is concluded that the Mobile 6 model predicted emission factor accurately and the Caline 4 model coupled with Mobile 6 emission factor is suitable for Indian road condition.

Key words: Air quality model, Mobile 6, Caline 4, carbon monoxide, nitrogen oxides

SVI/O-28 Cyanotoxins : Characterization and Impacts on Mammals along with Aquatic Organisms

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Cyanobacterial toxins are the naturally produced poisons stored in the cells of certain species of cyanobacteria. These toxins fall into various categories. Some are known to attack the liver (hepatotoxins) or the nervous system (neurotoxins); others simply irritate the skin. These toxins are usually released into water when the cells rupture or die. Very few cyanobacterial toxins have actually been isolated and characterized to date. Better methods of detection are being developed to help us learn more about them, especially to find out which toxins are problematic in aquatic resources and what conditions encourage their production. Although the toxins appear in general to be more toxic to mammals, including humans, then aquatic organisms. The toxicity of many lake populations of cyanobacteria is known to have an effect on some potential zooplankton grazers and the toxins may thus have an important effect on the food web in a lake. The detailed distribution of cyanotoxins in correlation with their effects, types, mode of actions will be discussed during presentation.

Key words: Cyanotoxins, cyanobacteria, food web, mammals

SVI/P-1 Comparative Study of Two Toxicant on Two Species Prey Predator System

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In this paper a mathematical model is proposed to study the comparative behavior of two toxicant on two species prey predator system. The rate of emission of toxicant is taken to be constant. With the existence of interior equilibrium point we also derived the condition for the local and global stability of the system. Finally, we have discussed the ecological interpretation with numerical example.

Key words: Mathematical model, toxicant, prey predator system, ecology

SVI/P-2 Impact of Crude Oil on Productivity of Algal Periphyton Communities in Artificial Streams

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An experimental evaluation of the effect of crude oil carried out using indoor artificial streams in order to assess long-term (24 day) exposure of periphyton community to the pollutant. Using a gradient (0, 0.2, 0.4, 0.8, 1.6, 3.2 ml l^{-1}) of crude oil contamination the responses of the algal community assessed by measuring algal biomass, ash-free dry mass (AFDM), and chlorophyll *a.* Results obtained from this experiment showed that concentrations ranging from 0.2 to 0.8 ml l^{-1} has increased biomass in algal periphyton. Following enhancing effect of crude oil on algal productivity at low concentration (0.2 to 0.8 ml l^{-1}), a decreasing effect observed at concentration 1 to 3.2 ml l^{-1}. The changes observed at concentrations ranging from 0.2 to 0.8 ml were not significantly different when compared to control. While decreases observed in biomass, AFDM and chlorophyll *a* at concentrations ranging from 1 to 3.2 ml were significantly ($p<0.05$) different from control. This experiment demonstrates that long-term exposure of the periphyton community to crude oil causes reduction of biomass, AFDM and chlorophyll *a* respectively.

Key words: petroleum hydrocarbons, crude oil contamination, periphyton, artificial streams

SVI/P-3 Evaluation of Decentralised Composting Systems

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Municipal solid wastes are collected irregularly and dumped in uncontrolled manner or burned in outskirts of cities causing environmental and public health problems. The present study was aimed to develop a decentralised composting system in terracotta vessel and to compare with similar composting systems. Both aerobic and vermicomposting of municipal solid waste in terracotta vessel and compost bins have been attempted.

Aaerobic composting of organic waste was done in compost bins, terracotta pots and terracotta vessel. Aerobic composting of municipal solid waste for three months resulted in a volume reduction of 47% in compost bins, 58% in terracotta vessels and 95% in terracotta pots. Carbon and nitrogen of the substrate decreased gradually during the study period.

Vermicomposting of organic waste was done in terracotta vessel of height 60 cm and radius 45 cm using earthworms like *Lampito mauritii, Eudrillus eugeniae* and *Eisenia foetida.* Vermicomposting was monitored for pH, moisture content, carbon and nitrogen. Vermicomposting in terracotta vessel reduced the substrate volume by 70% in three months. Carbon and nitrogen of the substrate decreased gradually during the study period.

Aerobic composting of organic waste in terracotta vessel has proved to be suitable option for composting at household level.

Key words: Municipal solid waste, vermicomposting, terracotta vessel

SVI/P-4 Organochlorine Insecticides in Summer Fruits and Vegetables Growing on River-bed Side

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The use of organochlorine insecticides (OCI) in developing countries has been of serious concern because of their persistent nature. Pesticides, in large amounts, are being used in agricultural sector and public health programmes every year. As a consequence of insecticide use, the presence of residues in food commodities is insecticide. Considerable levels of OCIs have been detected in different components of environment such as air, water, soil, plants and animals. Although, insecticide residue analysis has been done in several food commodities, the present study deals with the analysis of organochlorine insecticide residues in summer fruits and vegetables, procured from different places near river Ganges at Kanpur, Varanasi and Haridwar. Most of the fruits and vegetables selected for the study have widespread distribution in the country and are popular summer delicacies. The concentrations of HCH isomers and DDT metabolites in fruits and vegetables will be presented. However, the results have shown that the levels of HCH are more than the levels of DDT in majority of the samples.

Key words: HCH isomers, DDT metabolites, summer fruits, vegetables

SVI/P-5 Impact of Organic Farming on Growth, Yield and Fruit Qualities in Cherry-Tomato

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After green revolution in India, the farmers are facing problems of severe/ drastic reduction in yield, soil degradation and soil sickness. Desertification of soil micro flora, along with various types of environmental pollution and other factors such as health hazard are threatening the very existence of human beings on this planet earth.

Hence, there is an urgent need to keep up the pace of the present development and ensure the prospects of development for the future generations, which can be achieved through sustainable agricultural systems.

Various treatments of organic manures in different combinations were applied to cherry tomato, variety Unnati on Aga farms Dist. Pune (Maharashtra) India, during the year 2004-05 maintaining control as untreated ones. From the overall results it was inferred that the treatment T3 (FYM + Ormichem + Sheep manure + Dynamic lifter) emerged as the best combination of organic manures as compared to the other treatments and control, for improving plant height, number of branches per plant, number of leaves and leaf area per plant. This treatment resulted in increased number of fruits per plant and higher yield. This organic farming treatment was also responsible for improving the processing and nutritional qualities along with post harvest life of the fruits.

Key words: Organic farming, growth, yield, processing, nutritional qualities, post-harvest life

SVI/P-6 Bio – Terrorism

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Terrorism is the catchword during the post 9/11 world. A term profusely used by all and sundry with least conceptualization of sociopolitical and economic contexts. Bio-terrorism can be defined as using any 'biological agent' to terrorize the 'others' by threatening of mass destruction catching them unaware. It can be also defined as wanton destruction of environmental and biological resources of 'one' by the 'powerful' in an irreversible manner. USA can be credited with pioneering the practice of Bio-terrorism in 60's, of last century in Vietnam. This paper shall attempt to cognate the various views on Bio-terrorism with a historical perspective so that the real 'focus' can be brought about.

Key words: Bio-terrorism, biological agent, mass destruction

SVI/P-7 Bio – Informatics

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Bio informatics is the endeavor to use information science and technology for upgrading the information already available in biological science as well as to come out with new insights and breakthroughs. It is an upcoming and promising field of activity and India as a country with a vast mass of educated people in information science can really make a mark in applying this activity even in environmental sciences. Being a leader in space technology among the developing nations further helps because it enormously increases the information potential. All kind of tools in mathematics i.e., equations and processor aimed at analysis can be useful (a bit lower or higher mathematics) in Bio informatics. Naturally the data processed being vast, processing machines- computers, need to be used as an aid henceforth is the relevance of appropriate software and their upgradation. Molecular Biology and its applied aspects like genetic engineering, Biotechnology, Protein designing, etc. are the beneficiaries of evolution of Bio informatics. In this paper a bird's eye view of Bio informatics with special emphasis on plant and environmental pollution is being presented.

Key words: Bio-informatics, mass education, mathematics

SVI/P-8 Antibacterial Activity of Different Polar Fractions of *Callistemon* species

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Callistemon lanceolatus is a small evergreen tree with alternate linear- lanceolate leaves having crimson flower in spike (like the brush of bottle). It is a medium sized tree, cultivated as an ornamental plant in the garden. *Callistemon viminalis* is exotic tree very commonly cultivated in the Indian garden. The farmer produces very large quantities of nectar and is much sought after in flowers by bees. *Callistemon* belong to family *Myrtaceae.* The family *Myrtaceae* consists of 100 to 150 genera and 3000 to 3500 sp distributed in tropical and sub-tropical regions confined mostly to Australia. Antimicrobial activities of different concentrations of methanolic and acetone soluble fractions of *Callistemon lanceolatus* and *C. viminalis* were investigated against six bacterial strains i.e., *Staphylococcus aureus, Escherchia coli, Klebsiella pneumoniae, Micrococcus luteus, Bacillus cereus and Bacillus pumilus. B*oth the extracts of *C. viminalis* and *C. lanceolatus* showed significant antibacterial activity against *Micrococcus luteus, Bacillus cereus* and *Bacillus pumilus,* however, both the fractions were found to be inactive against *E. coli, Klebsiellae pneumoniae* and *Staphylococcus aureus* strains, respectively. Methanolic fraction showed higher antibacterial activity at lower concentration than of acetone extract against all the bacterial strains investigated.

Key words: *Callistemon viminalis, Callistemon lanceolatus, Bacillus pumilus, Micrococcus luteus, Bacillus cereus*

SVI/P-9 Evaluation of *Acorus calamus* Oil in Post Harvest Management

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So far, pesticides have been the main weapons in controlling the pests in pre as well as post harvest management. Today we use around 81,000 metric tones of technical grade (80 % for agriculture and 20 % for public health). This becomes more significant as 67 % of the total pesticides are used in cotton and rice. Indiscriminate use of chemical pesticide has given rise to many well-known and severe problems including genetic resistance to pest species, toxic residues in stored products, increasing cost and dangerous handling. These problems increased the need for effective, cheaper and safe biodegradable pesticides. Use of botanical pesticides having broad-spectrum activities is safe as well as cheaper alternative to widely used synthetic pesticides.

Post harvest losses are more severe than pre harvest as it affects human population. Worldwide loss of foodstuff due to insects and rodents has been estimated by FAO of the United Nations as about 20 % (30 % in Asia and Africa and 10 % in Europe and North America). Several botanicals are being evaluated for the post harvest management, among which *Acorus calamus* (vach) is very important. Essential oil (calamus oil) is known to possess several insecticidal properties. In this way we have checked the efficacy of calamus oil against three major pests of stored products.

Contact and fumigant toxicity and repellency of essential oil of *A. calamus* (calamus oil) were evaluated in preliminary screening tests on three important pests of stored product pests including red flour beetle; *Tribolium castaneum*, khapra beetle; *Trgoderma granarium* and rice weevil; *Sitophilus oryzae*. Calumus oil was the most toxic against *S. oryzae* (LD_{50}= 1.2 ìg per insect) followed by *T. granarium* (5.4 ìg per insect) and *T. castaneum* (25.3 ìg per insect) when applied topically. The same trend was found in case of fumigant toxicity with LD_{50} values 7.38, 20.2 and 23.6 mg l^{-1} air for *S. oryzae*, *T. granarium* and *T. castaneum,* respectively. On the other hand maximum repellency was observed against *T. castaneum* (LD_{50}= 0.016 mg cm^{-2}) followed by *S. oryzae* (0.69 mg cm^{-2}) and *T. granarium* (0.92 mg cm^{-2}). The presence of high concentration of â - asarone is a major deterrent for use of calamus oil in pest management; however, it can be effectively used in lower concentrations in combination with other botanicals under proper supervision.

Key words: Botanical, *Acorus calamus*, essential oil, stored product pest

SVI/P10 A Comparative Study of Nutrient Status of Peel and Edible Portion of Bottle Gourd (*Lagenaria siceraria*) Grown in Kumaon Hills of Pithoragarh

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Besides rich and cheaper source of minerals and vitamins, vegetables are excellent source of fiber. In modern society, most of the vegetables are consumed after skin is peeled off, which results in considerable loss of nutrients. Bottle gourd (*Lagenaria siceraria*) is one such vegetable which is consumed after discarding the outer skin and the inner pith portion. Loss of nutrients in the peel was investigated to assess loss of nutrients. Peel and edible portions of seven varieties of bottle gourd grown in Kumaon Hills of Pithoragarh, were separated and analyzed for moisture, total sugar, total soluble solids, vitamin E, total minerals, protein, fat and crude fibers by standard methods of AOAC. FTIR spectra of the two portions were recorded to assess nature of nutrients in the two portions. Both edible and peel portions contained minerals however different metal ions in the two portions were linked with different atoms. Co-relation co-efficient between the variables for edible and peel portions were calculated. The study suggests nutrient value of peel. Incase this is not a preferred portion for food, it can be suitably utilized as feed.

Key words: Bottle Gourd, vitamin C, total minerals, protein, crude fibers

SVI/P-11 Increasing Trend of Cotton Pink Bollworm, *Pectinophora gossypiella* (Saunders) in Madhya Pradesh (India)

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Cotton is a commercial fibre crop of India and Madhya Pradesh. It occupies about 0.6 million hectares area in the state and produces about 1.7 million bales of lint. The productivity of cotton is low in comparison to the world due to several abiotic and biotic factors. Among the biotic factors insect pest plays a major role to causing the quantitative and qualitative seed cotton yield losses. The bollworms *viz*. spotted bollworm, American bollworm and pink bollworm are the most important because they damage mainly the reproductive parts of cotton plant. Among them pink bollworm *Pectinophora gossypiella* (Saunders) is considered as a major pests in many parts of the world including India. This study was carried out at J.N. Agricultural University, Regional Agricultural Research Station, Khandwa during 1995-96 and 2004-05, with the objective to find out the seasonal activity and extent of damage to the crop. On the basis of weekly survey data of ten years, it is revealed that the *P. gossypiella* incidence was initiated during 38 Standard Meteorological Week (SMW) in year 2003-04 with 0.7 per cent damage on reproductive bodies and maximum duration of pest activity have also been observed till 05 SMW, whereas, it was 39 SMW, 40 SWM, 41 SMW, 42 SMW and 44 SMW in the year 1995-96, 96-97, 97-98, 98-99, 99-00, 00-01 and 01-02, respectively. During the year 2002-03, the incidence was recorded from 48 SMW with 0.3 per cent and was remained up to 52 SMW. The maximum 33.5 per cent incidence was recorded during 1998-99 along with 47 SMW and active up to 05 SMW with 3.2 per cent damage.

Average of ten-year observations indicate that the pest appears in the 38 SMW with the initial losses about 0.7 per cent, however, the incidence reached its peak during 47 SMW (14.06 per cent).

Key words: Increasing trend, cotton, *Pectinophora gossypiella*

SVI/P-12 Comparative Study of Viscosity for Biodiesel Blend of *Pongamia* Oil

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India ranks 6th in the world in terms of energy demand. The energy demand is expected to grow at the rate of 4.85% per annum. Out of 113 mt crude oil production in 2003-04 in the country, the consumption of diesel fuel was accounted for nearly 40%. The rate of growth of diesel consumption is increasing rapidly. Since the world is facing the problem of limited fossil fuel resources coupled with environmental degradation, there is an urgent challenge for finding the alternative to conventional liquid fuel with especial reference to the diesel fuel. Biodiesel has been reported to be an ideal and ecofriendly liquid fuel capable of substituting the diesel in certain proportion. Literature survey has revealed that mixing of biodiesel with diesel in 20% proportion gives optimum engine operation in terms of power output. No systematic work has been reported which can give an idea about the fuel properties changes with respect to blending. The present paper will

attempt to determine the viscosity of the mixture of biodiesel and diesel to get a standard curve which could help to determine the viscosity of mixture of given blends. The percentage of blend, based upon the viscosity, may be directly used to presses the performance of the engine. Various methods for viscosity determination have been used and compared in order to find out the viscosity for specific blend.

Key words: Biodiesel, blend, calorific value, density, viscosity

SVI/P-13 *Jatropha* - A Hope for Biodiesel in Uttar Pradesh

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In the era of fuel scarcity and global warming, there is an urgent need to search of an alternative fuel for the substitution of conventional fuel. At present, the whole world is looking towards utilization of biodiesel in certain proportion (20% v/v) mixed with diesel. Uttar Pradesh state road transport corporation (UPSRTC) has consumed around 24 million liters diesel fuel in the year 2004 and expected to consume around 33.6 million liters of diesel by the year 2012. So approximately 6.8 million liters of diesel can be substituted by biodiesel at blend rate of 20%. The use of biodiesel would also reduce the GHG emission compared to diesel. This will secure the availability of diesel as well as environment safety for future generation also. Uttar Pradesh has vast amount of waste land (14 lakh hectares) which has potential of around 1900 million liters (as per Planning Commission, Government of India, 1363 liters ha^{-1}) of biodiesel derived from *Jatropha*. By the use of biodiesel in UPSRTC, around 19,500 tons of CO_2 emission per year would be reduced compared to diesel.

Key words: UPSRTC, biodiesel blends, calorific value, *Jatropha*

SVI/P-14 Tree Cover on Sea Coasts can Mitigate Tsunami Disaster

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Tsunami is a giant tidal wave of sea water made up of several strong waves, rolling into the sea shore and rising beyond 15m. It can be caused by undersea earthquake, as in the 2004 Indian Ocean earthquake, or by landslide such as the one which occurred at Lituya Bay, Alaska in 1964. Volcanoes can become a cause of Tsunami as in the Sunda Bay, Indonesia in 1883.

Tsunami can not be prevented or precisely predicted, but its effect can be mitigated by natural prevention such as the tree-cover on the sea shore line. Some locations in the path of the 2004 Indian Ocean Tsunami escaped almost unscathed. It was observed in these locations that Tsunami's intensity was snapped up by a belt of trees of coconut palms and mangroves. Mangroves serve as a natural buffer to strong winds and waves produced by Tsunami and allied events. The Palmyra tree plantation can become revolutionary prevention step for disaster management as they check sea incursion. It's protruding trunks that stand two metre high would act as a retention wall for the sand washed ashore.

Environmentalists and disaster management specialists have suggested tree planting along stretches of sea coast which are prone to Tsunami. Such plantation can offer a much cheaper and longer-lasting means of Tsunami mitigation than the costly and environmentally destructive measures of erecting artificial barriers.

Key words: Mitigate, Tsunami, disaster, landslide, mangroves, Palmyra tree, sea incursion

SVI/P-15 Seaweed Farming as an Environment Friendly Alternative Mode of Employment for Coastal Residents of Sri Lanka

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Seaweeds which have a wide range of uses possess great economic potential. Being a tropical island, Sri Lanka has a rich base of marine resources, which however have not been sufficiently utilized and available studies on their distribution and utilization are grossly inadequate. The coastal inhabitants of Sri Lanka depend to greater extents on fishing industry. However destructive activities such as sand and coral mining, coral fish catch are prevalent. This paper intends to investigate the potential of developing seaweed farming as an alternative employment avenue for the coastal inhabitants who depend for their livelihood on such destructive activities such as coral and sand mining. Sri Lanka's 1600km long coastline has abundant habitats rich in marine algal flora. 396 species (147 genera within 56 families) are known to occur among them. This includes the recently identified 11 new species by the authors. The following species have been identified as the most suitable species that can be used in seaweed farming on the basis of their growth rates, yield of agar, as a source of food etc.: *Gracilaria verrucosa, G. edulis, G. compressa, G. crassa, G. corticata, G. folifera, Gelidium micropterum, Hypnea musciformis, Sagassum tennerium, Ulva sp., Caulerpa sp., Codium sp., Enteromorpha sp., Turbinaria sp., Ahnfeltia sp.* and *Gelidiella sp.*

Investigations have identified many suitable sites for seaweed cultivation along the southern coast (e.g. Rekawa lagoon), western coast (eg. Puttalam lagoon) and on the eastern coast (e.g. Trincomalee) which conform to required salinity, depth and turbidity levels. *Hypnea* sp. was found to grow well on abandoned shrimp ponds which are found in large numbers along the western coast. *Euchema* sp. has been successfully cultivated in test cages placed at suitable locations in the ocean. Ocean sites could also be modified through shelter structures for successful cultivation. The most suitable methods adopted for sea weed culture are the long line, fixed off bottom and raft methods. According to available data, the market value of seaweeds could range from $400-600 per metric ton and could bring a monthly income of around 7,000-10,000 SL rupees for a family. The average cost of living of a 4 member family in the coastal zone ranges from SL rupees 5,000-7,500 p.m.

Key words: Algae, farming, corals, sand, mining, alternate employment, income

SVI/P-16 Fluoride Content in Ground water from Southwest Region of District Unnao, U.P.

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The significance of fluoride in water has always been a subject of debate. As on one hand intake of fluoride in controlled quantity is considered beneficial (less than 1.0 mg l^{-1}) for human health in preventing dental cavities, while on the other hand excessive intake is known to cause dental and skeletal fluorosis. The recent implication, though not universally accepted, of involvement of fluoride in acting as carcinogen and mutagen, has added yet another dimension to the unresolved role of fluoride on human health. It was thought worthwhile to monitor the levels of fluoride concentration in southwest region of district Unnao, Uttar Pradesh.

Fluoride concentration in ground water, in India, varies considerably. In some parts, the fluoride levels were below 0.5 mg l^{-1} while at certain other places values as high as 20 ppm were reported. The high fluoride content in ground water is generally associated with low con-

centrations of calcium, magnesium and high concentrations of bicarbonates and in certain cases nitrate ions. Results of the analyses of water samples of south-west region of Unnao District indicated the fluoride levels to range from 0.21-4.8 mg l^{-1}. The results of the analysis will be discussed.

Key words: Fluoride concentration, ground water, fluorosis

BVI/P-17 Bio-Efficacy of Pesticides Against Teak Skeletonizor, *Eutectona machaeralis* Walk. on Teak Seedlings

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The teak (*Tectona grandis* Linn. f.) is an important and valuable timber tree species of India. It provides best quality hard wood for making furniture. Forest department annually raise teak seedlings in large scale for afforestation programme. In Madhya Pradesh, number of insect pests cause damage to seedlings among which the defoliator, *Hyblaea puera* Cramer and teak skeletonizer, *Eutectona machaeralis* Walk. are observed as major pests and reduce the vigor of seedlings and stunt the growth by damaging foliage and skeletonizing them through eating on parenchymatous tissues.

'The present studies were carried out during 1999-2000 and 2000-2001 at Karaboh forest nursery of Chhindwara district Madhya Pradesh (India) to evaluate the insecticides of chemical and botanical origin against the *E. machaeralis*, during 1999-2000. All the treatments were found effective over control, seven days after the spray. Profenophos 50EC was found best followed by acephate 75SP. It was statistically at par with profenophos 50EC. Lamdacyhalothrin 5EC and triazophos 40EC, were statistically at par with that of acephate 75SP, Quinalphos 25EC, endosulfan 35EC and monocrotophos 36EC. Achook® was also effective with only 7.03 larvae per quadrate. The number of larvae per quadrate, in control bed, was 13.79. After fifteen days, monocrotophos 36EC remained effective and statistically similar to acephate 75SP. Triazophos 40EC, quinalphos 25EC and monocrotophos 36EC were next in activity. Lambdacyhalothrin 5EC and Achook® were least effective and statistically similar to the control.

During 2000-01, seven days after the spray, results were quite similar to the previous year. Profenophos 50EC was found most effective with 2.37 mean larvae per quadrate and statistically similar to the next effective insecticide acephate 75SP. Monocrotophos 36EC followed in activity, although, it differed significantly with that of control and Achook®, but was statistically at par with that of quinalphos 25EC, endosulfan 35EC, lambdacyhalothrin 5EC and triazophos 40EC. After fifteen days, the results obtained were with some deviation. Profenophos 50EC, although, was most effective with 6.73 mean larval population, but did not differ significantly with that of acephate 75SP. Triazophos 40EC followed in activity and was at par with acephate 75SP, Quinalphos 25EC, endosulfan 35EC and monocrotophos 36EC.

Key words: Teak, *Hyblaea puera, Eutectona machaeralis*, pesticides, bio-efficacy

SVI/P-18 Dimethyl Sulfoxide Induced Early Maturing Mutants in Jute (*Corchorus olitorius* L.)

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Presoaked seeds of jute (*Corchorus olitorius* L. var. JRO-632) were treated with 1% Dimethyl Sulfoxide (DMSO) for 6 hours. Early maturing mutants were screened in M_3 in contrast to the normal looking flowering plants. A number of yield component parameters were recorded including plant height, basal diameter, plant spread, root length, pod per plant, seeds per pod, pod length/breadth ratio, number of primary branches, number of secondary branches, leaf angle, branching angle, first flowering date, 100% flowering date, total duration, % of pollen sterility, and weight of 100 seeds, which were found to vary from the control plant. Chromosome analysis revealed aberrations like stickiness, fragmentation, polyploidy, clumping, laggard and bridge formation, etc.

Key words: Jute, dimethyl sulfoxide, early maturing mutants, plant growth, chromosome

SVI/P-19 Field and Residual Toxicity of Endosulfan and Monocrotophos to Honeybee spp. and their Foraging Behaviour in Fennel (*Foeniculum vulgare* Mill.)

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Field and residual toxicity of two insecticides namely endosulfan 35 EC and monocrotophos 36 SL to four honeybee species viz., *Apis mellifera* L., *A. dorsata, A. florea* F. and *A. cerana* F. were carried out on fennel seed crop during 2002-03 at CCS Haryana Agricultural University, Hisar. Endosulfan (2 ml l^{-1}) and monocrotophos (1 ml l^{-1}) caused 35-70 and 10-40% bee mortality during spray. Residual toxicity of endosulfan persisted even after 72h of their application against *A. mellifera* and *A. dorsata*. It became safer for *A. florea* and *A. cerana* after 2nd and 3rd day of their application on crop, respectively. Monocrotophos was found to be extremely toxic to *A. cerana* even after three days of spray as it killed 50 per cent of its foragers. However, it was found safer to other three species after 2nd day of its application on fennel. Reasons for susceptibility differences among species are discussed. Insect abundance and foraging behaviour of *Apis florea* and *A. cerana* were evaluated during present study. *A. florea, A. cerana, Polistes* spp. and ten dipteran flies (Syrphid) visited the fennel crop during blooming season. *A. florea* was the predominant pollinator in terms of abundance, time spent on flower and number of flowers visited by single bee in five minutes.

Key words: Fennel, field toxicity, honey bee spp., insecticides, residual toxicity

SVI/P-20 *In vitro* Propagation of *Aconitum heterophyllum* L. through Nodal Explant: An Endangered Medicinal Plant

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A protocol has been developed for *in vitro* shoot proliferation from callus cultures of *Aconitum heterophyllum*. Callus initiation occurs from nodal segments on MS basal medium fortified with NAA (0.5 mg l^{-1}) and BAP (0.25 mg l^{-1}). Callus was transferred on MS basal medium supplemented with BAP (0.25 mg l^{-1}) for shoot proliferation. The best response for shoot proliferation was obtained in MS+NAA (0.2 mg l^{-1}) + BAP (0.25 mg l^{-1}). The well developed shootlets were transferred to root induction medium containing MS+ IAA (1 mg l^{-1}). The rooted plantlets were finally transferred to green house for hardening and field transfer.

Key words: Nodal segments, explant, *Aconitum heterophyllum*

SVI/P-21 Medico-Ethnobotanical Importance of some Weeds of Kota District of Rajasthan

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The term weed is applied to plant species growing where it is not required. In normal course the weeds are uprooted and thrown away. It would be of interest to find out the utility of such weeds. The aim of present study is to know some weeds, which have medico-ethnobotanical importance.

Although weeds, in general, are harmful to the crop but some of them may be useful for man. Many such wild plants are still popular and are used as medicinal plants in India. A large number of weeds have medicinal properties. These weeds grow under extremes of temperature and varied climatic conditions. Indigenous medical practices have identified the usefulness of some weed plants as a source of medicine.

Present paper describes the medico-ethnobotanical importance of some weeds of Kota District of Rajasthan. The study revealed occurrence of more than 20 weed species, which have medico- ethnobotanical importance. The botanical names, family, local name and parts used as food, fodder, use in religious ceremonies and in treatment of a variety of diseases have also been described.

Key words: Medico-ethnobotanical, weeds, indigenous

SVI/P-22 Biodiversity : A Scenic Beauty of Ranthambhore National Park in Rajasthan

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Ranthambhore National Park is located in East Rajasthan in Sawai Madhopur district between $25^0$55' and $26^0$12' N latitude and $76^0$23' and $76^0$39' E longitude. It extends over about 392 sq. km. area. The Ranthambhore National Park adjoins Keladevi Sanctuary in the northeast and southwest direction. The forests of the park are in continuation with the Sawai Mansingh Sanctuary, which in turn further south-west touches the Kualaji Game Reserve.

Three main objectives of the study are:-

- To maintain essential ecological processes and life support systems on which human survival and development depends.
- To preserve genetic diversity on which such processes and systems as well as almost all-scientific, technical and medical progress depends.
- To ensure the sustainable utilization of species and ecosystems (forests, grazing lands, wildlife, fisheries etc.)

The poster describes the important medicinal plants in the national park with special reference to floristic diversity. It also describes flora as well as fauna present in the National Park.

Forests of Ranthambhore National Park are of dry deciduous type containing best *Anogeissus* forests of the state with associates like *Terminalia arjuna*(Arjun), *Butea monosperma* (Dhak), *Acacia catechu* (Khair), *Boswellia serrata* (Salar), *Sterculia urens* (Kadaya) etc. Some important plants like *Gloriosa superba*, *Mucuna pruriens* and *Centella asiatica* are also observed in the forest area.

Main fauna observed in the forest area are tiger, leopard, jungle cat, chital, sambar, nilgai, chinkara, sloth bear, wild boar, jackal, hyaena, common langur, common fox etc.

Key words: Biodiversity, national park, dry deciduous

SVI/P-23 Cytokinin Free Regeneration Protocol of an Endangered Medicinal Plant *Picrorhiza kurroa*

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An *in vitro* methodology has been developed for mass propagation of *Picrorhiza kurroa* Royle Ex Benth, an endangered medicinal plant without using cytokinin. Single media combination of media favour shoot as well as root formation in this species. MS medium supplemented with auxins were the best (5-100%). Among the various strengths of Murashige and Skoog media sucrose and growth regulators tested, MS basal media supplemented with 0.6 mg^{-l} showed the best response for shoot proliferation. Maximum nodes per shootlet were observed in medium containing lower percentage of sucrose and myoinositol while shootlengh was maximum in 0.8 mg^{-l}. The root induction per explants was maximum in the medium containing MS basal medium supplemented with 0.2 mg^{-l}. The rooted plantlets were hardened in polycups containing sterile soil, sand and vermiculite (1:1:1). Plantlets thus developed were successfully established and finally transferred to green house and then successfully transferred under field conditions

Key words: *Picrorhiza kurroa*, cytokinin, hardening, MS basal media

SVI/P-24 A Versatile Plant – Neem (*Azadirachta indica*)

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Neem, the versatile medicinal plant is the unique source of various types of compounds having diverse chemical structure. Very little work has been done on the biological activity and plausible medicinal applications of these compounds and hence extensive investigation is needed to exploit their therapeutic utility to combat diseases. A drug-development programme should be undertaken to develop modern drugs with the compounds isolated from Neem. Although crude extracts from various parts of Neem have medicinal applications from time immemorial, modern drugs can be developed after extensive investigation of its bioactivity, mechanism of action, pharmacotherapeutics, toxicity and after proper standardization and clinical trials. As the global scenario is now changing towards the use of non-toxic plant products having traditional medicinal use, development of modern drugs form neem should be emphasized for the control of various diseases. In fact, time has come to make good use of centuries-old knowledge on neem through modern approaches of agriculture development. For the last few years there has been an increasing trend and awareness in neem research. Quite a significant amount of research has already been carried out during the past few decades in exploring the chemistry of different parts of neem. Several therapeutically and industrially useful preparations and compounds have also been marketed, which generates enough encouragement among the scientists in exploring more information about this medicinal plant. An extensive research and development work should be undertaken on Neem and its products for their better economic therapeutic utilization.

Key words: Neem, medicinal plant, agricultural use, pollution

SVI/P-25 *Asterocapsa* Chu, an Aerophytic Cyanobacterium under Enviromental and Culture Conditions

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Cyanobacteria are the most ancient prokaryotic micro-organisms and they grow in all types of habitats including aerial, sub-aerial, aquatic, and terrestrial and so many other diverse habitats. The present communication deals with the development of a special type of ornamented envelope in an aerophytic Cyanobacterium, *Asterocapsa* Chu collected from exposed surface of an old monument and first time reported from India. In *Asterocapsa* collected from nature, a special type of ornamentation was observed in the envelopes; however, development of such type of envelopes was absent while growing in culture conditions. The development of ornamented envelopes was studied in cultural as well environmental condition continuously for three years. On the basis of cultural and environmental study it has been concluded that environmental factors are responsible for ornamentation in envelopes of *Asterocapsa*.

Key words: Cyanobacteria, aerophytic, *Asterocapsa*, ornamentation, envelope

SVI/P-26 Environmental Pollution Due to Persistent Organic Pollutants

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Our environment is suffering the critical stress in the form of chemical pollution these days. According to an estimate of Environmental Protection Agency (EPA), USA, there are about 80,000 chemicals registered for use in commercial products and an average of 2,000 - 3,000 new chemicals are registered every year. Out of these, 75 % have no basic toxicity information and more than 90 % have not been tested for their health effects on infant and children. Fetuses and infants are the population, which are more vulnerable and sensitive to the harmful effects of chemicals. A small disturbance in the highly choreographed process of development can have profound and long lasting effects on an infant, immediately as birth defects and later as subtle dysfunction of various systems. Pregnant and child-bearing age women are exposed to toxic chemicals in their environment and can pass these toxicants to the developing fetus via placenta and to the infant via milk. Persistent Organic Pollutants (POPs) which include certain chlorinated pesticides, PCBs, dioxins, and furans, are lipophilic and stable contaminants. The residues of these pollutants have been reported in a wide range of environmental media and biota from different parts of the world. However, there is paucity of data on the magnitude of these contaminants especially on dioxin and furans from our country. The data generated by our institute under a WHO sponsored multicentric program involving other countries on human milk samples indicated that the residues of b-BHC, pp'-DDE and pp'-DDT were highest in the developing countries like China, India and Mexico. Our recent study on biological monitoring of the congeners of dioxin and furan in the food and human milk samples collected from Gujarat indicated the presence of these contaminants in sizeable amounts. Residues of five congeners of dioxin and furan were detected in egg, chicken and human milk samples collected from the incinerator and waste disposal site of municipal corporation (Gujarat). The mean TEQs for total dioxin were 9.32, 9.38 and 6.35 pg/g in egg, chicken and human milk respectively. Findings suggested the contamination of our environment with highly toxic pollutants.

Key words: POPs, dioxin, bioaccumulation, food, human milk

SVI/P-27 Organic Cultivation of Coriander, Adopting Integrated Use of Traditional Manures and Biofertilizers

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The concept of organic farming is gaining growing importance throughout the world in view of increasing consumption of fertilizers and other plant protection chemicals leading to residual effects on soil degradation. India is a country with traditional farming for centuries and use of chemical fertilizers is only around 4 decades old. India is the largest producer, processor and exporter of spices. About 4,500 tonnes of coriander seeds are exported annually, earning 2.53 million US$. The spice export has recorded approximately 20% increase in last few years, and organically grown spices have shown better promise than the conventional ones. In spite of this encouraging scenario, organic cultivation of spices could not get enough momentum and so far about 13,000 ha of land (0.01%) had been brought under formal organic farming system in India.

A field experiment was planned on organic cultivation of coriander on partially reclaimed sodic soils in Randomized Block Design with 4 replications and 7 treatments, comprising of control, recommended NPK, *Bacillus* (Anmol Biophos @ 10 kg ha^{-1}), *Pseudomonas* (Anmol Pseudo @ 2.5 kg/ha), *Azotobacter* (Vasudha biobooster @ 6 kg ha^{-1}), their combinations and commercial organic manure with FYM. All the biofertilizers and manures were applied as basal dose. The crop was grown by seeds in the *Rabi* season of 2004-05, and observations were recorded on plant height, number of branches and umbels per plant, and yield. The highest seed yield was recorded with integrated use of FYM and biofertilizers (1.37 t ha^{-1}), closely followed by combination of Celrich and biofertilizers (1.27 t ha^{-1}), and significantly superior than recommended dose of NPK (1.12 t ha^{-1}). The bacterial fertilizers alone could bring significant improvement in yield (0.96-0.98 t ha^{-1}), when compared with control (0.85 t ha^{-1}), though the differences among different biofertilizers viz., *Azotobacter, Bacillus* and *Pseudomonas* were non-significant. The yield levels recorded on partially reclaimed sodic soils were found comparable with normal soils.

Key words: Coriander, organic cultivation, biofertilizers

SVI/P-28 Effect of Sulfur Dioxide on Health Status of Persons Residing in Industrial Vicinity of Faisalabad, Pakistan

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Air pollution has been attributed to the reduction and impairment of wildlife population, birds, mammals and insects. Once SO_2 is released into atmosphere, it may be converted to other compounds that cause serious effects. In the present study, health status of male and female residing in the industrial vicinity was analyzed to seek the toxic effects of SO_2. The correlation between SO_2 in the environment and biochemical parameters was established. Results revealed that hemoglobin level of female was significantly decreased as compared to male while erythrocyte sedimentation rate was much raised. No considerable effect on total leukocyte and differential leukocyte count was observed. A remarkable effect on immunity was detected especially in female workers as IgE and IgG levels were increased when tested though ELISA.

Key words: SO_2, haemoglobin, ESR, TLC, DLC, ELISA

SVI/P-29 Industrial Applications of Galactomannan

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Galactomannans are mainly found in the endosperm of seeds from the leguminosae or pea family. Important sources are the seeds of *Cyamopsis tetragonoloba* for galactomannan 1,2 (guar), *Caesalpinia spinosa* for galactomannan 1,3 (tora), *Ceretonia siliqua* for galactomannan 1,4 (locust bean) and *Cassia tora* for galactomannan 1,5 (cassia gum). These polysaccharides are used either in their native states or as carboxyyallely, hydroxyalkyl trimethylammoniumalkyl- derivatives to thicken aqueous systems. Their properties depends mainly on their chemical structure, i.e. chain length, availability of cis- 0H groups, steric hinderance, substituted chain length i.e., molecular weight of the polysaccharide influence viscosity and the rheological properties of the aqueous solution. Solubility in water depends on the extent of intermolecular hydrogen bonding and where steric hinderence keeps the chain at such distance from each other that water can penetrate in between and hydrate or dissolve the galactomannan. The textile industry uses galactomannan and derivatives, thereof, in printing inks and as sizes for textile weaving. The paper industry makes use of the galactomannan in paper coating for retention and thickening in paper coating, and also in printing inks. Galactomannans and their derivatives also play an important role as ameliorating agents in drilling fluids and oil recovery, and in the suspension and flotation of minerals, but the main field of application is still the use as gelling or thickening agents in the feed and food industries.

Key words: Galactomannan, leguminoseae, polysaccharides, viscosity, derivative, bonding

SVI/P-30 Degradation of *Jatropha curcas* oil and biodiesel

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Biodiesel can replace or blend with petroleum diesel with little or no engine modifications, it is a viable alternative to several categories, including recreational boats, inland commercial and ocean-going commercial ships, Army and Navy Fleet. Small boats that are used frequently in rivers can use biodiesel since biodiesel has been found to be relatively harmless for fishes and other aquatic flora and fauna. Independent third-party, peer-reviewed studies show that biodiesel has the highest energy balance of any fuel and is a renewable source of energy. However, while biodegradation is a virtue, some individuals have pointed it out as a limitation. It has been reported that biodiesel degrades about four times faster than petroleum diesel fuel. Also, when blended with biodiesel, the degradation rate of petroleum diesel tripled when compared to diesel alone, according to a 1995 University of Idaho test. C16-18 methyl esters are considered biodegradable based on their chemical nature and test data collected for experimentally determined oxygen demand and carbon dioxide production as a percent of calculated theoretical values. C16-18 methyl esters do not show any micro biological inhibition up to 10,000 mg/L. Independent tests have found that pure biodiesel is non-toxic, readily biodegradable and essentially free of sulfur and aromatics. There is often a debate on shelf life of oil and diesel. In tests performed by the University of Idaho, biodiesel in an aqueous solution after 28 days was 95 percent degraded. Diesel fuel on the other hand degraded only 40 percent. In a second study done in an aquatic environment (CO_2 evolution), various biodiesel products degraded 85.5-88.5 percent in 28 days, which is the same rate as sugar (dextrose). Diesel degradation was 26.24 percent. There have been internet reports that biodiesel in presence of water degrades in a couple of days and is rendered useless. Reports like this have been criticized as not authentic and rumours. In a study conducted at this Institute, it was found that oil extracted from *Jatropha curcas* degrades when stored at high temperature in presence of water. In fact, FFA content increased three fold when oil was stored in presence of moisture. Ultraviolet radiations on the other hand did not cause any degradation of oil. Storage of seeds, oil and diesel need to be further investigated for Indian conditions. Deterioration in storage is not a deterrent but only demands system modifications while processing and transesterification.

Key words: Biodiesel, *Jatropha curcas,* degradation

SVI/P-31 Noise Pollution Modeling and Management Plan for an Educational Institution

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The unbridled growth of vehicular population in urban has resulted in the deterioration of environmental quality, in terms of noise pollution. The objective of the study is to predict the noise levels in and around Alagappa College of Technology and School of Architecture and Planning based on traffic volume, speed of the vehicle and geometric mean of the road and also compare the predicted noise level with observed value and recommend appropriate measures for noise minimization.

The noise levels, using a sound level meter, were recorded at 15 locations in and around Alagappa College of Technology and School of Architecture and Planning. The maximum noise levels in the classroom were 74.05 dB (A) and 72.91 dB (A). These maximum noise levels in the auditorium were 72.71 dB (A) and 71.5 dB (A). The maximum noise levels in the library were 63.54 dB (A) and 62.76 dB (A), which are not within the permissible noise levels of 35-40 dB (A) for auditorium and classrooms and 40-45 dB (A) for libraries according to IS: 4954(1968). Further, the noise levels are also not within the permissible noise levels according to Indian Ambient Noise Standards (CPCB 2000). This standard specifies permissible noise levels for silence zone during day time as 50 dB (A).

A mathematical model has been used to predict the equivalent noise level by taking into account of following parameters: - mode-wise classification of vehicles, speed of the vehicle and geometric mean. By comparing the observed and predicted noise levels, it was observed that all the values are exceeding the permissible limits. The contour maps were drawn to identify the relationship between the distance from the road and the noise level. It showed that distance from the road is inversely proportional to the noise level and it also indicates that up to 200m distance from the intersection was mostly affected by traffic noise.

It was also proposed to reduce the noise level to the permissible limits by adopting appropriate Traffic Management Plan based on mathematical modeling. It was found that if 99% of the traffic volume of Lorries were reduced, the noise levels gets under 49.27 dB (A) at the end of the road. Similarly, if 75% of Auto-rickshaws were reduced, the noise level gets under 48.94 dB (A); if 99% of cars were reduced, the noise level gets under 48.9 dB (A); if 99% of Two wheelers were reduced, the noise level gets under 49.30 dB (A); if 99% of Buses were reduced, the noise level gets under 48.21 dB (A). Similarly, number of vehicles as a combination of (i) Lorries and buses (ii) Auto-rickshaws and cars were 99% reduced, the noise level gets under 48.56 and 49.28 dB (A) respectively. The permissible noise level according to Indian Ambient Noise Standards (CPCB 2000) is 50 dB (A) during day time for silence zone. The above result shows that all the values are within the permissible limits.

Key words: Noise pollution, mathematical model, management plan, permissible limits

SVI/P-32 Performance and Emission Characteristics of a CI Engine Fueled with Biodiesel of Cottonseed Oil

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This paper concentrates on using vegetable oils as a replacement for diesel fuel by converting it in to biodiesel. The oil used for the study is cottonseed oil. In general, raw vegetable oils can be used successfully for short-term use in nearly any percentage as a replacement for diesel fuel. When tested for long-term use, blends above 20 percent with diesel, nearly always result in engine damage or severe maintenance problems. Reduction in viscosity and improvement in volatility are suggested as a way to improve the performance of vegetable oils as long-term fuels.

This study investigates the use of raw cottonseed oil and its ethyl esters (biodiesel) as a fuel for a diesel engine. Cottonseed oil is not ideally suited as an engine fuel as such because of its high viscosity and low volatility. A process of transesterification has to be done to improve the properties to make it comparable with diesel. Properties of the biodiesel of cottonseed oil were evaluated and compared with diesel and was tested as a fuel in a single cylinder, direct injection diesel engine that is a popular one in the agricultural field, to evaluate the performance, combustion and emission characteristics. The data, thus, generated by the biodiesel were compared with the data obtained using diesel and raw cottonseed oil. The engine exhibits a very good performance without any problem of combustion. Specific concentration is shown towards CO, HC, NOx and smoke emission and their environmental impacts. It is concluded that the biodiesel of cottonseed oil can be used as an alternate fuel for diesel engines without any engine modification.

Key words: Biodiesel, diesel, cottonseed oil, viscosity, performance, emission

SVI/P-33 Phytotoxicity of *Cassia siamea* Lam.

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Cassia siamea Lam. an exotic planted tree was screened for its phytotoxicity using various bioassays. The aqueous leachate of various concentrations of *C. siamea* ranging from 1-3% were tested for its biological activity on crops, wheat (*Triticum sativum* variety Raj.1482) and rice (*Oryza sativa* Variety PR106); and duckweed *Lemna inequisetifolia* and *Spirodela polyrhiza*. The experiment was conducted in laboratory conditions on seed germination and seedling growth bioassay and duck weed growth bioassy. Various parameters such as the length of radicales and cotyledons were taken, at 7 DAS.

The results revealed that higher concentrations i.e. 2 and 3% were toxic for the growth of crops, wheat and rice. However, at 1% concentration, the *C. siamea* did not show any toxicity. But the same was found toxic for both the water plants in all the concentrations. The present bioassay study reveals the phytotoxic nature of an exotic tree, which should be thoroughly investigated before planting this species on large scale under social forestry program for sustainable development of arid zones of Rajasthan.

Key words: *Cassia siamea*, wheat, rice, duckweed

SVI/P-34 Strategic Planning of Eco-Tourism in India

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Tourism is one of the fastest growing industries in developing countries, which are often rich in traditional and minority cultures, as well as in biological diversity. Many Eco-tourism regions, in fact, are safe-havens for traditional cultures, architecture, religions, beliefs and traditional knowledge. In addition, they are also important in environmental terms, since they are repositories of biological diversity and help in conservation of rare or endangered plant and animal species. The greater part of the world's renewable clean water resources are formed and stored in potential Eco-tourism areas, and such regions are often areas of great scenic beauty, making them prime tourist destinations.

There is, therefore, a need to assess prospects for the development of culturally and ecologically sustainable tourism in the Eco-tourism regions of developing countries. This article will identify the tourist potential of a selected number of ecosystems, will develop cultural and Eco-tourism in these regions, and will promote best practices in this regard. Specifically the research will explore forms of sustainable tourism that could provide income-generating activities in the tourism sector, including in pilgrimage tourism, so as to contribute to poverty alleviation and provide valuable sources of employment for the poor.

Thus one of greatest advantages of strategic planning of models for Eco-tourism is that it could be developed and promoted with its minimal negative ecological impacts.

After recognizing the Eco-tourism potential in India, this article suggests several methods for development of Eco-tourism models that can be used for India or similar regions. Hence such type of studies is being conducted at Bhugaon Lake in Pune (Maharashtra). The details about development of this potential site for Eco-tourism are in progress. This model may be useful to develop other such sites in Pune and nearby tourist places

Key words: Eco-tourism, strategic, planning, modeling

SVI/P-35 Antifungal Activity of Ethyl Acetate Fraction of *Cyperus rotundus* rhizome against Certain Fungi Responsible for Food Spoilage and Plant Diseases

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Antifungal activity of ethyl acetate fraction of *Cyperus rotundus* rhizome was tested against ten fungi (*Alternaria* sp., *Alternaria solani, Alternaria tennusima, Curvularia* sp., *Curvularia pennisetti, Colletotrichum gleosporides, Erysiphe cichoracearum, Fusarium* sp., *Helminthosporium* sp., *Brachysporium* sp.) isolated from soil and diseased affected parts of the plants.

To test the antifungal activity of ethyl acetate fraction of *Cyperus rotundus* rhizome, different concentrations of extract was prepared and effect on spore germination of test fungi was observed separately. From the results obtained, it was observed that the maximum inhibition of spore germination was found at 3000 ppm followed by 1500 ppm. *Curvularia pennisetti* and *Colletotrichum gleosporides* were found to be most sensitive and showed 100% inhibition of spore germination at 750 ppm. *Helminthosporium* and *Alternaria* spp. were found to be resistant against the ethyl acetate constituent of *Cyperus rotundus* rhizome.

Key words: Antifungal, plant disease, food spoilage

SVI/P-36 Separation of Hexavalent Chromium by Reverse Osmosis using Polyamide Membrane

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India is one of the largest leather producing countries. Unfortunately this industry causes huge environmental pollution by way of discharging large volume of tanning effluent. The problem of environmental pollution from tanneries was taken up seriously only in the recent years. It is now well recognized that the tanning industry is a potential source of pollution. Tannery effluent mainly consists of chromium in a hexavalent state as well as in trivalent state. Chromium is classified as priority pollutant. It is toxic at a concentration of 0.01 mg l^{-1} and the presence of the chemical in excessive quantities makes water unusable. In this communication, separation of hexavalent chromium by reverse osmosis, using polyamide membrane, developed by FILMTEC (FT 30), USA, is presented. Experiments were conducted to observe the process performance at various conditions and to estimate the separation efficiency. Complete study on separation of hexavalent chromium is performed with FT 30 membranes. Under different operating conditions like pressure, feed flow rate, feed concentration and pH, permeate flow rate measured and sample analyzed to find out separation/rejection of hexavalent chromium. The effect of pressure was a critical factor that governed the efficiency of the process. As the operating pressure increased, the percentage of hexavalent chromium separation decreased with constant chromium concentration. The operating pressure was increased from 10 to 30 kg cm^{-2}, at a fixed feed concentration, the degree of separation fell from 93% to 86% with chromium concentration 0.1149 mg ml^{-1} at a pH of 5.0. Separation efficiency was also closely related to the solution pH and interfering radicals. At a pH range of 6-7, maximum separation of hexavalent chromium was observed. It seems likely that the effect of pH on separation efficiency might be related to the degree of ionization or association of the chromium ions. As ions in the medium increase separation of hexavalent chromium increases. Percentage separation increased from 89% to 93% with the addition of 500 ppm NaCl to the feed concentration of 0.154 mg ml^{-1} in the presence of same equivalent amount of trivalent chromium. Since large number of ions are present in the boundary layer, hexavalent chromium cannot pass through the membrane. From the result obtained, it is obvious that separation, using reverse osmosis, is effective in separating hexavalent chromium from dilute solutions. By changing the operating parameter, feed flow rate, feed concentration, pH and interfering radicals separation efficiency of more than 90% can easily be achieved.

Key words: Environmental pollution, chromium, reverse osmosis, tannery effluent

SVI/P-37 Isolation and Analysis of Microcystin from Natural Blooms

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Algal blooms are potential health hazards in water supply reservoirs, ponds, farm dams, lakes and rivers. Increased eutrophication and global climatic changes have made cyanobacterial toxicity as an emerging environmental issue. The toxins produced by these bloom-forming cyanobacteria have caused fatal poisoning of mammals, birds, and fish and may also exert adverse effects on humans. The cyanotoxins fall into four categories on the basis of their effects- Heptotoxins, Neurotoxins, Cytotoxins, and Dermatotoxins. Hepatotoxins are more widespread in occurrence and microcystins are the most important toxins of this class. The microcystins are a group of cyclic heptapeptides produced by a number of cyanobacterial genera *Microcystis, Anabaena, Nostoc, Planktothrix.* Microcystins are reported to act as okadaic acid class of tumour promoters through inhibition of protein phosphatases 1 and 2A. We have isolated toxins from *Microcystis, Anabaena, Nostoc, Spirulina, Anacystis, Cylindrospermum*, *Merismopedia* and *Synecococcus*, collected from natural blooms of northern India and tested for the presence of microcystin. Toxin was isolated according to Birk *et al.* (1989) and production was verified by Thin Layer Chromatography of the algal extracts on silica gel plates in methanol: water: acetic acid (60:38:2, v/v). The toxins were also examined by recording their absorbance at 238 nm, as 'Adda' amino acid present in microcystin gives a characteristic wavelength absorbance at 238 nm. The Adda moiety is required for toxicity and is important in the binding of toxin to protein phosphatases. Knowledge about the isolation, purification and properties of cyanobacterial toxins could prove very important in predicting and preventing these noxious blooms.

Key words: Algal blooms, cyanobacterial toxins, microcystin, protein phosphatases, Adda

SVI/P-38 Climatic Effects on SO_2 Dry Deposition over a Cassava Plantation in Rayong, Thailand

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Presently, SO_2 has become a considerable emission problem in the East Asia region. The long term exposure to high SO_2 concentrations can affect human health and the environment. Approximately half of the SO_2 is delivered to the earth by the dry deposition process. Therefore, an assessment of SO_2 dry deposition is necessary for understanding its qualitative and quantitative effects. In this research, the SO_2 dry deposition was studied in terms of SO_2 dry deposition flux and velocity and their relationships with significant climatic parameters, such as net radiation, soil heat flux, and relative humidity. The SO_2 dry deposition was determined using the Bowen Ratio Technique. All necessary parameters were measured above the Cassava plantation at the site in the province of Rayong, Thailand during the period from June to September 2004. The range of significant time for the Bowen Ratio Technique was from 8:00 to 17:00. In the results, the average transfer coefficient was 10.6 cm s^{-1}, the average dry deposition flux was 0.17 mg m^{-2} hr^{-1}, and the average dry deposition velocity was 0.14 cm s^{-1}. Furthermore, these results confirmed that net radiation, soil heat flux, and relative humidity have an effect on SO_2 dry deposition.

Key words: SO_2 dry deposition, climatic effects, cassava, Bowen Ratio Technique

SVI/P-39 Efficacy of Neem (*Azadirachta indica)* and *Bergera koenigii* as a Grain Protectant Against *Sitophilus oryzae* in Wheat

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The plant kingdom is rich source of compound with insecticidal activity. In the last few decade increasing environmental pollution and health hazards due to synthetic insecticide, has given way to the use of botanicals especially neem based product, which has gained worldwide attention. Neem is one of the most commercial exploited species and there are more than 80 formulations available in the market. They are not only effective against pest but also relatively safer to natural enemies. Hence an attempt was made to study the insecticidal activity of Neem, *Azadirachta indica* (Meliaceae) and Curry leaf *Bergera koenigii* (Rutaceae) against store grain pest of wheat - *Sitophilus oryzae* L.

In the laboratory Neem and Curry leaf were dried at room temperature and grinded. Twenty gram wheat varitiey DL 803-3 were taken in glass tubes and kept in incubator. The powder form of Neem and Curry leaf were taken in three doses 1, 3 and 5 g kg^{-1} grain and mixed in these tubes. Five pair of ten day old beetle were inoculated in each treatment and kept in 30±5 °C temperature and 70±5 % relative humidity. The observations of mortality of beetle were recorded 2, 7 and 15 day after treatment. Experiment was replicated three times.

Data reveled that mortality was more in the treated tubes than in untreated control, whereas, maximum mean per cent mortality (61.10) was found in Neem leaf powder treated grain, i.e., 5 gm Kg^{-1} grain in comparison to minimum in untreated control (26.65). After fourteen days treatment the mortality rate was 80 when treated with neem powder. On the basis of present investigation it can be concluded that both the plants - Neem (*Azadirachta indica)* and Curry leaf (*Bergera koenigii*) was effective in reducing the infestation of *S.oryzae* in storage condition.

Key words: *Azadirachta indica*, *Bergera koenigii*, *Sitophilus oryzae*, wheat

SVI/P-40 Salt Tolerance of *Aloe vera* in Sodic Soil Environment

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Scarcity of medicinal herb, in the natural forests, has attracted the attention of agriculturists, for their cultivation on wastelands. In order to do so *Aloe vera*, an important medicinal plant, used in health products, face creams, soaps and several other herbal formulations, were examined at different sodicity levels. Plastic pots were filled with already standardized soil of 8.39 (control), 15, 30, 45 and 60 ESP levels. Three sprouted suckers of uniform size were transplanted in a pot with five replications. All planted pots were irrigated with tube well water having pH 7.4 and EC 0.95 d Sm^{-1} at weekly interval, except in rainy season. Number of emerged sprouts and total leaves/ pot was recorded at monthly interval. After four months of transplanting, all mature leaves were harvested thrice in a year. The over all performance of plants stressed with 15 and 30 ESP was significantly better than that of control and 45 ESP, while plants treated with 60 ESP failed to grow and could not survive. Number of emerged sprouts and leaves per pot/year was significantly higher on 15 and 30 ESP in comparison to control and 45 ESP treatments. Fresh and dry weight of succulent leaves stressed with 15 ESP enhanced significantly to that of plants grown in control, 30 and 45 ESP treated pots. However, plants raised in control and 30 ESP stressed soil had almost similar fresh and dry weight with insignificant differences, but they differed significantly from 45 ESP treatments. The moisture content in *Aloe vera* leaves was 98.1, 97.6, 97.3 and 96.8 of the fresh leaves for control, 15, 30 and 45 ESP treatments, respectively, which is an important component of Aloe gel. Growth of *Aloe vera* ameliorated the sodic soil to different degrees corresponding to their yields at different ESP levels.

Key words: Sodic soil, salt tolerance, *Aloe vera*

SVI/P-41 Organic Farming

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Organic farming system 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 (crop, animal and farm wastes, aquatic 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.

Organic farming approach involves following five principles: (i) Conversion of land from conventional management to organic management, (ii) Management of the entire surrounding system to ensure biodiversity and sustainability of the system, (iii) Crop production with the use of alternative sources of nutrients such as crop rotation, residue management, organic manures and biological inputs, (iv) Management of weeds and pests by better management practices, physical and cultural means and by biological control system, (v) Maintenance of live stock in tandem with organic concept and make them an integral part of the entire system.

Organic farming helps in maintaining environment health by reducing the level of pollution, it reduces human and animal health hazards by reducing the level of residue in the product. It helps in keeping agricultural production at a higher level and makes it sustainable and also reduces the cost of agricultural production and improves the soil health. It ensures optimum utilization of natural resources for short-term benefit and helps in conserving them for future generation. It not only saves energy for both animal and machine, but also reduces risk of crop failure. It improves the soil physical properties such as granulation, and good tilth, giving good aeration, easy root penetration and improves water-holding capacity. Organic farming also improves the soil's chemical properties such as supply and retention of soil nutrients, and promotes favorable chemical reactions.

Key words: Organic farming, organic wastes, residue management, soil health

SVI/P-42 Introduction of Some Eco-friendly Arboreal Ornamental/Economic Plants in N.B.R.I., Lucknow

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The plant wealth is the basis of our lives- as it provides food, fodder, fuel, furniture, wood, medicines and raw materials for numerous purposes. Besides, the plants also play an important role to maintain our environment neat, clean and healthy. They beautify our gardens, houses/residences, roadsides etc. with their beautiful flowers and provide shade with green leaves. They are the only natural resources of Oxygen- the life-gas, essential for all organisms. Our Institute is playing an important role in introduction of potential ornamental and economic plants. Some promising indigenous and exotic collections, would be enumerated in the paper.

Key words: Ornamental, indigenous plants

SVI/P-43 Accumulation and Effects of Formaldehyde in Plants : Perspective for an use for Indoor Air Pollution Treatment

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Formaldehyde, benzene and toluene are volatile organic compounds, classified as carcinogen, which can be present in indoor air as well as in home or in working place. This work aims at collecting data about air purification capacity of three houseplants: *Dracaena marginata, Chlorophytum comosum* and *Scindapsus aureus* and about physiological effects of pollutants.

Plants were exposed in two glass chambers (6 plants in chamber of 300L and 20 plants in chamber of $1m^3$) to different concentrations of formaldehyde, benzene and toluene, during different periods. Different configurations of plant models were tested i.e. plants with non-sterilized soil and sterilized soil (i.e. without microrganism), plant without soil (i.e. hydroponic culture) and leaves alone. In order to take into account a potential soil efficiency contribution, soil without plants was also tested. Data of temperature, humidity, CO_2 concentrations, luminosity and pollutant concentrations were recorded. Relative humidity was stabilized to 45% by air-cooling system.

Preliminary results showed that kinetic of pollutant elimination changes with the nature of pollutants. Formaldehyde was eliminated faster than toluene. We noted that humidity plays a key role in formaldehyde elimination and has to be rigorously controlled during the experiment. Furthermore, concentrations of eliminated pollutant adsorbed to leaf surface are approximately the same for *Chlorophytum comosum* and *Scindapsus aureus*. *Dracaena marginata* appeared to be less efficient. Although micro organisms in soil without plants take part actively in toluene elimination, "soil with plant" model is still more efficient.

VOC concentrations in leaves were measured using GC/MS (Varian). We've never found benzene or formaldehyde in leaves but concentrations of toluene were proportional to those used in the glass chamber. These results suggest that different ways exist for the accumulation of VOCs in plants, depending both on nature of pollutants and of the plant species. Benzene and formaldehyde could be metabolised by the leaves, and toluene only accumulated on the surface.

No macroscopic effects of pollutants were observed on leaves. However, concentrations of reduced glutathione (an antioxidative molecule) and malondialdehyde (a marker of membrane lipid peroxidation) detected in plant leaves could be a sign of oxidative stress caused by toluene exposition. This is particularly true when leaves were exposed to benzene.

Key words: Formaldehyde, indoor air pollution, accumulation, effects, house plants

SVI/P-44 Natural Dyes – Sustainable Eco-Friendly Textile Dyeing on Silk, Wool and Cotton

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Under the present scenario of increasing environmental consciousness, there is demand for eco-dyeing and processing of textile using safe colouring agents and chemicals. The usage of natural dyes is more relevant because their extraction and application do not disturb our eco-system. These are considered non-toxic, biodegradable and eco-friendly which made them exceedingly popular among nature loving and health awared people. As most of the natural dyes are adjective in nature hence they require a fixing agent or mordant for textile dyeing. Considering environmental aspects and eco-friendly standards there is need to use safe natural dyes with safe permitted chemicals and natural mordants in textile dyeing.

Under present study, eco-friendly textile dyeing was performed using a natural dye extracted from onion skins with safe mordants as a fixing agent. These were alum, ferrous sulphate, copper sulphate, stannic chloride, stannous chloride and oxalic acid, under 5 to 10 % concentration. 5 to 10 % of tannic acid, 10 % myrabolan (*Terminalia chebula*) extract, 2 % eucalyptus dye extract and 20 % paddy field soil extracts were also used as natural mordant. The dyeing experiments on silk, wool and cotton were performed using 1, 5 and 10 % dye baths, maintained at 50-55 °C. In view to obtain a variety of shades, the dyeing experiments have been carried out under following conditions *viz*. (a) without any pre-fixing or pre-mordanting (b) pre-fixing with natural mordant and (c) pre-fixing with natural mordant followed by mordanting with chemical salts. A wide range of light and dark shades of different colours have been obtained, most of which were fast to water washing.

Key words: Natural dyes, onion skin dye, eco-friendly, mordants, dyeing, pre-fixing

SVI/P-45 Radioprotective Potential of a High-Altitude Medicinal Herb of Himalayas *Rhodiola imbricata*

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One of the major problems faced in the modern world today is that of pollution caused due to radioactive material and radiation emission from radiation sources. Recently, a lot of interest has been generated for the development of potential drugs of herbal origin for the mitigation of deleterious effects of ionizing radiation mainly to protect against radiation leakages resulting from mishaps in nuclear reactors, deliberate use of dirty bombs etc. The radio modifying effects of a fractionated extract of the high-altitude plant species *Rhodiola imbricata,* along with its electron donation potential, super-oxide ion scavenging, nitric oxide scavenging potential and anti-hemolytic activity were evaluated in the present study. The reducing power of the fractionated extract increased in a dose-dependent manner. The absorption unit value was significantly lower (0.028±0.009) than ascorbic acid [(0.049±0.007)] ($p<0.05$), confirming the potent reducing ability of this fraction. Superoxide ion (O·-) scavenging ability of the extract exhibited a dose-dependent increase (0.025- 3 mg/ml) and was significantly ($p<0.05$) higher than that of ascorbic acid in the concentration range of 0.025- 0.25 mg/ml. Nitric oxide (NO) scavenging ability exhibited a dose-dependent increase (0.1- 2 mg/ml), which was comparable to vitamin C at concentration of 0.1-0.75 mg/ml and was significantly ($p<0.05$) higher in comparison to ascorbic acid at 1-2 mg/ml concentrations. The concentration that induced 50% inhibition in the formation of nitric oxide (IC50) was observed to be 0.5 mg/ml. *Rhodiola* extract also exhibited anti-hemolytic potential preventing radiation-induced membrane degeneration of human erythrocytes, with maximal percentage inhibition of 87.8±1.25% at a concentration of 1 mg/ml. In conclusion, it can be stated that *Rhodiola* extract provides protection against gamma radiation via multifarious mechanisms that act in a synergistic manner. The study shows that *Rhodiola* has immense potential for alleviation of damage resulting due to radio pollution.

Key words: Radioprotection, radio pollution, radiation-damage, high-altitude plant, *Rhodiola imbricate*

SVI/P-46 Quality analysis of seeds in *Rauvolfia serpentina* growing in natural and cultivated condition

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Rauvolfia serpentina Benth. commonly referred to as 'Sarpgandha' has for centuries been used in Indian medicine. It is valued mainly for the alkaloids. The major active alkaloid 'reserpine' is used in the treatment of hypertension and as a tranquilizing agent. Though *Rauvolfia serpentina* has a wide distribution, its natural propogation is not widely successful due to high seed sterility. Since root is the main reservoir of the alkaloids, optimum yield of root is obtained when plants are raised through the seeds. For such (natural) propagation it is therefore essential that seed quality should be better in respect to healthy

and sound seed formation. However, to analyze the seed quality seeds were collected from the taxa growing naturally in the forests and gardens of different geographical regions. Randomly collected seeds of each wild and cultivated sample were studied for the analysis of seed quality in respect to healthy/sound and empty seed formation. It was observed that percentage of sound/healthy seeds always remained comparatively high in all the seed samples. It ranged from 55-60% and 30-35% in wild and cultivated taxa respectively. Thus the results indicate that for *R. serpentina,* natural environmental condition is more suitable for healthy/sound seed production.

Key words: *Rauvolfia serpentina*, seed quality, wild and cultivated taxa

SVI/P-47 Organic Farming and its Advantage over Conventional Farming : A Case Study

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Agriculture is as old as civilization and people use to practice traditional kind of farming without using any synthetic fertilizers in the olden days. As science became more and more advanced and the demand for the food grains increased, people have started using inorganic fertilizers and chemical to boost up their production levels. But, these conventional practices have led to unsustainability and other problems. In the recent past, people have again gone back to their original kind of farming by using their own traditional manures and they could be able to meet their requirements both in terms of quality and quantity. The present paper is an attempt to evaluate both organic and conventional farming systems under coffee-based agroforestry in Kodagu district. This is one of the second largest coffee producing districts in India having 29% of its area under coffee cultivation.

Key words: Organic farming, conventional farming, coffee

SVI/P-48 Sleeve Boom Sprayer for Environmental Protection in Agriculture

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In order to achieve better crop protection against the background of increasing pesticide use, deleterious effect of residues on environment due to release of toxic chemical spray in to atmosphere due to drift and drip of spray droplets, sleeve boom sprayer to be operated by most common size tractor (30-35 HP) efficiently has been developed. The performance of its most important component viz. blower has been evaluated in laboratory as well as in the field. The design dimensions of various components of axial flow blower i.e. impeller blade hub, casing and diffusers were calculated and axial flow blower was developed. The different shapes of the airfoil viz. cambered type (Ca), tapered (Ta), and flat under surface type (FU) were selected for the design of blades and fabricated with Fiberglass Reinforced Plastic (FRP) and Aluminum (Al). The provision was made to fix up the blades in impeller hub at selected levels of stagger angle i.e. 8^o, 16^o, 24^o, 32^o and 36^o in order to get different levels of air discharge. Performance of the blower was evaluated for its capacity to develop a required air discharge for cotton crop, with respect to its power consumption in wind tunnel. For field evaluation spray droplets were collected on photographic paper placed at various positions in the plants. Its analysis was done using computer image analyzer.

The trend of the curve show that the air discharge increases linearly with the increase in impeller speed. The air discharge with Ca-FRP impeller is comparatively higher as compared to others with the maximum and minimum air discharge of 1.32 and 3.51 $m^3 s^{-1}$ at 8^o and 36^o stager angle respectively. The relationship between power consumption and blower speed found was of quadratic type and exponential with stagger angle.

Key words: Pesticide, environment, impeller, blower, air discharge, cotton crop

SVI/P-49 Hazardous Waste: Effective Management to Minimize Environmental Threat

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Rapid industrialization and the lack of deployment of methodologies to handle hazardous waste has enhanced the pollution load alarmingly. Only 20 – 30% of industrial waste is hazardous in most of the industries but when this hazardous waste is mixed with non-hazardous waste the 100% waste becomes hazardous. Deterioration of the environment, lack of knowledge as well as seriousness of enforcement agencies for compliance of hazardous waste disposal has posed a real threat for survival of future generations. The present methodology talks about training and continual awareness up to worker level and category wise waste segregation at source by adopting colour coded bins for different waste types.

Key words: Hazardous waste, non-hazardous waste, waste disposal, training, awareness

SVI/P-50 Biodiversity of Insects under Neem Based Agroforestry

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Neem based agroforestry had a significant impact on the incidence of insect pests of tree and crop components and their interactions, the abundance of their natural enemies, the density and the role of soil microfauna in nutrient cycling. The positive interactions in the neem - crop association was the sharing of a number of natural enemies, the most important being spiders. But the density and diversity of spiders on neem trees with and without crop association did not differ significantly. The activity of ground fauna was higher in the green gram and sun hemp crops associated with neem trees recording 866 and 558 individuals per 8 traps respectively. The predominant taxa were carabids, spiders and ants. Other predatory groups were the staphylinids, cicindellids, reduviids and centipedes. The carabid and spider species observed in the neem based agroforestry system was higher with a species richness index of 1.48 and 2.85 respectively as against 1.22 and 1.56 in sole crop. The trees provided a more favourable habitat for beneficial arthropods than herbaceous plants and agroforestry may contribute to increasing arthropod diversity compared with monocrops. Collembolans and mites were the dominant soil fauna observed and the density of collembolans was nearly double under agroforestry when compared to sole crop. The collembolan population reached a peak of 743.13 individuals per m^2 in October on greengram. The density of acari was 158 m^{-2} in the agroforestry plots.

Key words: Bio diversity, species richness, insects, soil fauna, predators, pests

SVI/P-51 Role of Insects in Bioterrorism through the Ages

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Bio terrorism is a more deadly but silent form of terrorism that lacks the sound and fury of the plane blasts but could cause more widespread pandemonium and havoc for a longer period of time. Biological warfare can be considered as the military use of living organisms or

associated materials that are intended to cause disability, disease, or death in humans, animals, or crops for hostile purposes. Agents include pathogenic micro-organisms, toxins and bioactive substances, which may be weaponized, using both military and civilian-type delivery systems. Insects in Warfare have a long history of greater than 10,000 years. Historically, Social Insects (Hymenoptera) have been the most frequently used insect "weapons". The *STINGING* insects' *viz*., wasps, ants and bees are the most feared of all insect taxa and cause of most entomophobia among humans. Other categories of insects used in bio-terrorism are those that produce toxic substances, insect vectors of human disease and agricultural bio terrorism through use of insects that affect crops and livestock. Insects can also be used as early warning system. The presence of spores or toxic substances in the atmosphere are sensed by insects such as firefly and honey bee and can be used to detect bio-terrorism attacks.

Key words: Bio terrorism, insects, vectors, agricultural bioterrorism

SVI/P-52 Comparative Study of Viscosity for Biodiesel Blend of *Pongamia* Oil

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India ranks 6th in the world in terms of energy demand. The energy demand is expected to grow@ 4.85%/annum. Out of 113 mt crude oil production in 2003-04 in the country, the consumption of diesel fuel was accounted for nearly 40%. The rate of growth of diesel consumption is increasing rapidly. Since the world is facing the problem of limited fossil fuel resources coupled with environmental degradation, therefore, there is an urgent challenge for finding the alternative to conventional liquid fuel with especial reference to the diesel fuel. Biodiesel has been reported to be an ideal and ecofriendly liquid fuel capable of substituting the diesel in certain proportion. Literature survey has been revealed that mixing of biodiesel with diesel in 20% proportion gives optimum engine operation in terms of power output. No systematic work has been reported which can give an idea about the fuel properties changes with respect to blending. The present paper will attempt to determine the viscosity of the mixture of biodiesel and diesel to get a standard curve which could help to determine the viscosity of mixture of a given blends. The percentage of blend based upon the viscosity may be directly used to preaccess the performance of the engine. Various methods for viscosity determination have been used and compared in order to find out the viscosity for specific blend.

Key words: Biodiesel, blend, calorific value, density, viscosity

SVI/P-53 Air Pollution with Reference to Dispertion for NOx and its Ground Level Concentration from a Point Source by Computer Based Mathematical Modelling (ISCST3)

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Air quality is dynamic complex environmental phenomenon exhibiting large temporal and spatial variation. These variations are due to changes in the rate of emission of pollutant from sources or changes in the meteorological conditions. Once the pollutants are released into air their fate is solely determined by the prevailing atmospheric condition.

Ideally monitoring ambient air quality, analyzing a sufficient number of representative samples of ambient air is preferred to air quality modelling. Monitoring may not be feasible in all situations. Thus, it is imperative that one has to look into other means and methods to assess and estimate the air quality before hand to plan a city or for an industrial development basing on the data and facilities one has.

Air pollution dispersion models are capable of providing the most problematic concentration of pollutants to occur at any location within the area of concern in relation to source for known characteristics when adequate meteorological data is available.

Industrial source complex short-term ($ISCT_3$) Model is developed by Environment Protection Agency (EPA) USA (1989 to 1992) based on ISC_2 and according to their air quality guideline the ISCST3 model is one of the most versatile and user friendly model. The user also has considerable flexibility to utilize formatted ASCII files that contain hourly records and meteorological variable. The paper deals with dispersion pattern of NOx using ISCST3 model.

Key words: Pollution, air quality model, meteorology, dispersion, turbulence, NOx, ISCST3

SVI/P-54 Effect of UV-B and Herbicide Oxyfluorfen on *Nostoc muscorum*

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Use of herbicides is an integral component of modern agriculture despite the fact that many of them are toxic and have mutagenic effect on soil micro-flora. They cause deleterious effect on Cyanobacteria, the primary producers of our ecosystem. Herbicide oxyfluorfen and UV-B induced changes in biochemical parameters related to photosynthesis in paddy field cyanobacterium, *Nostoc muscorum*, was studied in laboratory conditions. In our observation it is clearly evident that photosynthetic pigments are highly sensitive towards the herbicide, oxyfluorfen and UV-B exposures. UV-B induced oxidative stress in cyanobacterial cells. Pigments, especially phycocyanin were adversely effected with the exposure of high doses of herbicides. UV-B exposed cyanobacterial cells showed a continuous deterioration in pigments and finally caused their death.

Key words: Oxyfluorfen, *Nostoc muscorum*, photosynthetic pigments, oxidative stress, UV- B

SVI/P-55 Variation of Secondary Metabolites and Bioactivities of *Bergenia ciliata* (Haw) Sternb.

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Bergenia ciliata (Haw) Sternb. Commonly known as rock foil (local name Pashanveda) belongs to the family Saxifragaceae, is a wild medicinal herb found in cold and temperate region between an altitude 1600-3200 m in Nepal. Its root is used in Ayurvedic medicine for dissolving stone of the kidneys, bladder and other diseases.

Flavonoids are one of the important secondary metabolites produced by plants to protect themselves from the adverse environmental conditions, harmful microorganisms and the insects. The present study explored the flavonoids variation of *B. ciliata* collected from seven different places of central and western Nepal. Chromatographic and spectroscopic analysis of flavonoids revealed that the morphological difference did not affect the constituent of the plant. The TLC pattern suggested an existence of intra-population variation in Dolpa and Hemja whereas existences of inter population variations was found in the species of Daman, Dhunche, Manang, Pharping to that with Dolpa, Henja and Panchase.

Antibacterial effect against ten different bacteria also reveled the presence of flavonoids variation in *B. ciliata*. methanol and aqueous fractions were found to be more effective due to the presence of

flavonoids in comparison to hexane and chloroform factions.

Key words: *Bergenia ciliata*, secondary metabolites, Paashanveda, antimicrobial, flavonoids

SVI/P-56 Exploring Endophytic Fungi from Himalayan Conifers as a Novel Natural Resources for Drug Discovery and Biocontrol Agents

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During the last couple of decades, the isolation and subsequent screening of microbes from diverse habitats has led to the discovery of many novel and useful secondary metabolites. It was reported that only 5% of the world's fungi are currently known. Though Nepal constitutes 1,822 (2.38%) out of 70,000 fungi of the world. Among them, endophytic fungi, are one of the largely untapped natural resources that likely have several economically important applications in the future.

A large number of endophytic fungi were isolated and identified from the inner bark of five healthy Himalayan conifers namely *Taxus wallichiana*, *Podocarpus neriifolius, Cedrus deodara, Abies spectabilis* and *Tsuga dumosa* that are found around the similar altitude and environment. Most of the endophytic fungi isolated Deuteromycetes, few Ascomycetes and Actinomycetes (filamentous bacteria). They exhibited antibacterial and antifungal activities against a large number of pathogens. Anticancer drug, taxol was produced by most of the endophytic fungi. Some of the endophytes produced same or the similar type of secondary metabolites present in their hosts showing chemical mimicry for adaptation indicating the affects of chemical environment in the production of secondary metabolites.

Thus, the potential of endophytic fungi from Himalayan conifers as a source of bioactive secondary metabolites remains largely unexplored. Overall investigations also indicates that the Himalayan conifers can provide a diversity of new endophytes likely to be of significant utility in the discovery of new drugs as well as biocontrol agents.

Key words: Endophytes, Himalayan conifers, anticancer drug, taxol

SVI/P-57 Use of Biopesticides to Control the Pests on the Vegetable Crops

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In organic farming, pests and diseases of crops are controlled by various cultural as well as scientific methods without any synthetic chemical pesticides. The traditionally used botanical pesticides are still finding importance due to their active chemical constituents with diverse biological activities. These indigenous natural products or pesticidal plants are easily available as local resources that are biodegradable and relatively safe and avoid the human health risks associated with chemical pesticides, environmental friendly and do not persist residue in the environment.

Hence, with the aims to assess and evaluate an alternative for the hazardous chemical pesticides, two different treatments of four different indigenous pesticidal plants, the extract of *Acorus calamus* (Bojho) and the mixture of essential oils/ extract of *Eupatorium adenophorum* (Banmara), *Lantana camara* (Masimo kanda), and *Azadiracta indica* (Neem) in three different concentrations (0.5, 1 and 3%) were sprayed in the field of cauliflower at Bhaktapur along with the replications of negative and positive controls to control the hazardous pests mainly the aphids. The number of insects present in the plant was counted before and after spraying the extracts of different concentrations and compared the results with the positive and negative controls. The results showed that the mortality percent of the insects were increased from 0.5 to 3% extracts of the selected pesticidal plants. Both the treatments are very effective and the results are statistically significant ($p<0.001$) indicating these plant extracts could be used as an alternative means for controlling aphids instead of chemical pesticides.

Key words: Organic farming, biopesticides*, Azadiracta, Eupatorium, Lantana*

SVI/P-58 Particulate Matter ($PM_{2.5}$): Its Status in India and Need for a National Standard

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Fine particulate matter or $PM_{2.5}$ are those particles whose aerodynamic diameter are less than 2.5 µm. $PM_{2.5}$ are a serious treat to human as they have the potential to enter deep into the alveolar of human lung and finally reaching to other part of the organs through the blood circulation. At present, India does not have any standards for $PM_{2.5}$. Central Pollution Control Board has at present three monitoring stations monitoring $PM_{2.5}$ round the clock using the beta attenuation monitoring method. Looking at the data obtained at these monitoring stations (Published in the CPCBs website) and also to those research work carried out in this field, it is important to note that $PM_{2.5}$ constitute 60 – 70 % of the total particulate matter. The potency of $PM_{2.5}$ and also being a major constituent of particulate pollutant, it is important to frame national standards at the earliest.

Key words: $PM_{2.5}$, aerodynamic diameter, CPCB

SVI/P-59 Seasonal Variations in Isoprene Emission from Tropical Deciduous Tree Species

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Isoprene is dominant constituent of the global biogenic volatile organic compounds (VOCs) budget. It plays an important role in regulating the atmospheric trace gas composition including tropospheric ozone concentrations. In this study, monthly measurements of isoprene emission rates were carried out over 1 year period (December 2002 – November 2003) from four Indian deciduous tree species *viz. Ficus relegiosa*, *Ficus infectoria*, *Pongamia pinnata* and *Morus alba* using branch enclosure method. Significantly high monthly variations in isoprene emission rates were observed in case of all four-plant species. Each plant species exhibited pronounced seasonal variation in isoprene emission. Maximum isoprene emission was observed during summer and minimum during the winter or spring months. Variations in isoprene emission with changes in temperature were investigated for *Ficus relegiosa* and *Dalbergia sissoo*. Isoprene emissions were found to be dependent on temperature.

Key words: Biogenic, isoprene, seasonal variation, deciduous, tree, temperature

SVI/P-60 Biodiesel: The Road Ahead

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Biodiesel provides an opportunity for farmers to grow and use this resource on the farm. Farmers throughout the world are investing heavily on biodiesel cultivation and utilization. The economic benefits

of using biodiesel are shown to accrue to farmers, local communities, end users and the nation as a whole. The use of biodiesel and biodiesel blends result in a noticeable change in exhaust odour. The user can appreciate the reduction in smell and change of odour. Users also report no eye irritation. Since biodiesel is oxygenated, diesel engines have more complete combustion than with petroleum. Current seed stocks have been collected commercially without consideration of seed source, oil content and seed productivity. Genetic enhancement is crucial to develop a weedy species like *Jatropha curcas* to a commercial "crop". Methodology for genetic enhancement and improvement for such non-conventional crops is different from the ones used in forestry. Many forestry experts recommend improvement as they would do in case of a forest tree species, while *Jatropha curcas* is an introduced, acclimatized plant that is planted around agriculture fields as a fence or planted to cover waste lands. The strategies to improve this "crop" are different from agriculture or forest crops. We have collected various accessions from different parts of the country and are monitoring performance of mixed lots to identify promising individuals. Individual tree progenies are also being evaluated for variability. Selection parameters are not dbh and height as one would do in a forest species, but canopy, seeds produced per plant and oil content. Healthy individuals with these traits are selected and their progenies are being evaluated. Promising individuals are further multiplied clonally. Model plantations have been raised at 350 acres of land. A population of individuals with high oil content and high seed production will form the base for further silviculture improvement in this biodiesel "crop".

Key words: *Jatropha curcas,* tree improvement, selections, genetic enhancement

SVI/P-61 The Role of *Lantana camara* in the Improvement of Wheat Crop in Wheat Rice Cropping System

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The Wheat Rice Cropping System is facing a new problem of depleting nutrient resources particularly organic matter and fertility factor of soil. The use of high level of nitrogen application without adequate supply of other plant nutrients is mainly responsible for the low factor productivity of fertilizer. The use of 3% dry matter of *Lantana camara* L. had favourable impact on the growth and yield of wheat crop under field conditions. Moreover, *L. camara* consists of phytohormones salicyclic acid and gibberellic acids. Hence the use of *L. camara* in the form of dried plant material in the field can replace the hazardous chemical fertilizers for better ecofriendly growth and yield of wheat crop.

Key words: *Lantan camara,* wheat, salicyclic acid, gibberellic acid

SVI/P-62 Indian Experience of the Kyoto Protocol

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In all 141 nations came together for a legal binding international agreement for climate protection – The Kyoto Protocol 2005 which aims to control a rise in temperature. This rise in temperature is widely blamed on mounting human emissions of heat trapping gases that could trigger drought, floods, rise in sea levels and extinction of thousands of species by 2100. The Indian sub-continent with a tropical climate and the vast biodiversity can be exploited to reverse the climatic change in the world. This will provide India, major economic gain as it has no liability to cut down GHGE's as of now. India has adopted large number of techniques for carbon sinks. Carbon trading by the known ways, clean energy projects using solar, wind, biomass energy etc. carbon dioxide saving projects like industrial tree plantation (afforestation), burn off land fill gas, small hydropower generation plants, municipal solid waste management, sugar mill cogeneration are some of the measures. All these measures have a potential of giving India a trading of 5 billion dollars by 2012. Carbon sink projects already being used to phase out ODP's have provided India a gain of 240 million dollars.

Key words: Carbon sink, biodiversity, extinction, ozone depleting particles

SVI/P-63 Phytochemical Studies on Bioactive Constituents from *Terminalia belerica*

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Since the dawn of the human creation, diseases have been effecting man kind. According to the annual reports of medicinal chemistry, 60% of the approved drugs for anti-infectious diseases, are of natural origin. It proves the important role of natural products in recent drugs.

Terminalia belerica fruit rind is used as one of the ingredients of 'Triphala'. Earlier workers have reported significant number of compounds from the crude fruit extract of the plant. The stem of *T. belerica* was investigated phytochemically. A new flavon glycoside has been isolated from the ethanolic extract of stem of *T. belerica*. It has been identified as Luteolin 7-O-a-L rhamnopyranoside by the joint applications of chemical methods as well as spectroscopic methods.

The ethanolic extract of dry powdered stem of *T. belerica* was concentrated. It is tested for antifungal and antibacterial activities by 'disc diffusion method'. The results were expressed in terms of inhibition zones. The same process was repeated with control. The test microorganisms are: Bacterial species - *Bacillus subtilis*, *Escherichia coli, Bacillus anthracis and Salmonella stanley;* Fungal species – *Aspergillus niger* and *Chrysoporium tropicam*.

Results show that ethanolic extracts of stems of *T. belerica* show promising anti fungal and antibacterial activities against all the test microorganisms.

Key words: *Terminalia belerica*, antifungal, anti bacterial, disc diffusion method

SVI/P-64 Assessment of Antibacterial Activity of Clove using Hemocytometer Technique

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Several spices, particularly garlic (*Allium sativum*), clove (*Eugenia caryophyllus*), ginger (*Zingiber officinale*), turmeric etc., are used extensively in Indian diet. In developing countries like India, which is one of the largest producers of spices; use of spices to combat these pathogens can not only prove to be successful in terms of their bactericidal and bacteriostatic properties but also economical.

Keeping in view the great potential of spices, the following paper evaluates the antibacterial activity of Indian spices namely clove against common food borne pathogens namely *E. coli, S. aureus* and *B. cereus*. A method previously used for blood counting has been applied to study the number of dead cells per ml produced due to the antibacterial effect of spices. Clove was found to be extremely potent against all the three bacteria at 1% levels. Hemocytometer technique was standardized and found to be extremely effective giving rapid results.

Key words: Antibacterial activity, spices, hemocytometer, food-borne pathogens

SVI/P-65 A Critical Study on the Impact of Environmental Pollution on Human Health in India

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In developing countries poor people are often unable to secure even the bare necessities for a healthy life; adequate food, water, clothing shelter and healthcare. They often live in an unhealthy environment. In rural areas inadequate shelter, over crowding, lack of safe water and sanitation, contaminated food and air pollution are the greatest environmental threats to human life. These conditions are compounded by poor nutrition and lack of education, which make people in remote sectors in India more vulnerable to environmental health risks. Often unhygienic living conditions spread diseases such as typhoid, cholera, malaria and hepatitis. Exposure to infectious and chemical agents can hamper educational participation and performance, thereby reducing the future potential of individuals as well as the societies. Water availability and quality are paramount issues in India with urban demand for water exceeding supply by as much as 30 percent. With over three quarters of the population lacking adequate sanitation, water-borne diseases are prevalent, including diarrhoea, which kills 500,000 children each year. Air pollution and improper waste disposal are also major concerns. Growth in the transport, power, and manufacturing sectors has worsened air quality, contributing to respiratory and other health-related problems.

This paper explores the complex links between environment, development, and health. It explores the ways in which environmental factors, particularly environmental change, can degrade health; either directly, by exposing people to harmful agents, or indirectly, by disrupting the ecosystems that sustain life. It elucidates the understanding of the complex links between the environment and health in both the global and the local environment which are critical to health and well being. The paper further examines how improved environmental management can reduce these risks and preserve both human health and environmental quality.

Key words: Environmental pollution, education, health risks

SVI/P-66 Utilization of Agro Waste in Paper Industry

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Man is both creature and modular of his environment, which gives him the opportunity for intellectual, moral social and spiritual growth. Civilization is taxing the environment, by not only consuming the natural resources but by throwing out the waste products into the environment. Many of the waste products are at present used or reused in uneconomic manner or left completely unutilized, causing a great hazard to human environment. Eco-friendly has become the catch word of today's civilization. Eco-friendly fibres and fabrics are gradually gaining importance as consumer are perpetually looking for bio degradable recyclable and eco-friendly textiles to preserve their natural environment, flora and fauna. Plant fibres have been used for making paper and clothing for a long time. Among natural fibres 90% are of vegetable origin and among them 80% is constituted by cotton and the remaining by other long vegetable fibres like- hemp, sisal, coir, abaca and pineapple fibres etc. They are classified as minor fibres. Among the minor fibres, maize, bhindi, arhar, til fibres are also having great potential as unconventional fibres, which could be analysed and evaluated for their use in paper industry. These fibres are abundantly available throughout the world, particularly in India and they come from renewable resources. Other large sources are recycling agro fibre based products such as paper, waste wood and other agriculture waste.

With the thrust on environmental friendly technologies, natural fibres paper would occupy a dominant role in years to come. Paper demands can be fulfilled with eco-friendly ways by converting waste to wealth.

Key words: Agro waste, biodegradable, paper industry

SVI/P-67 Isolation and Enrichment of Photosynthetic and Heterotrophic Organisms from Cowdung

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The present study was intended and conducted for isolation of photosynthetic and anaerobic bacteria from cowdung sample. Three days old cowdung (stored in polythene bag) 100 gm, was suspended in 1M sodium phosphate buffer (100 ml) in air tight closed round bottom flask under interrupted stirring condition. Very fast evolution of gas was observed when subjected to tungsten bulb (2000 lux light intensity) at 35°C suggesting the involvement of nitrogenase enzyme. Further, these samples were streaked on solid plates containing 2% agar for isolation of micro- organism. Media composition used for isolation of heterotrophic bacteria named CDN1 was Y-19 medium (R)

Photosynthetic bacteria was isolated on PNS medium (ref) named CDN2. The effects of glucose, sucrose, fructose, maltose and lactose on growth of CDN1 and malic acid, glutamic acid, citric acid and succinic acid on growth of CDN2 were also studied. Growth curve of these two organisms showed its duplication time. Based on these informations, sewage sample was tested as organic source for these two organisms and can serve in future as potential means of waste management.

Key words: Nitrogenase enzyme, photosynthetic bacteria, heterotrophic bacteria, isolation, enrichment

SVI/P-68 Effect of Quinolphos on Chironomus Larvae (Chironomidae)

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Fresh water resources were subjected to pesticide pollution and toxicity. Attempt had been made to establish the toxicity of quinolphos against *Chironomus* larvae at normal pH (7.0) and temperature 25°C, LC_{50} was determined at 24, 48, 72 and 96 hr. At 24 hr LC_{50} was 37.5 ppb, at 48 hr 33.2 ppb, at 72 hr, 27.5 ppb and at 96 hr 24.3 ppb. Presumable concentration recorded was 0.00126. Presumable harmless concentration recorded was 0.00076. Thus the fourth instar larvae of *Chironomus* may be considered as sensitive indicator of the stress of quinolphos pesticide added to the aquatic ecosystem and persisted mostly in the sediments.

Key words: *Chironomus*, quinolophos, toxicity

SVI/P-69 *In vitro* Propagation for Mass Multiplication of *Podophyllum hexandrum*: a High Value Medicinal Herb

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A protocol has been developed for *in vitro* shoot proliferation from callus cultures of *Podophyllum hexandrum* Royle. Callus initiation occurs from root segments of established *in vitro* grown seedlings on

Gamborg's B5 medium (half strength) supplemented with 2,4-D (0.5-1.5 mg/l) and BA (0.2-1.0 mg/l). The rhizome of this plant contains several important lignanas and most important being podophyllotoxin, main precursor for anticancer drugs teniposide and ertoposide. In addition *Podophyllum hexandrum* has been reported to have radio-protection properties. Ruthless collection has led to the disappearance of this important medicinal plant from many areas of Himalayas. Thus, there is need for immediate conservation of this important medicinal plant through tissue culture means. In the present study, shoot proliferation occurs from callus cultures cultured on basal MS medium fortified with BA and IAA either alone or in combination (0.5-5.0 mg/l) each. Regenerated shoots were rooted with high efficiency on MS medium fortified with activated charcoal (0.5-1.0%) and NAA (0.5-2.0 mg/l). The rooted plantlets were transferred to jiffy pots containing sand, soil and vermiculite in 1:1:1 ratio and hardened plants were grown under *exvitro* conditions for field transfer.

Key word: Podophyllotoxin, *Podophyllum hexandrum*, *in vitro* propagation, and medicinal herb

SVI/P-70 Artificial Colouration and Use of Synthetic Dyes in Vegetables and Other Foodstuffs

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Addition of colour in foods like fruits and vegetables is done to give a 'natural' look and appeal. Further, many manufacturers utilize chemical dyes to promote the sale of their products, as they feel many consumers would not purchase colorless products because they equate 'colorless with tasteless'.

Synthetic food colors are found in a wide variety of products, from sodas, candy, dessert mixes to commercially prepared baked goods, sausages, hot-dogs, toothpaste and dry convenient diets for birds and other animal companions. Chemical dyes, of course, are also used in many drugs and cosmetics, for artificially coloring vegetables, fruits and other foodstuffs simply to entice the customers. These synthetic dyes colorants whether organic or inorganic cause acute to chronic health problems like gastric disorders, muscular spasms and paralysis, hormonal and neural disorders, renal and hepatic malfunctioning including failures, benign and malignant tumours. Above mentioned lines definitely put us on serious and sensitive plains and demand for preventions in all possible ways.

Key words: Synthetic dyes, vegetables, fruits, drugs

SVI/P-71 Seasonal Fluctuation of Zooplankton in Gavinath Pond Water Birsinghpur, District – Satna

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The abstract describes the seasonal fluctuation of the major zooplankton communities- rotifera, copepoda, cladocera and ostracoda of a polluted water body, Gavinath pond, Birsinghpur. A total of 15 species comprising 6 rotifers, 3 copepods, 5 cladocerans and one ostracoda were recorded. Quantitatively rotifera dominated the other 3 groups followed by cladocera, copepoda, and ostracoda. Total zooplankton and rotifers exhibited a well-marked bimodal pattern of fluctuation while copepods showed a single peak. The different zooplanktonic groups exhibited limited migration with the depth. The rotifers and copepods have higher population in surface water while cladocerans showed their maximum population in deeper water.

Key words: Zooplankton, seasonal fluctuation

SVI/P-72 Chemical pools of Cr, Cd and Ni in agricultural soil irrigated with sewage mix effluent

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The heavy metal content of soils depends on the nature of the parent rock. The entrance of sewage, sludge, industrial effluent, fertilizers and other anthropogenic activities may enhance the heavy metal content of soil. Possible adverse effect of heavy metals in agricultural soil as a result of untreated waste water utilization has begun to focus on the chemical forms of trace metals in relation to their uptake by plants.

The present study was conducted to determine chemical pools of Cr, Cd and Ni in soils collected from the industrial area around Jagdishpur (UP). The obtained data shows that the degree of metal enrichment was site specific and appeared to be dictated by proximity to the sewage disposal, the relative abundance of clay particles, total organic carbon and organic matter content of the sewage mix effluent. Much higher levels of COD, BOD, sulphate, nitrate, solids and alkalinity were obtained in the collected samples. The concentration of trace elements in sewage mix effluent were observed to be : Cr -41.2 ppm, Cd -22.5 ppm and Ni -27.6 ppm. All these sources cause accumulation of trace metals in agricultural soils, pose threat to food safety issues and potential health risks due to transfer of metals from soil-to-plant. The findings of the present study with toxicity of hazardous elements and metal composition in various parts of agricultural crops in near by areas will be discussed during the presentation.

Key words: Effluent, irrigation, agricultural soil, trace metals, availability

SVI/P-73 Fog Water Harvesting: Assessment of Quality and its Potentiality over Northern India

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The depleting water resources and the growing water needs in India, have forced rainwater harvesting to be made compulsory in urban areas. Fog is one alternative source of water. Fog water harvesting offers another potential resource, particularly over the plains in northern India because dense, wide spread and prolonged foggy days in winter seasons. Fog droplets coalesce on mesh screen and flow by gravity into a supply network. The technology is sample and can be maintained and managed by the users. Fog water harvesting can be able to provide water for small rural communities and mountainous regions in northern India. Fog water collection system can be easily assembled and its installations very simple on site. Assembly is not labor intensive and required little cost.

During the study fog water has been harvested through a preliminary designed passive net installed in selected cities. In actual field, a 4x4 m fine nylon-mesh, made in grids of 2x2 m, supported on a steel stand has been placed in an open field. The yield in four state capitals in India i.e. Delhi, Lucknow Dehradun and Patna were 7.5, 4.3, 7.35 and 4.10, liters of water per sq m per day, respectively, during December-January 2003. The physico-chemical characteristics of fog water were analyzed and found that the value of pH, colour, taste, dissolved

oxygen, biochemical oxygen demands, chemical oxygen demands, total dissolved solids, total suspended solids, fluoride, chloride, nitrates, hardness , sulphate, phosphate, Fe, Mn, Cu, Zn, Cr, Cd, Co, Ni, S, and P, were lower than the recommended limits of WHO. The results shows the physico-chemical quality is better than from existing water sources used for agriculture and domestic purposes however the geography of the catchments area of any location is important when discussing the chemical composition of harvested fog water. The metal composition of fog water with physico-chemical variables will be discussed during the conference.

Key words: Fog water, harvesting, physico-chemical assessment

SVI/P-74 Phenolic Acids in Different Preparations of Dry Fruits

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Dry fruits occupy an important group in agricultural and confectionery commodities being used by many civilizations all over the world to fulfill flavor, taste and nutritional requirements. Healing of various physical, emotional and psychological emotional problems have been reported in traditional medical system by these dry fruits; with this view, HPLC analysis was performed to estimate phenolic acids in 11 dry fruits (Date, Cardamom Almond, Coconut Groundnut, Resin, Kishmis, Cashew nut, Pista, Makhana, Chiraunji) commonly used in India in different forms. In all 8 phenolic acids; viz., tannic, gallic, caffeic, vanillic, o-coumaric, ferulic, cinammic and salicylic acids could be identified on the basis of their retention time with standard compounds and co-chromatography. Various preparations of dry fruits were made. Maximum amounts of tannic, ferulic and salicylic acids were found in Pista. Gallic and vanilic acids were found maximum in Chiraungi. Caffeic and o-coumaric acids were found maximum in Resin and almost respectively. Cinnamic acid was found maximum in Groundnut. These phenolic acids acts as insecticides, antibacterial, anticonvulsant, anti-inflammatory, catalyses peroxidases; act selective induction in cell death in cancer cells, inhibitory against HIV-protease enzymes, free radical scavengers and biological antioxidants.

Key words: Dry fruit, phenolic acid, nutrition

SVI/P-75 Use of Open Top Chambers to Evaluate the Impacts of Ambient Air Pollution on *Beta vulgaris*

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This study deals with the evaluation of the effects of ambient air pollution on Palak (*Beta vulgaris* L. var. All green) plants grown at a sub urban site in Varanasi, India using open top chambers. Experiment was conducted during May- June 2002. Six open top chambers were installed at the field site with three receiving ambient air (non-filtered air; NFCs) and another three received filtered air (FCs). Three open plots were also established to study the chamber effects. Eight hourly air monitoring was conducted at the experimental site for SO_2, NO_2 and O_3. The NFCs had significantly higher pollutant concentrations than the FCs. During the experiment, mean SO_2 concentration varied from 17-36 ppb, NO_2 from 27- 43 ppb and O_3 from 35- 71 ppb. The effects of pollutants on Palak plants were investigated by evaluating different morphological parameters, biomass accumulation and foliar nutrient concentrations. Plants growing in FCs showed significant increments of 37, 32, 17, 55 and 29% in total length, leaf area, number of leaves, dry root and shoot weights, respectively over plants grown in NFCs. Leaf area showed greater increments than leaf number in the plants of FCs. Similarly, increase in below ground biomass was more than above ground biomass in FCs as compared to the plants grown in NFCs. This observation suggests the greater allocation of resources to the roots of the plants in FCs. Foliar nutrient contents (Na, K, Ca, Mg, Fe) did not differ significantly between the plants growing in FCs and NFCs.

The results of the above study showed a strong negative effect of the ambient air pollutants on growth and biomass accumulation of plants. The concentration of O_3 showed maximum variation (35- 71 ppb) during the experimental period and was especially higher during the later stages of the experiment when the plant showed higher metabolic and growth activities. This suggests that O_3 may have caused maximum unfavourable impact on plant growth and development.

Key words: Ozone, *Beta vulgaris*, yield loss, biomass, nutrient

SVI/P-76 Transmission of *Myrothecium Roridum* in Cotton: Seed to Plant and Plant to Seed

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Cotton assumes place of pride in Indian economy, as it is one of the most important cash crops in India and plays a dominant role in industrial and agricultural economy of the country. *Myrothecium* blight of cotton caused by *Myrothecium roridum* Tode Ex Fries is an important disease of East Nimar of Madhya Pradesh. Studies were conducted to investigate the transmission of *M. roridum* from seed to plant and then from plant to seed. The seeds of *G. hirsutum* cotton collected from Badnawar were used for these studies, which had a high level of association of *M. roridum*. The association of the pathogen was confirmed by Standard Blotter Method. The seeds were sown in plots of 6 x 2.40 m^2 size. Observations were recorded on the percent plant infected by *M. roridum*. The mean incidence of *Myrothecium* leaf blight in plants grown from infected seed lot is 20.12% clearly indicating that the pathogen has been transmitted from the seed to the plant. The maximum transmission was found in the seedlot from Khargone (40%) followed by the lot from Badnawar (32%). The lowest transmission from seed to plant was in case of seed collected from Sardarpur (6%). The transmission of pathogen from seed to plant was in the range of six to forty percent. The seeds from infected plants were collected and recovery of *M. roridum* from such seed was attempted by Standard Blotter Method. The recovery of *M. roridum* in various seed lots derived from infected plants ranged between 11 and 33%. The maximum recovery was observed from Khargone lot (33%) followed by the lot from Badnawar (24%). The minimum recovery of 11% was observed in the seed lot from Bamansuta.

Seeds were collected from the infected plants and re-sown in plots of the same size to see whether the pathogen has been transmitted to the seeds. One hundred seeds were also tested in laboratory for recovery of *M. roridum* by Standard Blotter Method.

Key words: *Myrothecium roridum*, cotton, seed, pathogen

SVI/P-77 Impact of Cropping on Nitrogen Transformation of Similipal Biosphere Reserve of India

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One-year study accentuating the variations in nitrogen mineralization rates in Similipal Biosphere Reserve Forest Ecosystem has been discussed in the present paper. The forest and cropland ecosystems of Similipal Biosphere Reserve of India had been selected to quantify the status of impact of cropping on plant available nutrients and N-mineralization rate.

The values of nitrate-N for the forest and cropland ecosystems ranged from 8.33-10.47 and 22.13-26.4 mg g^{-1}, respectively and ammonia-N ranged from 7.18-8.4 and 9.42-11.2 mg g^{-1}, while phosphate-P ranged from 6.8-7.2 and 8.4-10.0 mg g^{-1}, respectively. Nitrate-N, ammonia-N and the phosphate-P concentrations in both the ecosystems are minimum in wet period, while maximum in dry period. The rates of nitrification and N-mineralization for forest ecosystem ranged from 7.07-10.33 and 8.40-13.78 mg g^{-1}, respectively and those for cropland ecosystem ranged from 5.2-8.13 and 6.56-11.20 g g^{-1}, respectively. The values of net nitrification and net N-mineralization are maximum in wet period and minimum in dry period. The results indicated significant difference due to site and season. The concentrations of available nutrients, *viz*. nitrate-N, ammonia-N and phosphate-P increased by 61, 52 and 42%, respectively, due to the conversion of forest into cropland. In contrast, the rate of nitrification is declined by 33% and that of N-mineralization by 40%, after the conversion of forest into cropland. Therefore, there is a need of nutrient management strategies for the prevention of nutrient loss due to cropping prevailing in the Biosphere Tiger Reserve.

Key words: N-mineralization, nitrification, immobilization, microbes, ecosystem, inorganic nutrients

SVI/P-78 Allelopathic Potential of *Randia* Leaf Lechates on *Allium cepa* L.

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Randia dumetorum (Gelphal), the medium sized shrubby plant growing luxuriantly in the forest of Mahabaleshwar is generally used as fish poison by the local tribes. Knowing this, different concentrations of aqueous leaf leachates of the above mentioned plant were screened for its allelopathic potential by using *Allium* test.

The results indicated that per cent seed germination, seedling survival, root and shoot length as well as mitotic index etc. were adversely affected by higher concentration of leaf leachates. These effects may be ascribed to various types of allelochemicals present in the leaves of this plant. The detection of allelochemicals and their effects on chromosomal behavior during mitosis is in progress.

Key words: *Randia dumetorum*, leaf leachates, cytotoxic effects, *Allium* test

SVI/P-79 The Study of Water Quality Index of Gambhir Dam Reservoir, Ujjain

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Gambhir dam is built on river Gambhir near Ujjain. The main purpose of this dam is to provide drinking water to Ujjain city. Ujjain is the host of Kumbh mela in every 12 years. To provide water for the city population and the pilgrims is a crucial factor, so before 1992 Kumbh mela this dam was built. This paper find, water quality index of Gambhir dam reservoir and four indexes for various beneficial use are formulated, these are public water supply, agriculture, industry, fish culture and non-contact recreation. Also monthly variation in water quality index for beneficial uses are studied.

Key words: Water quality index, Gambhir dam

SESSION-VII

PLANT RESPONSES TO ENVIRONMENTAL POLLUTION

SVII/L-1 The Influence of Air Pollution on Plant Fungal Disease

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Fungal diseases of plants result in enormous losses in crop yield and forest production world-wide. This has been recognised for many years and is the subject of large research and breeding programmes to elucidate and minimise the problem. Less well recognised is the widespread impact of air pollution on agriculture and forestry, particularly in the developing world. It is known that air pollution can change the response of plants to other stresses, both biotic and abiotic, yet this is a relatively poorly researched area. Thus air pollution has the potential to have major effects on yield via secondary impacts on these other stresses. In this paper an overview will be given of research into the effects of a range of air pollutants on a number of major diseases of vegetation caused by fungal pathogens, with some emphasis on research carried out at Imperial College.

Conventional wisdom has held that air pollutants reduce the severity of biotrophic fungi, but produce more mixed responses on non-biotrophs. This paper will include examples which indicate that this generalisation is not always applicable. Consideration is given to the potential importance of air pollution/fungal pathogen interactions in developing countries.

Key words: Fungal pathogens, plants, ozone, nitrogen dioxide, sulphur dioxide

SVII/L-2 Interactive Effects of Tropospheric Ozone and Anthropogenic Emissions on Plant Nutritive Quality for Ruminant Herbivores

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Tropospheric ozone (O_3) is the most significant phytotoxic air pollutant affecting vegetation in industrialized regions of the world, and O_3 concentrations are projected to increase between 0.3% and 2.0% per year on a global basis for the next 50 years. Effects of O_3 on growth and economic yield of forage crops have been investigated for some time, and the last decade has witnessed a major research effort directed toward elucidation of O_3 impacts on nutritive quality of forage crops for agriculturally important ruminant herbivores and on nutritive quality of wild and semi-natural herbaceous vegetation for ruminant livestock and wild ruminants. Evidence has accumulated over the past few years that indirect effects of O_3 on plants (e.g., altered nutritive quality) have been greatly underestimated and that they may be potentially more important economically than direct effects on growth and yield. Yield-based risk assessments underestimate the total economic impact of O_3 on herbaceous vegetation because no account is taken of decreased nutritive quality. The magnitude of total economic impact of O_3 to ruminant livestock and wildlife production is a function of cumulative effects on plant yield and nutritive quality under prevailing economic conditions. Until recently, very little was known about interactive effects of tropospheric O_3, a secondary air pollutant, and primary air pollutants emitted largely from anthropogenic sources on growth and yield of forage crops and other herbaceous vegetation; even less is known about combined effects of air pollutants on plant nutritive quality for ruminant herbivores. This paper discusses the interaction of tropospheric ozone with elevated CO_2, NO_X, NH_3, nitrogen and SO_2 in different meteorological conditions on the plant nutritive quality

Key words: Ozone, air pollution, forages, nutritive quality, ruminants

SVII/O-1 Role of Ethylene Diurea (EDU) in Assessing Impact of Ozone on Growth and Yield Losses in Mungbean (*Vigna radiata* L.) and Wheat (*Triticum aestivum* L.) Plants

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A field study was conducted to evaluate the suitability of ethylene diurea (N-[2-(2-oxo-1-imidazolidinyl) ethyl]- N' phenylurea; EDU) in assessing the impact of O_3 on mung bean (*Vigna radiata* L. var. Malviya Jyoti) and three cultivars of wheat (*Triticum aestivum* var. HUW234, HUW468 and HD2329) grown in suburban area of Allahabad city situated in a dry tropical region of eastern Uttar Pradesh, India. EDU is a synthetic chemical having anti-ozonant property. Mean monthly O_3 concentration varied between 64 and 69 mg m^{-3} during the experimental period. In comparison to EDU-treated plants, non EDU- treated plants showed significant reductions in plant growth and yield under ambient conditions. Significant favourable effects of EDU-application were observed with respect to photosynthetic pigments, soluble protein, ascorbic acid and phenol contents. EDU-treated plants maintained higher levels of pigments, protein and ascorbic acid in foliage as compared to non-EDU-treated ones. In wheat, cultivar HUW 234 was found more responsive than HD 2329 and HUW 468. The study clearly demonstrated that EDU alleviates the unfavuorable effects of O_3 on mung bean and wheat plants, and therefore, can be used as a tool to assess the growth and yield losses in areas having higher O_3 concentrations.

Key words: EDU, urban air pollution, ozone, growth, yield, *Vigna radiata, Triticum aestivum*

SVII/O-2 Plant Response on Aromatic Hydrocarbons Penetration

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The aim of this work is to elucidate involvement of key enzymes of nitrogen metabolism and Tricarboxylic Acid Cycle. Changes in activities of these enzymes enable to estimate the degree of hydrocarbons effect on intracellular processes.

The experiments were carried out on maize, ryegrass and kidney bean seedlings. Plants were exposed to aromatic hydrocarbons - benzene and 3,4-benzpyrene.

Effect of aromatic hydrocarbons on plants main metabolic processes was investigated, depending on: concentration (0.05mM, 0.1mM); exposure time (short-term exposure and prolonged exposure) and mode of illumination (ordinary illumination, darkness).

It was revealed, that at comparatively higher concentrations of aromatic hydrocarbons (0.1mM) the changes taking place in a cell are more strongly marked. However the plant can overcome the given doze of toxicant at the expense of ultrastructural reorganization and mobilization of energy resources, the evidence for it is the rise of glutamate dehydrogenase activity.

One of the important factors is the duration of plant exposure on medium with aromatic hydrocarbons. Some of the studied plants at prolonged incubation work out a protection mechanism against toxic action of the studied aromatic hydrocarbons and the observed stimulation of dehydrogenases activities obviously promote generation of additional energy, necessary for detoxification processes.

In the study of influence of light and darkness it was revealed that at ordinary regime of illumination the plant manages toxic effect of the studied aromatic hydrocarbons, through presumably, increase of glutamate dehydrogenase and malate dehydrogenase activities in plant roots. While in roots of plants, grown in dark a significant inhibition of all studied enzymes activities is observed, indicating deviation from a cell normal function.

Key words: Glutamate dehydrogenase, malate dehydrogenase, glutamine synthetase, Benzene 3,4-Benzpyrene, ultra-structure

SVII/O-3 Multiple Effects of Nitrate Seed Treatment on Germination Growth and Yield of Various Crops

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Nitrate is the main source of nitrogen for plants beside legumes and nitrogen fixing plant species. Therefore application of it to growing plants improves the growth and yield too. Present study summarizes the multiple effects of nitrate treatment to seeds in form of soaking/ hardening before its sowing in field on various life phases of plant species i.e. from germination to yield and its possible mechanism of action.

The studies regarding vegetative and reproductive phases of plant's life showed a positive impact of nitrate seed treatment. It induces nitrogen metabolism (nitrogen content / amino acid content / nitrate reductase activity), photosynthetic activity (dry bio mass of shoot and chlorophyll content of leaves), water utilizing capacity and various yield attributes over control (non soaked / non hardened seed) in tested crops:

An interesting result was obtained during study of yield attributes of mustard in respect to nitrate seed treatment; while the seeds of this crop were sown in late sowing season showed more effect in improving the seed yield plant-1 and other related traits of yield in comparison to timely sown sets; but in both cases control (non soaked seeds) was found inferior. Further, while the studies were extended in context to salinity stress and cold stress under the influence of nitrate seed treatment it was observed that this type of treatment has the capacity to induce stress resistant potential in crops like wheat and mustard both by improving their root system, proline content (indices of stress resistant) etc. Therefore, the work may open multiferous channels for the nitrate seed treatment and crop growth under various kinds of abiotic stresses.

Key words: Nitrate, seed treatment, germination, vegetative growth, yield attributes, stress responses

SVII/O-4 Physiological Effects of Ozone in the Endemic Mediterranean Plant *Lamottea dianae*

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Lamottea dianae (Webb) G. López (=*Carduncellus dianius* Webb) (Fam. Asteraceae) is a species with a very restricted distribution in eastern Spain, being classified as "Vulnerable " in the Red list of Spanish vascular flora. It is a hemicryptophytic perennial herb, with a basal rosette of leaves, and long stalks bearing several flowers. Photo-oxidants, and especially ozone, may represent a potential threat to sensitive Mediterranean endemic plants, as this area is becoming more populated and industrialized. However, there are almost no studies addressing the ozone effects on these valuable species. The results presented here are part of a wider study, and focus on the physiological effects of tropospheric ozone on *Lamottea dianae*. Plants exposed in OTCs to realistic concentrations of ambient air plus 30 ppb of ozone were compared to plants growth in charcoal filtered air (control). After 3-weeks of exposure, asymptomatic leaves of plants exposed to ozone experienced a significant reduction in CO_2 assimilation (A_{sat}), and water use efficiency (WUE), together with an increase in intercellular CO_2 concentration (c_i). These changes occurred without a significant decline neither in stomatal conductance (g_s), nor in the maximum quantum efficiency of photosystem II (F_v:F_m). Model calculations derived from the response of CO_2 assimilation rate to changing intercellular CO_2 partial pressure (i.e. A/c_i response curves) showed that CO_2 fixation capacity by Rubisco ($V_{c,max}$) and maximum RuBp regeneration capacity (J_{max}) declined significantly in these leaves. On the contrary, day-time respiration (R_d), Triose-P utilization (TPU), and relative stomatal limitation (RSL) were not affected. These results suggest that the initial impairment in assimilation observed in non symptomatic leaves seems to be mainly related to a decline in carboxilation efficiency of Rubisco, rather than to stomatal limitations or photoinhibitory damage. Significant reductions in stomatal conductance and F_v:F_m were observed only when leaves became more severely affected, showing clear visible injury. In addition to impaired CO_2 assimilation and low carboxilation efficiency, symptomatic leaves also showed significant reductions in chlorophyll content, transpiration rates, and some fluorescence parameters such as the quantum yield of electron transfer at PSII (F_{PSII}), and coefficient for photochemical quenching (q_p). These changes are similar to those observed during leaf senescence, suggesting that ozone accelerates senescence in *Lamottea dianae* leaves.

Key words: Air pollution, ozone, plants, photosynthesis, chlorophyll fluorescence, endemic plants

SVII/O-5 The Comparison of Physiological Responses of *Triticum aestivum* and *Glycine max* L. cv. Williams to Interaction of Cadmium and Salinity

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The effect of 0, 2.5, 5 and 10 mg Cd^{+2} l^{-1} [$Cd(NO_3)_2.4H_2O$] and 0, 10, 25, 50 and 100 mM NaCl on certain parameters of photosynthesis and growth was observed in *Glycine max* (dicot) and *Triticum aestivum* (monocot) plant. The inhibitory effects of NaCl were severe on *Glycine max,* whereas *Triticum aestivum* was tolerant. The accumulation of total soluble sugars were more in *Triticum aestivum* plants. With increasing cadmium in nutrient solution starch content was decreased in both plants. The survival percentage of *Triticum aestivum* plants under severe conditions of these two stresses separately was more than *Glycine max* plants.

By addition of different concentration of cadmium to solutions with salinity, final responses of *Glycine max* L. plants were better than *Triticum aestivum* plants. The number of *Glycine max* plants increased in comparison to the previous conditions. With increasing Cd in nutrient solutions and different contents of salinity, the inhibitory effects of these stresses alone on different growth parameters such as Relative Growth Rate (RGR), Leaf Water content per unit leaf area (LWCA), Relative leaf area Growth rate (RLAGR), Unit leaf rate (ULR), Specific leaf area (SLA), shoot dry matter (SDM), root dry matter (RDM), shoot fresh matter (SFM), root fresh matter (RFM), leaf area (LA), were decreased and *Glycine max* plants showed better growth than *Triticum aestivum*.

Key words: *Glycine max*, *Triticum aestivum*, growth parameters, cadmium, salinity, total soluble sugars, starch

SVII/O-6 The Physiological Responses of *Allium cepa* to Interaction of Cadmium and Gibberellins

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The objective of this study was to evaluate the consequences of cadmium stress and interaction of cadmium and gibberellins on physiological aspects of growth in *Allium cepa* (onion) plants.

In this investigation, the effects of Cd^{2+} and gibberellins on (1) seeds germination, (2) Seedling growth after 10 days culture, (3) plants growing from bulbs after 10 days culture and (4) plants growing from bulbs after 2 months culture, were studied.

The percentage of germination of onion seeds decreased with increasing concentrations of Cd in the growth medium. Gibberellic acid (GA3) at 0.03 mm induced percentage germination and seedling growth under cadmium stress. The primary effect of cadmium on plants was reduction in growth. Under Cd stress the fresh and dry weight and length of root and shoot and number of root were reduced.

The thickness of chromosomes decreased with increasing cadmium in medium, when Gibberellic acid was added this effect reduced.

The contents of total soluble sugars and starch in root and shoot, total chlorophyll and total protein contents decreased but the total protein content and activity rate of peroxidase increased in Cd treated plants. Increased Cd concentration in root and shoot of plants under stress were accompanied by declining concentration of potassium. Addition of Gibberellic acid to medium decreased of accumulation of cadmium in root and shoot. Gibberellic acid caused a partial elimination of toxic effects of cadmium on onion plants.

Key words: Germination, cadmium, gibberellic acid, chromosomes, growth, interaction, onion

SVII/O-7 Phytostabilization Studies on a Sediment Contaminated with Chromium

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The key issue in the process of phytostabilization is the selection of suitable plant species. In many areas of Hungary, the upper soil layer is contaminated with chromium by polluted discharges originated form leather and electroplating factories. The aim of our study was to evaluate the applicability to phytostabilization of some plant species that can be originally found in the Carpathian Basin. Our study presents the results of vegetation examinations performed in 1998 and 2001 in the units of a former secondary chromium contaminated sedimentation pond system of a Hungarian leather factory near town Kunszentmárton. In accordance with the vegetation period, sampling was performed on four occasions. From the spring sampling botanical measurements were made in order to identify the plant species existing in the pond units. From the sampling sites, plants and sediment beneath the plants were collected for chemical analyses. The ratio of Cr(III) and Cr(VI) in the sediment samples were determined with 1,5-diphenil-carbazide method of spectrophotometry. The Cr concentration in the sediment samples collected in 1998 was between 70-23722 mg/kg; the mean value was 5893 mg/kg. The mean Cr concentration was 3604 mg/kg in the sediment samples collected in 2001 and varied between 129-7230 mg/kg. The Cr(VI) species was only detectable in the sediment collected in 1998 and the average concentration value was 146 mg/kg. Our results show that in the sediment of the settling pounds the Cr can be found mainly in the form of $Cr(OH)_3$ and $(Cr_xFe_{1-x})(OH)_3$ because of redox potential, pH values and high concentration of Fe and Ca in the sediment. Plants of fresh soils and frequently flooded soils were present in highest numbers in the area both in 1998 and in 2001. Herbaceous plants dominated, but in 2001 a woody plant, *Populus alba* was present in great abundance. *Oenanthe aquatica* accumulated the greatest amount (827 mg/kg). The results of the examinations on the Cr accumulation of plant tissues, biomagnification ratio and accumulation factor would be discussed.

Key words: Chromium, phytostabilization, leather factory, helophyte vegetation

SVII/O-8 Heavy Metals in the System of Soil-Plant: Update, Moving and Distribution in Plant Organs

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Many years investigations of complex pollution effect by SO_2 along with heavy metals on higher plants growing in forest soils in northern taiga (68-69°N, Kola Peninsula, Russia) as well as experimental works had shown the heavy metals entering from polluted soil to plants and their distribution in different plant organs. It was shown that absolute content of macro- and microelements in plants was highly dependent upon many factors, major of them were: 1) heavy metal level of forest litter; 2) chemical nature of the metal; 3) mechanism of its fixing in the soil; 4) heavy metals mobility in soil and plant; 5) physiological requirement of plant organ for certain element; 6) different functions of various plant organs; 7) antagonism between metals.

Increase of heavy metal content in various component of forest ecosystems close to the metallurgic complexes was reported by many researchers. Analysis of data obtained showed a significant linear correlation between the active forms of Ni and Cu in the forest litter and their concentrations in various parts of *Pinus sylvestris* L. seedlings ($r=0.84-0.99$, $p<0.05$) as well as between the content of heavy metals active forms in the upper soil horizon and their accumulation level in the leaves of various plant species ($r=0.92-1.00$, $p<0.05$), which grew up at pollution gradient from smelter.

In polluted forest soils more than 80% of Cu total content was found in active forms which were available to plants, as contrary, the Ni compounds were less soluble than Cu ones (only 13% of Ni total content was found in active forms). The rate of Ni and Cu entering in plant from polluted soil and their moving to various plant organs limited by different capacity to make complex compounds with organic and inorganic substances. That is why the concentrations of Ni and Cu and their ratio in the forest litter and in the plants were strongly differed. Ni moves easier than Cu from polluted soil to the overground part of plants.

The Mn content in the leaves of all test plants decreases in the zone of damaged forest ecosystems (30-35 km from the smelter) and in surrounding of smelter (3-5 km) Mn concentration was 1.7-9.5 times lower as compared to the background level. Besides, in model experiments it was shown that the presence of heavy metals (Ni, Cu and others) in nutrient solution or in the soil inhibited Mn uptake by all plant organs. Thus, it shows an antagonism between Mn and heavy metals (Ni, Cu).

Key words: Nickel, copper, manganese, forest, litter

SVII/O-9 Impact of Sodicity on Essential Oil Composition

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The essential oils are aromatic essences, extracted from plants, flowers, trees, fruits, barks, grasses and seeds with distinctive therapeutic, psychological and physiological properties, which improve and prevent illness, leading to a distinctive therapy i.e. aromatherapy. Oils from natural, pure raw materials have been reported to give the maximum benefit instead of synthetically made oils. Further, the presence of different isomers and chemical compounds both good for health management and also injurious to health, causes a serious question in management of their utility. Present endeavour is an approach to improve the quality of essential oils using different soil conditions and agrotechniques. It is also an eco-friendly approach using sodicity as a tool for green chemistry.

Key words: Essential oil, sodicity, aromatherapy, green chemistry

SVII/O-10 Putrescine Alleviation of Growth in Indian Mustard under Salinity : Possible Mode of Action

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Polyamines (spermidin and spermine) and its obligate precursor a di-amine, putrescine are aliphatic compounds considered to be plant growth regulators which are implicated in induction of stress adaptation also. But, polyamines, in general and putrescine in specific mode of action is not very precisely known yet. Therefore, putrescine role in growth of salt stressed Indian mustard (*Brassica juncea* cv RH-30) was evaluated to throw some light on the possible ways of its response mediation in salt stress effected alteration. It has been proposed that putrescine elevate the level of nitrogenous metabolites and nitrate rductase activity in plants under salt stress and thereby considered to be nitrogen source for plant growth. In addition, putrescine is also implicated in replenishing the reduced titre of polyamines caused by salinity, which depends on salinity level. Moreover, cell osmotic disturbances is one of the major factor for hampering growth and development in plant salinity. This has been evaluated by measuring proline and Na^+/K^+. The Na^+ accumulation increase was checked by putrescine supplementation, without effecting K^+ level. On the other hand proline was increased tremendously in the presence of putrescine. The free radicals generation is common phenomenon hampering growth of the plant under stress condition which was also suppressed by putrescine through inducing antioxidant enzymes system. The most responsive enzyme APX and GR regulation is under examination. It was envisaged that putrescine having multifacet effect might be acting on genetic level also. This was apparent due to induction of certain novel protein(s) in leaf and root tissues under severe salt stress. It is discussed for drawing strategies for biotechnological approach to develop salt tolerance in oil crop specifically and crop plants in general by exploiting putrescine.

Key words: Putrescine, mustard, salinity, free radicals

SVII/O-11 Investigation of Heavy Metal Effects on Water Resources and Agricultural Products in Khozestan Province after Kuwait Oil Wells Fire in 1991

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Kozestan province is one of the most fertile province of IRAN with great resources of water. This province experienced two environmental disasters: 1. The eight years war of Iraq against Iran and 2. The Kuwait oil wells fire due to Iraq attack on Kuwait in 1991.

In this research, water samples were collect from 10 different areas and in each area 3 sample stations were chosen. Sampling area was determined by random systematic method on province map. Samples were collected and prepared, following standard methods and 9 elements viz. Hg, Pb, Cd, Ni, Co, Fe, Mn, Cu and Zn were analyzed in all samples by AAS. It was observed that the amount of some toxic metals such as Hg, Pb, Cd and Ni in all samples of water were higher than the WHO standards (Fe was higher in 50 percent of samples) unlikely, amounts of Co in 30 percent of samples was higher than the this standard, and amounts of 3 elements of Mn, Zn, Cu were lower than the WHO standards. The soil samples were also analyzed for those elements. This research result showed that the productivity of some agricultural products decreased significantly in 1991, specially when they were compared with the data availabel for previous and later years after 1991.

Key words: Iran, Persian gulf war, Kuwait oil wells fire, environmental pollution, heavy metals

SVII/O-12 Some Intriguing Insights into Aluminium and Salicylic Acid Induced Adaptive Responses to Genotoxic Stress in Plants

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Genomic stability and adaptive evolution are of paramount importance for the species survival and fitness under stressful environment, and the key for sustenance of the biodiversity. Of the different cellular targets, DNA is the target of genotoxic stress that could be evaluated by cellular responses manifested as chromosome aberration, micronucleus or comet. Evidences available over the recent past increasingly point to the involvement of reactive oxygen species (ROS) in metal-induced genotoxicity. Interestingly, metals and oxidative agents in low conditioning doses induce adaptive response that confer genomic protection when subsequently subjected to genotoxic challenge; referred as metallo- or oxi-adaptive response, respectively. The underlying mechanism of metallo- or oxi-adaptive response, however, remains elusive.

We present here a comparative account of adaptive responses induced in root meristem (*Allium cepa*) or embryonic shoot (*Hordeum vulgare*) by two contrasting metals: cadmium (Cd^{2+}) and aluminium (Al^{3+}), two oxidative agents: hydrogen peroxide (H_2O_2) and paraquat (PQ); and a signalling phytohormone: salicylic acid (SA) to three different types of genotoxins namely maleic hydrazide (MH), a S-dependent clastogen that induces no DNA strand break; ethyl methane sulfonate (EMS), an alkylating mutagen; and methyl mercuric chloride (MMCl), an aneugen-cum-clastogen. The pattern of genotoxic adaptation to MH, EMS and MMCl induced by the conditioning agents exhibited a remarkable difference between the metals (Cd and Al) as well as between the oxidative agents (H_2O_2 and PQ). Adaptive responses induced by Al and SA that shared similarity with PQ, but differed from H_2O_2. Our subsequent biochemical investigations provided evidence

that Al or SA at conditioning doses induced oxidative stress in root tissue of *A. cepa*, which was marked by generation of H_2O_2 increased lipid peroxidation and protein oxidation, inhibition or induction of certain antioxidant enzymes *viz*. catalase, ascorbate peroxidase, guaiacol peroxidase and superoxide dismutase, cell death and DNA damage. The findings underscored the possible involvement of a H_2O_2-independent signal transduction pathway in the underlying adaptive response to genotoxic stress.

Key words: Genetic toxicity, adaptive response, ROS, metals, signal transduction

SVII/O-13 Environmental Pollution Causes Negative Effects on the Growth and Development of Plants in Doon Valley

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The present paper deals with the study of impact on plant growth and developments through the environmental pollution in the Doon valley and its surroundings. In this region some pollutants, such as pesticides, insecticides, fertilizers, domestic wastes and industrial pollutants are released from their sources and enter the environment which affect growth and development of plants. DDT is probably the most well-known of all insecticide and by the excess use of DDT most people in all parts of the world are affected. Doon region is densely populated and industrial center of Uttaranchal, the photochemical oxidants of this center have spread and mingled with that of its neighbours to cover entire areas with crop damaging, and plant tissue killing substances causing serious economic overtones. We have found decline in growth of plants in the surrounding areas of the factory and other pollution producing industries. The roots of some plants have the capacity to take up vast amounts of heavy metals. Our study is to identify the various places around the Doon valley, where vegetation growth is prevented due to pollution.

Key words: Plant growth, Doon valley, chemicals

SVII/O-14 Nickel Toxicity Induced Oxidative Damage in Roots of *Vigna radiata* (L) Wilczek syn Var K-851

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An experiment was conducted to study the changes induced in the roots of green gram (*Vigna radiata* L. Wilczek syn. Var. K-851) in response to Ni toxicity (100 µM Ni) for a period of 16 days. During this period the relationship between oxidative stress and Ni accumulation in roots was studied. Depression in root growth was observed after 3d of Ni supply. Enhanced H_2O_2 concentration in roots only 24 hours after Ni supply indicated early induction of oxidative damage. Membrane lipid peroxidation (increase in MDA concentration) was also observed early and was well related to Ni concentration in roots. The ascorbate concentration in roots showed an increase throughout the period of Ni supply, but dehydroascorbate concentration remained unaffected. The activity of the antioxidative enzymes, superoxide dismutase (SOD; EC 1.15.1.1), ascorbate peroxidase (APX; EC 1.11.1.1) and glutathione reductase (GR; EC 1.6.4.2) increased initially but decreased after 6 d of exposure to excess supply of Ni. The activity of peroxidase (POD; EC 1.11.1.7) increased up to d 4 but remained unaffected there after, and that of catalase (CAT; EC1.11.1.6) decreased with the duration of excess Ni supply. Our studies indicate that oxidative damage (H_2O_2 and MDA) was initiated in advance of inhibition of root growth and was related to magnitude of the Ni accumulation in the roots. Increase in Ni accumulation on prolonged exposure to Ni lead to breakdown of the antioxidative defense system in the roots.

Key words: Ni toxicity, green gram, oxidative damage, roots

SVII/O-15 Response of Urban Trees to the Deposition of Air Pollution in Central Khorassan, Iran

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In arid areas and in areas with poor rainfall, as in the province Khorassan in Iran, urban parks are not only of great ecological significance, but they also have an important recreative function. If these regions are densely populated, urban parks and also roadside trees are strongly endangered by air pollution, especially by exhaust gas from cars. The aim of our investigations is to analyze the response of urban trees to the deposition of air pollution in the densely populated town of Mashhad in the Province Khorassan (Iran) and to consider which measures are necessary to ensure at long term their protective and recreative function. To achieve this aim, investigations were carried out in different polluted area of the town of Mashhad on two often planted urban tree species; *Platanus orientalis* and *Fraxinus ornus*. In 2003 and 2004, samples were collected from the leaves of the above-mentioned tree species both at the beginning and at the end of the vegetation period. The heavy metals Pb, Cu, Ni, Cr, Co, and Zn were measured in the blades and veins of collected leaves. Moreover, in the case of *Platanus*, the effect of air pollution on the anatomical and morphological characteristics of leaves was also examined. The results of the above-mentioned investigations will be presented.

Key word: Mashhad city, heavy traffic, heavy metals, tree, air pollution

SVII/O-16 Arsenic Contamination in Agricultural Soil: Effects on Nutrient Uptake and Yield of Rice (*Oryza sativa* L.).

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Use of arsenic contaminated groundwater for irrigation in rice fields has resulted in elevated concentrations of arsenic in top soils. Pot experiments were conducted to investigate the effect of arsenic on nutrition uptake and yield of rice. The doses of arsenic applied in the experiments were – 0, 10, 20, 30, 40, 50, 60, 70, 80 and 90 mg kg^{-1} soil. Experiments were laid out in CRD with three replications for each treatment. BRRI Dhan–26 (a HYV Rice of Bangladesh) was used as test crop. It was observed through the experiments that tillering, panicle number, percentage of filled grain, 1000 grain weight and total grain yield were affected significantly. Highest yield of rice (32.29 gm pot^{-1}) was found in treatment containing 20 mg of As kg^{-1} soil followed by 30 (25.026 gm), control (24.633 gm) and 10 mg of As kg^{-1} treatments (24.33 gm), where as the lowest was in 90 mg of As kg^{-1} soil treatment (0 gm yield). The observed decrease in rice yield was due to detrimental phytotoxicity of arsenic applied in soils. Nutrition uptake in different tissues of rice plant was also affected significantly with the soil arsenic concentrations. Nitrogen content in different tissues of rice plant (shoot and grain) decreased significantly with the increase of arsenic concentrations in soils. At the same time, tissue phospho-

rus concentrations were best correlated with the concentration of arsenic in soils. Shoot and grain phosphorus levels were increased with the increase of soil arsenic concentrations which is seemed to be due to the use of inorganic arsenicals (sodium arsenate). Potassium concentrations in shoot and grain of rice decreased significantly compared to control. Decrease in potassium uptake in above ground parts could be the result of a competition with Sodium present in soil solution, since the arsenical used in this studies was a sodium salt. But, Fe showed a synergistic relationship with As in the present experiment.

Key words: Arsenic, nutrition, rice, soil contamination, uptake, yield

SVII/O-17 Radish Tolerance to the Impact of Ozone Stress

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Investigations on radish tolerance to the impact of ozone were carried out under phytotron conditions. The aim of the study was to establish the radish tolerance intervals to the impact of ozone according to variation of physiologic plant measurements. Radish (*Raphanus sativus* L. cv. *•ara*) were used in vegetative experiments. 12-day-old plants were treated with ozone. Different ozone concentrations were kept as follows: 0 (control), 80, 160 and 240 ìg m^{-3} (7 h each day, 5 days per week). A photoperiod of 16 h was used and air temperature at 21/17 ºC (day/ night) was maintained. Biometric measurements of plants, photosynthetic pigment concentration, and photosynthesis productivity were determined at the end of treatment, one week and two weeks after treatment.

It was established that increase in ozone concentration reduced photosynthetic pigment concentration in leaves. The greatest reduce in concentration was observed for chlorophyll *a* and the lowest for carotenoids. Rapid regeneration of new leaves was the typical reaction of plants to ozone stress. Increased concentration of all photosynthetic pigments was observed in regenerated leaves immediately after treatment, though later, in two weeks, it dropped down to the level of control plants. Consequently, assimilation area of plants increased immediately after impact, but reached the values of control plants in two weeks as well. Ozone stress reduced rhizocarp diameter of radish, photosynthesis productivity and biomass. The greatest negative effect of ozone was determined at the concentration of 160 µg m^{-3}. Though higher ozone concentrations caused stress in plants and damage to photosynthesis apparatus, plants quickly regenerated assimilation apparatus due to induced homeostasis. The highest investigated ozone concentration of 240 µg m^{-3} was still tolerated by radish plants.

Key words: Radish, ozone, photosynthetic pigments, biometric measurements

SVII/O-18 The Impact of Salicylic Acid on Water Hyacinth

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Lantana has a strong potential to kill water hyacinth in experimental studies as well as in the field. The salicylic acid, which is an important constituent of *Lantana camara L*. (Lantana), was investigated for its impact on the growth of water hyacinth (*Eichhornia crassipes* Solm.Mart).

Two experiments were conducted to see the influence of salicylic acid on water hyacinth. The first experiment was performed in small plastic buckets using various concentrations of salicylic acid. Another experiment was setup in cement experimental tanks 2x3x2 ft. in the Department of Botany University of Rajasthan, Jaipur. The various concentrations of salicylic acids were made ranging $10^{-2,}$ 10^{-3} and 10^{-6} M and water hyacinth was grown in it. The treatments were replicated thrice.

The water hyacinth was killed at $10^{-2,}$ and 10^{-3} M concentrations of salicylic acid. However, toxicity was less evident at lower concentrations in 10^{-6} M and in all the treated sets of the first experiment conducted in buckets. The symptoms appeared on water hyacinth plants were exactly similar with those symptoms obtained when treated with aqueous leachate of Lantana.

The toxicity of Lantana decreased after 7 days. Therefore, the treated water samples were also tested for their toxicity using duckweed bioassay for 26 days. It was observed that the toxicity of salicylic acid was lost after 13 days. In addition to this, *Spirodela polyrhiza* and *Lemna inequisetifolia* and some insects were found to grow in experimental tanks treated with salicylic acid.

The present study revealed that salicylic acid was highly toxic to the growth of water hyacinth and it disintegrated from the system within 13 days. This study confirmed that toxicity of Lantana was due to salicylic acid. Further work is in progress.

Key words: Water hyacinth, lantana, salicylic acid

SVII/O-19 Ozone Fumigation Effects on Scots Pine (*Pinus sylvestris* L.) Seedlings

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The study examined scots pine seedlings sensitivity to ozone exposure. The fumigation was conducted from June 1 to June 28, 2005 using four closed walk-in chambers of controlled environment (40 m^3 each) located at the Lithuanian Institute of Horticulture. Four year old potted saplings, were placed in the chambers of controlled environment and exposed to three ozone concentrations: 80 µg m^{-3}, 160 µg m^{-3}, and 240 µg m^{-3} for 7 h $day^{-1}$and 5 days $week^{-1}$. One chamber was used as control, with no ozone in the chamber. There were 20 saplings per variant. The ozone concentrations were generated using ozone generator OSR-8 and the concentrations were measured using a Portable Ozone Monitor OMC-1108 (Ozone Solutions, Inc.).

Ozone exposure (oxidative stress) stimulated needles senescence expressed as discoloration (chlorotic mottling), leaf drying, necrosis, and defoliation observed visually. The extension of the visual symptoms had a tendency to increase during time and with increasing ozone concentrations.

The growth of the apical shoots in all the treatments and control had an exponential pattern and no statistically significant differences were recorded among the variants.

No consistent pattern of the changes in biomass was found along the gradient of ozone concentration. More data on the biomass of all the fractions will be available after active growing season.

It can be stated, that even comparatively low ozone concentration (80 µg m^{-3}) is of potential risk to Scots pine seedlings in regard to visible injuries. No growth inhibition was observed during one month of fumigation. However more long-term data is required in order to make final conclusions.

Key words: Closed chambers, ozone fumigation, scots pine seedlings, visible injury, increment, biomass

SVII/O-20 Impact of Waste Transformed Vermicomposts on the Germination of Two Species of Seeds and Shoot Length of *Phaseolus auretus* (Moong)

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Impact of three varieties of vermicompost transformed from three organic wastes (biocon, diary and pharmaceutical), using the worm, *Eisenia fetida,* on the germination of two kind of seeds (radish and moong) and shoot length of later was assessed. The results were compared with normal vermicompost (NVC) and FYM as controls.

Effect of 10 % aqueous extract of each transformed vermicompost (vc) on the germination rate of two seeds was recorded. Extract of vc of biocon waste was found to be better for the germination of both the seeds when vc was prepared by using the waste and cattle dung in the ratio of 1:3 and the worst when the ratio was of 3:1. In case of diary waste converted vc, the rate of germination of moong seeds was higher when vc was prepared by using 1.5 litre waste with 2.5 kg coir pith and 1.5 litre water; while seeds of radish germinated well in the aqueous extract of vc transformed by using 0.75 litre waste along with 2.5 kg coir pith and 2.25 litre water and least in the vc extract formed by 3.00 litre waste with 2.5 kg coir pith. Aqueous extract of vc transformed from chemical waste of a pharmaceutical industry showed better results for the germination of both the seeds than that of their biological waste. VC from different organic wastes have better impact on the germination rate of the seeds than that of NVC and NVC was better than that of FYM.

Key words: Organic wastes, biocon, pharmaceutical, worms, *Eisenia fetida*, vermicompost

SVII/O-21 Complex Effects of Substrate Acidity, Heavy Metals (Cu, Cd) and Temperatures on Phytohormone System of Peas

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Research into complex effects of substrate acidity, and heavy metals on peas was carried out on the background of different temperatures under phytotron conditions. The objective of the present study is to determine the effects of stress factors on the phytohormone system of peas and to estimate adaptive capacity of plants to such effect. The effects of stress factors were divided into two stages: adaptive and main. For adaptive effects, acid substrate was formed by watering with H_2SO_4 – 4.16 ml l^{-1}, and heavy metal contamination by watering with $3CdSO_4 \cdot 5H_2O$ 0.08 ìM and $CuSO_4$ 1.0 ìM concentration solutions. For primary effects acid substrate was formed by watering with H_2SO_4 – 8.3 ml l^{-1}, and heavy metal contamination by watering with $3CdSO_4 \cdot 5H_2O$ 0.16 ìM and $CuSO_4$ 2.0 ìM concentration solutions. The experiment was conducted on the background of two temperature regimes: 24/17°C (day/night) – optimal temperature and 27/20°C – high temperature. The duration of each stage of treatment was 10 days. Photoperiod of climate chamber was 16 h. The contents of phytohormones IAA, GA_3, zeatin and ABA in the leaves of peas were measured by high pressure liquid chromatography (HPLC) system.

After adaptive treatment the contents of all phytohormones in pea leaves increased from several to more than ten times. The increase was more marked under optimal temperatures and was lower on the background of high temperatures. During the second stage of the test (main treatment) the content of phytohormones increased in all treatments, especially in adaptively-untreated plants under effect of contaminants. The contents of ABA and GA_3 under different combinations of treatment evened out after the second stage. Only the contents of zeatin varied considerably depending on the treatment combination, and the concentration of IAA significantly increased when the substrate was repeatedly acidified with H_2SO_4. Consequently, any stressful treatment disturbs phytohormone system and appreciably increases synthesis of all phytohormones. Additional stressor (high temperature) reduces plant tolerance range, therefore plants exert a weaker response to it. Reduction in the contents of phytohormones after additional exposure to stressor should be regarded as plant adaptive evidence.

Key words: Pea, heavy metals, substrate acidity, phytohormones

SVII/O-22 Interactive Effects of Copper and Cadmium on Metabolic Turnover in Isabgol Spike

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Isabgol is an important medicinal plant. Seeds contain mucilage and it is used in inflammatory conditions of the mucous membrane of gastrointestinal and genital urinary tracts, in chronic dysentery and diarrhoea. Excess copper inhibits the growth while cadmium is phytotoxic in nature. Generally action of single heavy metal was evaluated with leaf metabolism. In the soil more than one heavy metals are present and as seeds are medicinally useful, moreover metabolism is a sum of growth, it was of interest to study the metabolic turnover in the spike of Isabgol grown with toxic concentration of single metal Cu, Cd and mixture of Cu+Cd contaminated soil. Isabgol plants were grown in pots without and with heavy metal i.e. 600 mg $CuCl_2$ per kg soil, 600 mg $CdCl_2$ per kg soil, and 600 mg $Cucl_2$ per kg soil + 600mg $CdCl_2$ per kg soil. At the time of flowering, spike of control and treated plants were analysed for invertase activity, nonreducing sugar and reducing sugar content, protease activity, protein content, total amino acid content, polyphenol oxidase activity, peroxidase activity, IAA oxidase activity and phenol content. Yield and seed mucilage were also recorded. Cu and Cd inhibited the invertase activity, nonreducing sugar and reducing sugar content, protease activity, protein content, total amino acid content, polyphenol oxidase activity, peroxidase activity, and phenol content but stimulated the IAA oxidase activity. Interaction of metal gave additive effects on most of the studied biochemical parameters. The seed weight was also lowered by Cu, Cd and Cu+Cd and it was in the order of Cu+Cd> Cd> Cu. Cu, Cd, Cu+Cd lowered the mucilage content of the seeds and lowering was in the order of Cu+Cd > Cd > Cu. Cu was detected in seeds of control, $CuCl_2$, $CdCl_2$, $CuCl_2$+$CdCl_2$ treated plants and uptake was in the order of Cu+Cd> Cd> Cu i.e. addition of Cd increased the uptake of Cu from the soil. Cd was absent in seeds of control but detected in the seeds of Cd, Cu+Cd treated plants. Amount was more in the seeds grown with mixture of both the metals i.e. Cd uptake was promoted by the Cu. The data suggest that Cu, Cd acted as synergistic element with reference to growth and metabolism of Isabgol spike.

Key words: Copper, cadmium, interaction, metabolism, isabgol spike

SVII/O-23 A laboratory study on the use of *Eichhornia crassipes* in treatment systems for crepe rubber serum and skim latex serum

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Sri Lanka produces about 75,000 MT of raw rubber of different types and 20,000 MT of latex concentrate annually resulting in about 100,000 MT of rubber factory effluents. Majority of the factories discharge their effluents without proper treatment, causing environmental problems. The use of water hyacinth (*Eichhornia crassipes*) in conventional ponding systems for treatment of effluents from crepe rubber factories (crepe rubber serum) and latex concentrate factories (skim latex serum) was investigated, using laboratory models of single and twin tank systems. BOD, COD and pH of the two types of effluents can be brought down to permissible levels. A 100% reduction in BOD and over 80% reduction in COD for both types of serum was obtained with both single and twin tank systems after 10 days of running the system. A significant reduction in total solid content was also observed. The 10-d retention period in water hyacinth system is a considerable improvement over the 22½ - d retention period of conventional ponding systems which require large ponds extending over large areas of land. Uptake and accumulation of N, P, K, Na, Mg and Ca by water hyacinth plants in treatment systems were also investigated. Water hyacinth plants in both single and twin tank systems for both types of serum, showed significant increases (5% - 0.1% level) in all nutrients investigated except for Ca, which showed a slight decrease.

Key words: Effluent, crepe serum, skim latex, water hyacinth, pollution control

SVII/O-24 Effect of Chromium on Growth Attributes of Sunflower (*Helianthus annuus*)

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To exploit plant potential for remediation of soil and water, contaminated with a variety of compounds, several techniques have been established. In the present study, a pot experiment was conducted to evaluate the effect of chromium-contaminated soil on growth attributes in sunflower. Three different levels of chromium i.e. 20, 40 and 60 mg kg^{-1} were applied to three varieties of sunflower. The data showed that germination was affected by increasing chromium level as well as root and shoot length were decreased with increase in chromium concentration. A gradual decrease was observed for various morphological parameters like root fresh and dry weights, shoot fresh and dry weights and plant height with increase in chromium level. A comparison among chromium treatments obtained a significant decrease in yield parameters in three varieties. Chemical parameters in sunflower varieties were greatly affected by various levels of chromium contamination. Sodium, potassium, phosphorus and nitrogen were gradually reduced as chromium was increased. However, chromium uptake by roots was maximum followed by shoots and seeds, which did not show any remarkable difference. Having revised the overall picture of chromium toxicity in sunflower, it is concluded that sunflower has an ability to remediate high levels of chromium from contaminated soil.

Key words: Phytoremediation, chromium, sunflower, morphology, yield

SVII/O-25 Facilitative Effects of Top-Canopy Plants on Growth and Reproduction of Dwarf Shrubs in Severely Polluted Habitats

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Several field experiments and observations indicated that positive plant-plant interaction (facilitation), which are as important for shaping plant communities as competition, become stronger in harsh environmental conditions. However, all evidences supporting this hypothesis, so far, originated from natural stress gradients.

Habitats affected by aerial pollution represent a specific example of distributed and stressful environment. We studied effects of top-canopy plants on understorey vegetation in industrial barrens (heavily polluted secondary open habitats) around the Severonikel smelter (Kola Peninsula. N.W. Russia) to test the hypothesis that the importance of facilitation increases with increase in pollution load. We compared vegetative growth and reproduction of four dwarf shrub species (*Vaccinium myrtillus, V. uliginosum, V. vitis-idaea, Empetrum nigrum*) under tree canopies and in between-tree gaps in industrial barrens and in virgin forests.

In forest habitats, both berry yield and reproduction, were higher in dwarf shrub patches growing in gaps than under tree canopies. In contrast, in barren habitats dwarf shrub species reproduced better under tree canopies than in gaps, vegetative growth and biomass production were also higher under canopies. As indicated by relative neighbour effect, the impact of top-canopy plants of dwarf shrubs shifted from negative, in forest habitats to generally positive in barren habitats. Thus, we for the first time demonstrated the increasing importance of positive plant-plant interactions with an increase in environmental severity for human-induced stress gradient.

Artificial shelters (wooden fence) significantly improved the performance of *V. myrtillus* patches growing in open microsites; their growth and biomass production increased to the level of naturally sheltered (under shrubby birch canopies) bilberry patches. This result indicates that physical sheltering is the primary mechanism behind facilitative effects of top-canopy plants on dwarf shrubs in industrial barrens, where strong winds and thin snow cover considerably contribute to the severity of environment. The importance of sheltering for plants should be taken into account in development of rehabilitation measures for heavily polluted areas.

Key words: Dwarf shrubs, facilitation, industrial barren, sexual reproduction, vegetative growth

SVII/P-1 Anatomical and Reproductive Effects of Ozone in the Endemic Mediterranean Plant *Lamottea dianae*

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The Mediterranean region is the most diverse area of Europe in terms of vascular plants, hosting many taxa with a restricted distribution or endemic. If the sensitivity of Mediterranean woody species to ozone is still poorly known, information on endemic plants is almost completely lacking. In this paper, we have studied the effects of ozone on *Lamottea dianae* (Webb) G. López (=*Carduncellus dianius* Webb) (Fam. Asteraceae), an endemism from a few localities from eastern Spain. Plants of this species were exposed in OTCs to realistic concentrations of ambient air plus 30 ppb of ozone, and were compared

to plants growth in charcoal filtered air (control). Ozone produced yellow-brown stippling on the upper side of the leaves after 3-weeks of exposure. Anatomical changes observed included an increase in intercellular spaces, citoplasmic collapse in the cells, and an increase of callose deposits in mesophyll cells. In the ozone enhanced treatment, production of composite flowers per plant was reduced significantly, as was also the total number of healthy seeds per plant. Ozone also increased importantly the percentage of altered pollen cells (smaller than normal ones, and irregular in shape) in the anthers. It is concluded that increased levels of ozone might represent a threat for this endemic species by affecting not only the vegetative tissues, but also reproduction, a key aspect for the survival of this plant, given its reduced population.

Key words: Air pollution, ozone, plants, pollen, seed production, endemic plants

SVII/P-2 Some physiological aspects of bacteria containing fertilizer, Phylazonit MC®

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Bio-fertilizers containing less artificial compounds and plant growth promoting bacteria are good tools to reduce environmental damages and enhance the yield. Reduction in photosynthetic pigment concentrations and the amount of dry matter are indicative for the adverse circumstances. The soil pH and the bacterial composition of rhizosphere modify the solubility, and availability of metals. The heavy metal tolerance and mineralization depend on activity of soil life as well.

The application of PHYLAZONIT MCâincreased the yield pH in the laboratory and in the field experiments. The physiological basis is: an increased chlorophyll synthesis, a more intensive uptake of nutrients causes a more intensive growth of leaves. Due to the more active bacterial soil life the level of several organic compounds, as malic acid, citric acid, and syderophores is higher, that makes the solubility and availability of nutrients easier in the rizosphere. We observed a moderate effect of Al-toxicity when PHYLAZONIT MCâ was applied. Supposedly the complex formation of released organic acids by the bacteria prevents the uptake of Al, even under Al-stress. We came to the conclusion, that the PHYLAZONIT MCâis an alternative for replacing chemical fertilizers with a biologically active, environmentally protective agent, and at lower cost. The use of PHYLAZONIT MCâ is also offered under environmental conditions polluted with heavy metals.

Key words: Bio-fertilizer, ion-uptake, Al-tolerance, extra yield, yield-quality

SVII/P-3 Effects of Atrazine on the Periphyton Community: An Experimental Evaluation

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The potential hazard of industrial chemicals and effluents in lotic systems are usually evaluated using standardized single-species bioassay. This bioassay can include both in laboratory and *in situ* toxicology test. While effective as a screening tool, single-species toxicity tests have limitations in accurate prediction of ecosystem responses in some situations. As an alternative to the single species toxicity tests, evaluation can be made using artificial streams as a laboratory to field bridge for lotic systems. Another rationale for using artificial stream rather than *in situ* streams ecotoxicology studies is to prevent harm to the environment as a result of the studies themselves. The influence of atrazine on various aspects of community productivity and community structure of algal periphyton from Gamasiayab River, Kermanshah Province in western Iran was examined by establishing a gradient of atrazine concentrations in indoor artificial streams. Following 21 days the effect of atrazine was evaluated by measuring dry mass, ash-free dry mass (AFDM) and chlorophyll *a* and biovolume in the periphyton community that established on unglazed tiles in the streams. Results obtained from this experiment demonstrated that atrazine significantly ($p<0.05$) depressed periphyton biomass. Diatom biovolume calculated in this study are 57.1×106, 36×106, 31×106 and 5.8×106 ìm^3 cm^{-2} for snail densities of 0, 0.015, 0.03 and 0.06 individuals per cm^2, respectively. A group of species which are found primarily in the grazed treatments include *Achnanthes lanceolata, Cocconeis pediculus*, and *Ulothrix sp.* In contrast, ungrazed assemblage had high relative amount of non adnate diatoms such as *Nitzcshia linaris*, *Gomphonema sp*. and non filamentous chlorophytes such as *Scenedesmus sp*.

Key words: Artazine, periphyton, artificial streams, biomass, chlorophyll-*a*, community productivity, community structure

SVII/P-4 Efficiency of *Azospirillium* and *Bacillus polymyxa* on Germination, Seedling Growth and Chlorophyll Content of *Hordium vulgare* L.

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Green revolution has brought rapid increase in food grain production and extensive usage of non-biological materials that repudiated pollution in environment. Moreover, demand of chemical fertilizers and agrochemicals have increased which have caused salination in soil (soil pollution). However, the use of bio-fertilizers is cheap nonpolluting, nonleaching and can be used as a safe-guard of crop productivity with soil fertility.

The seeds pf *Hordeum vulgare* L. were pretreated with biofertilizers (*Azosprillium brasilense* & *Bacillus polymyxa*) in different combination (Azo, PSB and Azo + PSB) for 10-15 hr then followed by shade drying for 2-3 hr and placed in petriplate for germination and Simbhaoli Organic Manure (SOM) in polythene bag with soil (4 kg). It is observed that biofertilizers has promotery effect on germination relative index (GRI) radicle and plumule length, phytomass and chlorophyll content (Proto. Chl, Chl *a* and *b*) NFB (*Azo*) and PSB (*B. polymyxa*) with SOM have enhanced plant growth significantly over the control. PSB increases the movement of Phosphorous (P) in soil by diffusion and its reaction with soil constituents which transfers soil nutrients for absorption by root. Availability and efficiency of phosphorous and nitrogen have been discussed for integrated nutrients management system (INMS).

Keywords: *Azosprillium brasilense* (NFB), *Bacillus polymyxa* (PSB), *Hordeum vulgare,* Simbhaoli Organic Manure (SOM)

SVII/P-5 Indigenous Technology for Ecofriendly Utilization of Distillery Effluent as Ferti-irrigation in Crops: Sustainable Development

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Jubilant Organosys Ltd. (VAM Organics Ltd.) Bhartiagram, Gajraula (J.P. Nagar) is a molasses based distillery and produces pharmaceutical, textile and other chemicals but generate distillery effluent (DE) 3500 to 4000 litre per day @ 15 litre per litre of alcohol. Spent wash is most complex and cumbersome waste having excessive BOD, COD and is major source of surface and ground water, air and soil pollution in anthropocentric environment. The problem of high BOD and COD could be overcome either by bioenergy (Methane) production through ETP or ferti irrigation of partially treated distillery effluent (PTDE) as presowing irrigation or after proper dilution in standing crops.

Ecotechnological application of DE through pipe line/tankers has improved organic matter N.P.K., S, Mg, micronutrient and microbiota status of soil and showed significantly increased germination relative index (GRI), chlorophyll stability index (CSI), growth and yield of *Saccharum officinarum, Triticum estivum, Brassica juncea, Zea mays, Pennisetum vulgare, Oryza sativa, Helianthus annus, Arachis hypogea, Solanum tuberosum, Lagenaria vulgaris* and other vegetable, forage crop and tree (*Eucalyptus)* but had adverse effect on *Populus* and *legume crop (Pisum sativum*). However, growth of earth worm have been recorded in II/III year after ferti-irrigation in RBD plots. Untreated effluent could be used for reclamation of saline sodic soil. The use of DE in composting of press mud cake (PMC). PMC alongwith *Eicchornia, Azolla*, Sugar cane trash bagasse, litter decomposition, flyash and city garbage have been successfully tested.

Utilisation of DE in decomposition of green manure (*Sesbania aculeata)* has been discussed. Foliar spray of liquid fertilizer (DE) in agriculture have curtailed the demand of chemical fertilizers and facilitate reduction in pollution load in aquatic and agroecosystem, it will pave the way to Gajraula as Eco city for sustainable development and to achieve vision 2020 of developed India.

Key words: Ecofriendly, distillery effluent, ferti-irrigation, decomposition, compost, sustainable development

SVII/P-6 Effect of Acid Rain on Growth, Physiology and Yield of *Pennisetum americanum* L. Leeke

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Rapid industrialization in 'industrial revolution' has left with us polluted air, green house gases, choked river, contaminated soil, depleted ground water and Ozone umbrella, global warming, El-Nino effect, endangered wild life and has exhausted natural resources. Jubilant Organosys Ltd. (VAM), Insilco, Ram Ganga Fertilizers Ltd., Kamaxi paper mill, Raunaq Automative parts Ltd., and Chaddha Rubber Ltd., are causing air, water (surface and ground) and soil pollution in industrial area of Bhartia Gram, Gajaurala J.P. Nagar. Samples of ambient rain were collected from its vicinity.

Acidic pH 5.0 has been observed of first ambient rain in June during rainy season 2004 and 2005. Simulated acid rain solutions of pH 2.0, 3.0 and 4.0 were prepared in distilled water with a ratio of 2:1 sulphuric acid and nitric acid combination. Ambient rain (pH 5.0) was taken as control. Effects of simulated acid rain were studied on *Pennisetum americanum* (L.) Leeke Cv-Multicut and I.C.T.P.-8203 which are grown as fodder crop surrounding industrial estate. It has been observed that germination relative index (GRI), seedling growth, dry weight of root and shoot, leaf size, number of tillers plant^{-1}, Stomatal index, chlorophyll stability index (CSI), seed yield plant^{-1} showed decreasing trend in pH 4.0>3.0>2.0 over the control in both the cultivars. However var.-I.C.T.P.-8203 is tolerant to acid than the var.-Multicut.

Key words: *Pennisetum americanum*, growth, pH, chlorophyll, simulated acid rain

SVII/P-7 Effects of Emissions and Dust of Cement Factory on Chlorophyll Content in *Nicotiana tabacum* and *Zinnia elegans*

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The aim of this research was to diagnose the effects of atmospheric pollutant and dust of a cement factory on the content of foliar pigments of two species considered bioindicators: *Zinnia elegans* and *Nicotiana tabacum*. The plants were exposed in four sites: one located at the base of the chimney; another at 300 m therefrom, another at around 3 km, with the fourth serving as a control, in a greenhouse 70 km away. In each locality 15 individuals of each species were evaluated, during 10 weeks for *Z. elegans* and 14 for *N. tabacum*. Visible damage, morphological characteristics and chlorophylls *a*, *b* and total chlorophyll contents were analyzed. Main factory emissions are SO_2 and NO_2, as well as a large amount of particulate material. Tendencies observed in both species in the polluted areas were: reduction of total chlorophyll content, as well as clorosis and premature leaf senescence. Both species proved to be efficient for studying the effects of this type of pollution, and the impact of the factory on plant growth as far as at least 3 km.

Key words: Air pollution, bioindicators, *Zinnia elegans*, *Nicotiana tabacum*, biomonitors

SVII/P-8 Immature Pea Embryo Response to Variable Manganese in Tissue Culture

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Excised embryos of pea (*Pisum sativum* L.) cv. HUDP-15 were cultured *in vitro* at 10 days after anthesis in B5 medium at variable Mn. Manganese was supplied as $MnSO_4$ at 0.6, 60 and 600 µM. The embryos developed into plantlets in 30 days of culture. The growth of the plantlets, observed as increase in number of leaves, rootlets, length, fresh and dry weight, was maximum at 60 µM Mn. Compared to this, the plantlets showed decrease in growth at deficient (0.6 µM) as well as excess (600 µM) Mn. At both deficient and excess Mn, shoot growth was affected more than that of roots. Plantlets at 0.6 µM Mn developed visible effects of Mn deficiency as chlorosis and later necrosis of the interveinal areas of leaves. Mn deficiency decreased the tissue Mn, Hill activity, chlorophyll concentration in shoots but increased their total protein content. Excess Mn supply resulted in an increase in Mn concentration of both shoot and root to about two fold from that of normal Mn without significant change in Hill activity, chlorophyll and protein content in shoots.

Key words: B5 medium, Hill activity, immature embryo, manganese, pea, tissue culture

SVII/P-9 Deltamethrin Induced Oxidative Stress Alters Ascorbate-Glutathione Cycle in *Glycine max* (L.) Merr.

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Plants face threats of pesticide toxicity, which hampers plant growth and development via altered soil microflora and fauna and by deleterious oxygenic conditions. 45-days-old plants of *Glycine max* (soybean) were exposed to several deltamethrin (synthetic pyrethroid insecticide) concentrations (0%, 0.5%, 1%, 1.5% and 2%) in the field conditions to study the long-term changes in the magnitude of lipid peroxidation, components of non-enzymatic (ascorbate and glutathione) and enzymatic (SOD, APX and GR) antioxidants and proline content at pre-flowering, flowering and post-flowering stages. Treated plants showed an increase in lipid peroxidation, dehydroascorbate, oxidized and total glutathione and proline contents, however, the ascorbate, total ascorbate and reduced glutathione contents decreased. The activities of SOD, APX and GR increased markedly in the treated plants. Changes in the parameter-studied were mostly dose dependent. It may be concluded that deltamethrin induces oxidative stress in plants and hence the non-enzymatic and enzymatic antioxidant systems and osmolytes alter their status to cope with the situation; the magnitude of alterations proportional to the level of pesticide stress.

Key words: Deltamethrin, ascorbate glutathione cycle, *Glycine max*, SOD-superoxide dismutase, APX-ascorbate peroxidase, GR-glutathione reductase

SVII/P-10 Effects of Ozone on Photosynthesis, Chlorophyll *a* Fluorescence, and Chlorophyll Content in Four Maple Species from Spain

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The effects of ozone in four maple species, *Acer campestre, A. opalus* subsp. *granatense, A. monspessulanum* and *A. pseudoplatanus* were studied in OTC under two different experimental conditions: in charcoal filtered air (CF), and in non filtered air plus 30 ppb ozone (NF+30). The four species of maple showed contrasting sensitivity to ozone as demonstrated by visible injury development, gas exchange, chlorophyll *a* fluorescence, and growth measurements. The most sensitive species were *A. opalus* and *A. pseudoplatanus*, while *A. monspessulanum* was the most resistant. Plant injury index (i.e. a combination of percentage of injured leaves and leaf surface affected) was more consistently related with results from physiological measurements than thresholds for the onset of first symptom of visible injury. Differences in ozone sensitivity may be related to anatomical features of the plants, mainly the abundance of intercellular spaces, and are consistent with higher stomatal conductance in the two most sensitive species. Tracking of the same leaves over time showed the following significant changes ($p<0.05$) in ozone-exposed leaves with regard to control leaves at the end of August (after 107 days of fumigation): an increase in intercellular CO_2 concentration (C_i) in all species; reductions in net photosynthesis (NP) and stomatal conductance (g_s) in two species, *A. opalus* and *A. pseudoplatanus* (in the former, NP was already significantly reduced after 69 days); a decline in maximum quantum efficiency of photosystem II (Fv:Fm) in *A. opalus*; lower water use efficiency (WUE) in *A. campestre, A. opalus,* and *A. pseudoplatanus*; and a reduction in total chlorophyll content in *A. campestre* (significant after 69 days). Comparison of fumigated leaves with control leaves showed that significant reductions of NP in ozone-exposed leaves may occur in some cases without a significant decline in g_s and Fv:Fm, suggesting than initially CO_2 assimilation is not limited by stomatal conductance. This reduction of photoasymilates results in a tendency to decrease growth, but not significantly within the exposure period for any of the species. Under these experimental conditions, the ecology and distribution of the species could not be clearly related to their sensitivity, as the most Mediterranean maples, *A. opalus* subsp. *granatense* and *A. monspessulanum* were the most and the least sensitive of all four species respectively.

Key words: Air pollution, ozone, plants, photosynthesis, chlorophyll fluorescence, visible injury

SVII/P-11 Effect of Chromium of Moss *Fissidens sylvaticus*: Analysis of Oxidative Stress as Toxicity Boindicator

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Effects of hexavalent chromium on moss *Fissidens sylvaticus* have been investigated. Treatment of moss shoot with chromium for 24, 48 and 72 h resulted in dose and time dependent accumulation of the metal in shoots. Chromium treatment prompted the generation of reactive oxygen species viz., hydrogen peroxide and superoxide radical in moss shoots. The concentrations of these reactive oxygen species were high after 48 and 72 h chromium treatment. Chromium treatment increased malondialdehyde content in moss shoots. High malondialdehyde content was recorded after 24, 48 and 72 h of chromium treatment. However, the time course analysis of lipid peroxidation did not show any significant increase in malondialdehyde content after 2, 6 and 12 h of treatment but drastic increase was observed after 18 h of chromium treatment. Chromium treatment resulted in decline in antioxidant enzymes viz., guaiacol peroxidase, glutathione reductase and superoxide dismutase after 48 or 72 h of treatment. Guaiacol peroxidase and glutathione reductase activity showed no significant difference after 24 h of chromium treatment but the superoxide dismutase activity was increased after 24 h of chromium treatment at 50 and 100 µM concentration. The non-enzymic antioxidants, viz. ascorbate and glutathione concentration showed different responses to chromium treatment to moss cells. The ascorbate content increased after 24 h of chromium treatment, its concentration declined after 48 and 72 h of treatment. Ascorbate concentration in moss shoots increased after 24, 48 and 72 h of chromium treatment. The results indicate that chromium can induce oxidative stress, as evidenced by increase in lipid peroxidation, reactive oxygen species generation and decline in antioxidant enzymes.

Key words: Antioxidants, chromium, *Fissidens sylvaticus*, lipid peroxidation, oxidative stress, reactive oxygen species

SVII/P-12 Effects of Industrial Effluents on Biomolecular Contents of Germinating Rice Seedlings

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The present study was undertaken to investigate the effects of effluents from three major industrial units of southern Orissa on two popular cultivated varieties (BAM 6 and T 90) of rice grown in the locality.

Pure line seeds were procured from Regional Agricultural Research Station of OUAT, Berhampur. Seeds were germinated under laboratory conditions, but the seedlings were transplanted to pots of equal sizes filled with soil and manure in appropriate ratios. Pots for five replicates for various concentrations of effluents viz. 10%, 20%, 50%, 75% and 100% were arranged and water was taken as control. Care was taken to maintain moisture content by irrigating the pots with equal volume of effluent/water periodically as per experimental set-up. Extraction and estimation of various bio molecules viz. Carbohydrates, Proteins and Nucleic Acids from leaves of young rice seedlings were carried out following standard protocols from 6th day of sowing on every alternative day up to 14th days of growth by random sampling.

It was observed that the CAIE drastically reduced bio molecular contents in both the varieties of rice, especially under the influence of higher concentration of effluents. This is possibly due to the presence of Mercury and various chlorinated compounds in it. SME has least inhibitory impact on seed germination which is attributed to the presence of various ions and compounds of organic nature. PME behaved in an intermediate way towards seed germination due to presence of Phenolic and other compounds.

With the increase in concentration of the effluents there was gradual decrease in seed germination showing a negative co-relation between them. Experimental data further revealed that T 90 Cultivar of rice was more successptible to effluent stress in compared BAM 6 under the impact of all the industrial effluents tried.

Key words: Chlor-alkali industry effluent (CAIE), pulp and paper mill effluent (PME), sugar-mill-cum-distillery effluent (SME), bio molecule, carbohydrate

SVII/P-13 Biochemical Response and Ultra Structural Changes in *Nostoc muscorum* under Cadmium Stress

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Increasing heavy metal concentration in fresh water bodies has lead to considerable risk to aquatic biota. In this context, microorganisms play an important role in regulating level of these ions due to the presence of functional groups, which may interact with dissolved metals. In this regard the effect of cadmium on *Nostoc muscorum* has been analyzed under controlled condition. The result showed the toxic effect of cadmium (Cd) on biomass, cell density and photosynthetic pigment of *N. muscorum*. Cd upto 5µm concentration showed stimulatory response with respect to cell density and biomass production while higher doses (>5µm) exhibit toxicity on these parameters. In contrast to the biomass and cell density there was severe effect on the chlorophyll *a* content of *N. muscorum* from the beginning of the experiment. The phycocynin, cystein and NPSH content of the tested species increased with increasing concentrations of Cd in the medium. Further, the toxicity of cadmium has been clearly visible under SEM observations. The shrinking of the vegetative cells were observed from 5µm concentrations, the increasing cadmium concentration (25µm) cells become elongated and burst with oozing out the cellular content . The data obtained from the study showed the *N. muscorum* has the tolerance under cadmium stress. Findings of the experiments will be discussed in relation to use of the alga in bioassay of Cd toxicity in aquatic environment.

Key words: Cynobacteria, *Nostoc*, cadmium, tolerance

SVII/P-14 Growth Performance and Biochemical Responses of Three Rice (*Oryza sativa* L.) Cultivars Grown in Fly-ash Amended Soil

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Health hazards to human through metal accumulation in crop plants are a growing problem in the world. In the present investigation, three rice cultivars namely Saryu-52, Sabha-5420, and Pant-4 were grown in garden soil (GS, Control) and various amendments (10, 25, 50, 75 and 100%) of fly-ash for a period of 60 days and effect on growth of plant was evaluated vis-a-vis metal accumulation in the plants. The toxicity of fly-ash (FA) at higher concentration (>50%) was reflected in the reduction of photosynthetic pigments, protein and growth parameters *viz*., plant height, root biomass, number of tillers, grain and straw weight. However, at lower concentrations fly-ash enhanced growth of the plants with increase in these parameters. The cystein and nonprotein- thiol (NPSH) content showed increase in their levels up to 100% fly-ash as compared to control, however, maximum content was found at 25% FA in Saryu-52 and Pant-4 and at 50% FA in Sabha-5420. Accumulation of Fe, Cu, Zn, Mn and Ni was investigated in roots, leaves and seeds of the plant. The accumulation of Fe was found maximum in all parts of the plant. Mn, Zn, Cu and Ni showed maximum accumulation in root while Fe exhibited maximum accumulation in leaves of the three cultivars. The metal accumulation order in studied rice cultivars was Fe>Mn>Zn>Ni>Cu in roots, leaves and seeds of plants. The results showed that rice varieties Sabha-5420, and Saryu-52 were more tolerant and could show better growth in higher fly-ash concentration as compared to other cultivar; i.e. Pant-4. Thus, Sabha-5420 and Saryu-52 have shown the potentiality to be used for cultivation in fly-ash affected agricultural fields.

Key words: Rice cultivars, fly-ash, amendment, heavy metals

SVII/P-15 The Study of Physiological Responses of *Brassica oleracea* L. to Cadmium and Salinity

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The objective of this investigation was to evaluate the consequences of salinity and cadmium stresses and interaction between them on some physiological phenomena of *Brassica oleracea* L. plants.

In this work, the effects of these stresses on seed germination and growth of one months old field grown plants were studies, also simple effects and interaction between NaCl and $Cd(NO_3)_2$ on concentration of chlorophyll *a* and *b*, soluble sugars, starch, total protein content, peroxidase activity and three cation concentration including Na, K and Cd were assayed.

Results of experiment show that the percentage of germination of *B. oleracea* was decreased with increasing of cadmium. Although Na did not show any statistically significant effect on germination, but interaction between Cd and Na resulted in decrease on this phenomena. One of the first effects of Cd on plants was reduction in growth parameters such as dry and fresh weights of roots and shoots, leaf surface area and leaf weight. The contents of chlorophyll *a* and *b* were reduced by Cd stress, which is appeared as chlorosis in leaves. Increase of soluble sugars and decrease of starch were observed due to cadmium stress. The contents of total protein and activity of peroxidase enzyme were increased with increasing salinity. Concentration of cadmium increased (in roots more that shoots) and K also increased parallel to increasing salinity indicating that, this plant adapted with these stresses.

Key words: Salinity, cadmium, growth, biochemical parameters, interaction, onion

SVII/P-16 Impact of Heavy Metals Stress and Salinity on Growth and Proline Accumulation in the Seedlings of Cauliflower

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Abiotic stress like salinity and heavy metals affect the growth and development of higher plants in general, there by affecting the productivity both qualitatively and quantitatively, in particular. In the present study, Cauliflower seeds were allowed to germinate and grow in absence (control) and presence of different concentrations (50, 100, 250, 500, 750 and 1000 mM) of NaCl, $CaCl_2$, $HgCl_2$ and $ZnCl_2$. Growth parameters and seed germination was observed after 5, 10 and 15 days of exposure to salinity and heavy metals. Maximum inhibition of seedlings growth was observed at 250 mM of NaCl which resulted into 66%, 67%, 61%, 56%, and 25% inhibition in seed germination, shoot and root length, fresh and dry weight, respectively after 5 days of germination. NaCl at 500 mM and above concentrations completely inhibited seed germination. Out of $CaCl_2$, $HgCl_2$ and $ZnCl_2$; $HgCl_2$ was found to be most toxic heavy metal with 94% inhibition in seed germination at 250 mM concentration. Shoot and root length, fresh and dry weights were inhibited by 69%, 88% 66% and 71% respectively, after 5 days of growth in presence of $HgCl_2$ (250 mM). On the other hand, only 66% and 55% inhibition in seed germination was observed with as high concentration as 1000 mM of both $CaCl_2$ and $ZnCl_2$ re-

spectively, after 5 days of seedling growth. Further, the extents in shoot length, root length, fresh weight and dry weight in presence of both $CaCl_2$ and $ZnCl_2$ were found to be less than $HgCl_2$. In general, development of root system was severely inhibited in presence of NaCl, $CaCl_2$, $ZnCl_2$ and $HgCl_2$ at all the concentrations tested as evidenced by decrease in root length. Attempt has been made to study the accumulation of proline during these stresses. Ten days old seedlings were transferred to different concentrations of NaCl, $CaCl_2$, $ZnCl_2$ and $HgCl_2$ and accumulation of proline was monitored after 15 hours of transfer. Sodium chloride induced accumulation of proline to a significant level after 15 hrs. Similarly, accumulation of proline was showed in all the concentration of heavy metals tested. Accumulation of proline may be a stress-induced response and over producing proline may confer tolerance to crop against these stresses.

Key words: Heavy metal, salinity, proline, cauliflower

SVII/P-17 Phytotoxic Effect of Chromium on *Eichhornia crassipes*

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Water hyacinth (*Eichhornia crassipes*) is a prolific aquatic weed of cosmopolitan distribution and has shown some promise in the biological management of aquatic pollutants, because of its ability to absorb and concentrate certain chemicals including toxic metals. This plant may be used as a bioassay to monitor low level of aquatic Cr.

Plant of *E. Crassipes* was employed to assess bioconcentration cytotoxicity and phytotoxicity of aquatic chromium. Plants were exposed to different chromium (0.01, 0.1, 1.0, 2.5, 5.0 and 10.0 ppm) contaminated solution culture for 24, 48, 72 and 96 hours.

Leaf and root samples from treated culture were taken for bioconcentration. Accumulation of metals was observed to be greater in roots (789.3 mg g^{-1} dw) in comparison to leaves (335.6 mg g^{-1} dw). Highest accumulation was found in the roots. The accumulation in root and leaf tissues was found to be both concentration and duration dependent providing evidence that *E. crassipes* is a good absorbent of aquatic Cr.

The mitotic index was increased at lower concentrations i.e. 0.01 and 0.1 ppm and decreased at higher concentrations ranging from 1.0 ppm to 10.0 ppm. So, it may be concluded that Cr inhibits cell division. Numerous micronuclei were also observed.

Chlorophyll *a* was more sensitive than chlorophyll *b*. Chlorophyll *a*, *b* and total chlorophyll were induced at lower doses i.e. 0.01 and 0.1 ppm and inhibited at higher doses ranging from 1.0 to 10.0 ppm with duration of exposure. However, an increase in carotenoid content was observed up to 2.5 ppm and reduced at higher concentration (from 5.0 ppm to 10 ppm) with duration of exposure.

So, it may be concluded from the present study that *E. crassipes* is tolerant to the elevated Cr concentration as there is no inhibition of chlorophyll and carotenoid upto 0.1 ppm. Therefore, it can be used as bioassay for biomonitoring and control of Cr pollution in the environment.

Key words: *Eichhornia crassipes*, chromium, phytoremediation

SVII/P-18 Effect of Enhanced Arsenic in Soil on Leaf Epidermal Features and Stomatal Apparatus of *Vigna radiata* (Linn.) Wilczek

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Mungbean, *Vigna radiata* (Linn.) Wilczek grown in soil with 5-35 mg/kg sodium arsenate ($Na_2HAsO_4.7H_2O$) exhibited various toxicity symptoms. Plant growth was affected and gross morphological and anatomical features were altered. At higher arsenic (As) concentration in soil, leaves showed curling, chlorosis and necrosis. Stomatal index increased with increase in concentration of As in soil. At higher concentrations, size of guard cells was reduced and stomata become permanently closed. Stomata from treated leaves exhibited significant changes in their ultrastructure. Electron micrographs of the guard cells exposed to As showed loss of structural organization and disintegration of cytoplasm. The plasma membrane withdrawed from the cell wall and the cell losed its integrity at higher concentrations of As. Trichome density in leaves of treated plants was far less. Trichomes in treated plants were distorted with disrupted cuticle. There was reduced wax formation exposing the trichome wall with gaps at several places.

Key words: Mungbean, arsenic, stomata, guard cells, ultrastructure

SVII/P-19 Morphologial and Ultrastructural Changes in *Bacopa monnieri* (Brahmi) Exposed to Cadmium

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Plants of *Bacopa monnieri*, a marshy plant, well known for its medicinal value were grown and acclimatized in laboratory conditions in Hoaglands nutrient medium. Plants were subjected to different concentrations of Cd taking Hoaglands Nutrient medium as the base. Plants showed certain drastic morphological changes like stunting of the shoot growth, thinning of shoots, damage of leaves at 10 mM and above concentrations. Light microscopic studies showed compactness in epidermal cells. Cd also reduces leaf pigmentation. However, ultrastructural studies showed changes in guard cells, stomata and epidermal cells. Effect of Cd, a toxic heavy metal, on growth and medicinal value of Brahmi is discussed with the help of selected parameters.

Key words: *Bacopa monnieri,* cadmiumm, morphology, ultrastructure

SVII/P-20 Effects of $HgCl_2$ on the Photosynthetic Pigments and NR Activity on *Abelmoschus esculentus* L.

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The study was carried out in terms of effects of $HgCl_2$ on the photosynthetic pigments and nitrate reductase activity of *Abelmoschus esculentus* L. at different developmental stages. The photosynthetic pigments (Chl *a*, Chl *b* and total Chl) in *Abelmoschus esculentus* L. treated with different concentrations of $HgCl_2$ (0.05, 0.10, 0.5, 1.0 and 2.0 mM) showed a significant decrease over the control except at 0.05 and 0.1 mM of $HgCl_2$ where it showed a linear response with respect to control and was found to be maximum at flowering stage The leaf nitrate reductase activity was progressively inhibited with the increase in time and concentration dependent.

Key words: Heavy metals, *Abelmoschus esculentus*, $HgCl_2$, photosynthetic activity, nitrate reductase activity

SVII/P-21 The Effect of EDTA on *Jatropha Curcas* and *Vicia Faba* Uptake, Selectivity, and Translocation of Heavy Metals When Grown in Fly Ash

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Use of two EDTA concentrations for enhancing bioavailability of iron, nickel, zinc, cadmium, chromium, aluminum and copper from fly ash was investigated in *Jatropha curcas* and *Vicia faba*. *J. curcas* is a popular plant for biodiesel and is being grown extensively on degraded sites. It can tolerate extreme soil conditions and produce a high biomass even when grown in contaminated areas. *V. faba* can produce high biomass with a fast growth rate and is reported to possess some degree of metal tolerance. A greenhouse study was conducted to investigate the feasibility of using *J. curcas* and *V. faba* for remediation of heavy metals from metal rich fly ash and evaluate the effect of chelating agents on metal uptake by these plants. *J. curcas* seedlings had relatively high dry weight yield of root and shoot as compared to *V. faba* under different treatments. *V. faba* showed higher oxidative stress with occasional chlorosis. It was found that EDTA at a rate of 0.3 g kg^{-1} soil significantly increased the shoot concentration of heavy metals in both the species. The study demonstrated that enhancement of heavy metals due to chelators in plants and metal–specific and is subjective to inhibition when multiple heavy metals are present. Results also showed that chelator enhance oxidative stress in plants with chlorosis and reduction in plant growth, ultimately decreasing the amount of metal accumulation. Studies on translocation of heavy metals is in progress. The study will be useful for recommending appropriate sites and protocols for *J. curcas* cultivation, on stress sites.

Key words: *Jatropha curcas, Vicia faba*, EDTA, heavy metals, oxidative stress

SVII/P-22 The Effect of Interaction between Ozone (O_3) Exposure and Ethylene Diurea (EDU) Treatment on the Performance of Herbaceous Medicinal Plants

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Use of chemical protectants is one of the methods to assess the effect of ozone on plants. Ethylene diurea, first used by Carnahan et al. (1978) has been shown to be a specific plant protectant against ozone injury. This study was done to assess the effect of ozone (O_3) exposure and its interaction with ethylene diurea (EDU) treatment on the performance of four herbaceous medicinal plants namely, *Achyranthes aspera* Linn., *Eclipta alba* (L.) Hassk., *Mentha arvensis* var. kosi, and *Vinca rosea* Linn. One set of the plants were given three treatments of 400 ppm of EDU by soil drenching before the ozone fumigation. When the plants were 35 days old, half of the EDU treated plants as well as half of the non-EDU treated plants were fumigated with 150 mg/m^3 of ozone for 2 hours daily for 12 consecutive days. The plants were kept in ambient environment with ozone concentration ranging between 29.22 to 40.06 mg/m^3. After 12 days of ozone fumigation the various morphological (shoot length, root length, number of leaves, leaf area, above ground biomass, below ground biomass and total biomass), physiological (membrane permeability) and biochemical (ascorbic acid content, chlorophyll *a* and *b* and total chlorophyll) parameters of the plants were studied. The results of these experiments indicate that ozone fumigation had adverse effects on all the four plants. While EDU treatment was able to give protection to all the plants from ozone injury, the degree of protection varied from plant to plant. Among the four plants *M. arvensis* var. kosi was relatively more sensitive to ozone and *E. alba* was least sensitive. EDU gave more protection to *A. aspera* and least to *M. arvensis* var. kosi. Among the parameters studied ascorbic acid and above ground biomass were found to be relatively more sensitive to ozone fumigation while root length, chlorophyll *a* and *b* and total chlorophyll were relatively less sensitive to ozone.

Key words: Air pollution, ozone fumigation, EDU, medicinal plants

SVII/P-23 Effect of Nickel and Cadmium on Regeneration of *Hyophila involuta* and *Funaria hygrometrica*

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Among the pollutants, heavy metals being non-biodegradable and non-perishable can cause severe problems if present in high levels. Mosses can accumulate heavy metals in their plant bodies in concentrations much higher than the other group of plants.

Effect of varying concentrations of nickel and cadmium was studied on regeneration of two endohydric cosmopolitan species of mosses, *Hyophila involuta* and *Funaria hygrometrica*. In *Hyophila involuta*, the upper tolerance limit for Ni was investigated to be 100 ppm for stem segments (10%) and 70ppm for detached leaves (10%), whereas that for Cadmium was 0.1 ppm for stem segments (5%) and 0.01ppm for leaves (5%). *Funaria hygrometrica* showed the upper tolerance limit for Ni as 60ppm for stem segments (10%) and 50ppm for leaves (5%), whereas that for Cd was 0.01ppm and 0.001ppm for stem segments (5%) and leaves (5%) respectively. As evident from the data, *Hyophila involuta* is more tolerant to Ni as well as Cd than *Funaria hygrometrica*. Cadmium was found to be more toxic than Ni. Due to the absence of cuticle and unistratose anatomy, the leaves of both the mosses are observed to be more sensitive than the stem segments.

Although the application of Ni and Cd reduced the percent regeneration in both the species, at least 5-10% regenerants at upper tolerance level are speculated to be the result of some mutations at the genic level or some already existing tolerant gene(s) becoming active on the onset of stress conditions.

The capacity of mosses to tolerate and accumulate high concentrations of heavy metals toxic for other groups of plants can be used to employ these tiny but gregarious plants in bioremediation of pollution in an eco-friendly way.

Key words: Regeneration, mosses, pollution, heavy metals, bioremediation

SVII/P-24 Utilization of Distillery Effluent in Decomposition of Pressmud Cake and its Effects on Seed Germination and Growth of *Coriandrum sativum* L.

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The Simbhaoli Sugar Mills Limited Distillery Division generates 3000 litters effluent per day with high BOD, COD and TDS. Disposal of effluents results obnoxious condition and a serious threat of environmental pollution. Its flow into the river, lake and nullah causes the depletion of dissolved oxygen and destroys aquatic flora & fauna. The production of pressmud cake (PMC) amounts to 3 to 7 percent of the quantity of cane crushed in a sugar factory. However, effluent contains large quantities of soluble organic matter and plant nutrients which can be assimilated in soil through decomposition of PMC.

Biocompost was formed from PMC by distillery effluent and *Tricoderma*

with flyash and aquatic weed *(Eichhornia)* in 4 combinations T_1(PMC + FA + DE + Trico + Eichho), T_2 (PMC + FA + DE + Eichho), T_3 (PMC + FA + DE), T_4 (PMC + FA + DE + Trico). It is observed that T_4 compost decomposes early than other combinations.

Biocompost (150 gm) was mixed with 5 kg soil in polythene bags. Seeds of *Coriandrum sativum* L. cv. Kalmi, a spice crop of 90 days were sown in winter season during 2004 in treated soil with biocompost. Results revealed that germination relative index (GRI), seedling growth, phytomass, proto-chlorophyll, chl *a* and *b* and plant height increases in T_1 Treatment than follow trends $T_2 > T_4 > T_3$ over the control. Manufacturing of biocompost will be ecological sound, environment friendly and economically viable for sustainable agriculture.

Key words: Pressmud cake, distillery effluent, *Coriandrum sativum* L., chlorophyll, biocompost, *Eichhornia,* sustainable agriculture

SVII/P-25 Effect of Enhanced Lead and Cadmium on Growth and Development of Aquatic Flowering Plant *Trapa bispinosa* Roxb.

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Trapa bispinosa is an annual aquatic herb cultivated in several parts of India, southeast Asia, China and Japan as a minor food crop. Its tender seeds, largest among aquatic angiosperms, are eaten raw, boiled or roasted. Since most of our water bodies are heavily polluted, it is of interest to investigate how individual contaminants affect plant growth, development and nutritional quality. Plantlets were transplanted into the cement tanks containing one fifth level of soil and fifty eight litres of water each. Treatments were given in the form of cadmium chloride and lead nitrate. Salt solutions were made in water for concentrations 0.5, 1, 5, 10 and 12.5 cadmium chloride and 1, 50, 100 and 200 lead nitrate in parts per million. Seed germination was inhibited up to 62.92% with 1 ppm cadmium chloride and 19.99% with 1 ppm lead nitrate. There was reduction in biomass, relative growth rate, stem length, anchorage and length of photosynthetic root, rosette diameter, number of leaves per rosette, length and width of lamina and petiole length. Stomatal index of leaf increased with rise in heavy metal concentration. At 5 ppm concentration of cadmium chloride the stomatal index increased by 48.89%, whereas at 50 ppm concentration of lead nitrate it increased by 6.96%. Size of the stomata was reduced. Guard cells and epidermal cells showed distortion. Abnormal stomata were observed in higher frequency. There was a decrease in trichome density too. There was substantial decrease in the level of chlorophyll and carotenoids followed by chlorosis and necrosis of leaf at high concentrations. Plants showed reduction in the level of soluble proteins, total sugars and starch content along with increase in the level of proline, free amino acids, total phenolics and malondialdehyde content. Reproductive parts of the plant also revealed the inhibitory effects of lead and cadmium. High doses of heavy metal delayed the time and intensity of flowering. Higher the concentration of cadmium in the medium, the greater was the delay in flowering. There was marginal delay in flowering with lead in the medium. There was reduction in the number of flowers and fruits too. The number of flowers was reduced up to 54% at 10 ppm cadmium chloride and 23.3% with 500 ppm lead nitrate. The fruits in treated plants were smaller, with reduced fresh and dry weight. There was reduction in total soluble proteins and sugar content in the kernel, indicating that the edible quality is also compromised.

Key words: *Trapa bispinosa*, lead, cadmium, pollution

SVII/P-26 Studies on the Effect of Nitrogen and Sulphur Application on the Seed Cotton Yield and Oil Content of *Gossypum hirsutum* Cotton Genotypes

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India having the largest cotton growing area in the world is currently at third position in production with average yield of 293 Kg lint ha^{-1} against the world average of 595kg lint ha^{-1}. One of the major constraints in realizing higher productivity is imbalanced and inadequate supply of nitrogen and sulphur nutrients resulting in extravagant vegetative growth attributed to hormonal imbalance. A field experiments was conducted at Regional Agricultural Research Station, Khandwa M.P. with the objective to evaluate the response of *G. hirsutum* cotton genotypes to nitrogen and sulphur levels on yield, yield attributing characters and oil content under rain fed conditions during three consecutive kharif seasons of 1999, 2000 and 2001. Both the genotypes KH-107 and Khandwa-2 responded significantly to the increasing levels of nitrogen giving 14.04% more seed cotton yield with 100 kg ha^{-1} nitrogen level (863.31 kg ha^{-1}) with maximum boll bearing (10.34 bolls per plant) over 50 kg N ha^{-1} level. Increasing levels of sulphur significantly enhanced the seed cotton yield and number of bolls per plant over control. Boll weight and plant height remained unaffected due to nitrogen application while sulphur application enhanced the plant height.

Seed oil content increased significantly with increase in nitrogen and sulphur levels. Maximum seed oil content of 18.4 and 18.3 % were recorded with 100 kg N ha^{-1} and 60 kg S ha^{-1} levels, respectively. Genotype KH-107 gave the best response of 18% seed oil content (Mean of fertilizer application).

Key words: *Gossipium hirsutum,* nitrogen, sulphur, seed oil

SVII/P-27 Foliar Characteristics of Some Common Tree of Kashmir in Relation to Air Pollution

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Plants like all other living organisms respond to air pollutants and exhibit changes in each and every aspect. Individual plants react differently when exposed to air pollution. Even same plant species reacts differently to different pollutants. Some species develop characteristic symptoms even when exposed to very low concentrations of certain air pollutants. The changes develop in a specific variety by a specific pollutant may be specific. The present paper highlights the changes in respect of various foliar characteristics as induced in response to pollutants from auto-exhaust and stone crushers.

Key words: Pollution, pollutants, stomata, auto exhaust, response

SVII/P-28 Effect of Intermittent Exposures of Sulphur Dioxide on *Alternaria brassicae* Infecting Black Mustard

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In vitro effects of 25, 50 and 75 ppb SO_2 were examined on the radial growth, sporulation and spore germination of *Alternaria brassicae* in microexposure chambers for 3, 6 and 12 h exposure duration. Effect of intermittent exposures of SO_2 at 25, 50 and 75 ppb on leaf-spot (*A.*

brassicae) and plant growth and yield of black mustard were examined in open top exposure chambers. Radial growth of the fungus significantly increased at 25 ppb SO_2 with all exposure durations. At 50 or 75 ppb concentrations, the radial growth was suppressed being significant at the later concentration. Sporulation and spore germination of *A. brassicae* was greater at 25 and 50 ppb SO_2 but significantly less at all exposure durations of 75 ppb SO_2. The fungus spores measured from 75 ppb SO_2 exposed Petri plates were relatively smaller in size than the control. Intermittent exposure at 75 ppb significantly decreased the plant growth and yield of black mustard. Inoculation with *A. brassicae* resulted to characteristic circular and concentric lesions on the leaves of black mustard grown in pots. The lesions also developed on the siliqua. The infected plants produced dry matter and seeds significantly less than non-infected plants. Concomitant exposures of plants to 75 ppb SO_2 caused significant reduction in the plant growth and yield of black mustard ($p<0.05$). The leaf lesions became moderate in the plants exposed to 75 ppb SO_2 but severe at 25 ppb. Joint effect of 25 ppb SO_2 and *A. brassicae* was synergistic resulting to greater reduction in the plant growth and yield of mustard compared to the sum of reductions caused by the two agents separately. The interaction between 75 ppb SO_2 and the fungus was found to be antagonistic.

Key words: *Alternaria brassicae*, sulpher dioxide, black mustard

SVII/P-29 Impact of Industrial Effluents on Chlorophyll Contents of *Polygonum barbatum* and *Vallisneria spiralis*

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Effect of urea fertilizer factory effluents, on chlorophyll content of *Polygonum barbatum* L. and *Vallisneria spiralis* L. has been studied, by using Baush and Lomb Spectronic 20 Spectrocalorimeter. The effluent pH is 5.8 and its total suspended solids and total dissolved solids were 31.0 and 1716.0 mg l^{-1} respectively. It has an adverse effect on Chl *a*, Chl *b* and Chl *c* respectively which is shown by studying the plants growing on both effluent affected and non-affected sites. The results, thus obtained show the remarkable difference in chlorophyll content of the plants. The study also revealed that, not only chlorophyll content but also gross morphology is greatly affected. In present paper an attempt has been made to provide a comparative account of *Polygonum barbatum* and *Vallisneria spiralis* growing in effluent affected and non-affected sites taking into considerations both chlorophyll contents and morphological response.

Key words: Fertilizer effluent, chlorophyll, *Polygonum barbatum, Vallisneria spiralis*

SVII/P-30 Biological Abnormalities Induced by Gamma Radiation in Onion

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The seeds of onion var. N-2-4-1, Phule safed and Baswant- 780 were exposed to various doses of gamma radiation. The abnormalities like seedling height, bulb skin colour and shape, inflorescence, anther colour and shape showed significant abnormalities as compared to untreated control. These seeds were sown in nursery beds, seedlings were transplanted in field and the mature bulbs were harvested. These bulbs were planted for seed production. During different growth phases various biological abnormalities were recorded. However, the percentage of abnormalities was very high at maximum dose of gamma radiation. These studies indicated that gamma radiations are effective to induce variation in onion, which may be exploited for onion improvement programme.

Key words: Gamma radiation, biological abnormalities, onion

SVII/P-31 Peroxidase as Biochemical Marker to Differentiate between Parental and Hybrid Lines of *Vigna mungo*

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Black gram is considered to have been domesticated in India from its wild ancestral form (*Vigna mungo* variety *silvestris lukoki*, Marechal and Otoul) which belongs to subgenus *Ceratotropis* in the genus *Vigna*. Natural distribution of *Vigna mungo* variety *silvestris* range from India to Myanmar (Tateishi, 1996). The area of traditional cultivation of Black gram is confined to South Asia and the centre of genetic diversity found in India. It is an annual food legume and is cooked as “dhal soup” in South Asia and adjacent regions.

We have used LBG 645, BL, VS, LBG 17, T9 parental lines and hybrid lines (F_1 645 X VS, F_1 VS X 645, F_1 BL X 645, F_2 645 X 17, F_2 T9 X 645, F_2 645 X VS) for the study. Peroxidase band profile obtained on polyacrylamide showed clear isozymic profile which is specific for parental and hybrid lines of *Vigna mungo*.

Key words: *Vigna mungo*, peroxidase, biochemical marker, parental line, hybrid line

SVII/P-32 Up and Down Regulation of Antioxidant Enzymes, their Isoenzymes and Heat Shock Proteins in Relation to Combined Stress in *Vigna mungo* Seedlings

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One of the most crucial functions of plant cells is their ability to respond to fluctuations in their environment. In nature, plants encounter a number of biotic and abiotic stress factors simultaneously that include drought, heat shock and heavy metals (both from air and water). Heat and metal pollution are the major limiting factors for crop growth and productivity. Understanding the reactions involved in plant’s response and events resulting in successful adjustments to these stresses are still the biggest challenge for the scientists. Oxidative stress from environmental sources and developmental transitions involve the formation of Reactive oxygen species (ROS) and the enhanced production of these ROS affect metabolism by oxidative damage to various cellular compartments including membrane lipid per oxidation, enzyme inactivation, the synthesis and denaturation of proteins and DNA mutation. The protection from such damages is characterized by the up and down regulation of many antioxidant defense enzymes such as superoxide dismutase (SOD), peroxidase (POD), catalase (CAT), ascorbate peroxidase (APX) and glutathione reductase (GR), heat shock proteins / stress proteins (HSPs) and by many natural antioxidants such as á-tocopherol, â-carotene, ascorbic acid and uric acid and glutathione.

We present the results of an analysis of antioxidant enzyme activities along with their isoenzyme patterns and gene expression in *Vigna mungo*. It is anticipated that a study of this nature dealing with combined stresses would add to our understanding of the complex process of plant responses to their environment and might also provide some insights for the engineering of crops for better environmental adaptation and increased agronomic value.

Key words: Antioxidant enzymes, isoenzymes, heat shock proteins, *Vigna mungo*

SVII/P-33 Morphological Peculiarities of *Vaccinium myrtillus* L. and *V. vitis-idaea* L. Partial Shrubs under Industrial Pollution

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Many years investigations of complex pollution effect by SO_2 and heavy metals on plants of lower strata and their populations in pine forests of northern taiga (68-69°N, Kola Peninsula, Russia) had shown the essential morphological peculiarities of two dwarf-shrubs species. The study was conducted in *Vaccinium myrtillus* L. and *V. vitis-idaea* L. coenopopulations (CP) situated 75 km (CP 1, background pine forest), 30 km (CP 2), and 15 km (CP 3) from smelter complex. The main components of the smelter complex emission were SO_2 with polymetallic dust. In the heavily polluted area (15 km) Ni and Cu content in the forest litter was 40–75 times higher than in the unpolluted one (75 km). Under the influence of these pollutants the main characteristics of these phytocenosis were changing. At medium and heavy air pollution (CP 2 and CP 3) the total number of shoots, their length and their life duration reduced by 1.5-2 times, and and their morphological structure was simplified.

Vaccinium vitis-idaea L. is less stable species to anthropogenic stress when compared to *V. myrtillus* The changing of environmental conditions led to decrease in essential morphometric parameters of partial shrubs, vitality of plants and productivity. The majority of dwarf-shrubs had died in the area of medium air pollution and under heavy pollution this specie was almost absent in the phytocenosis composition.

Key words: *Vaccinium myrtillus*, *V. vitis-idaea,* coenopopulation, morphogenesis

SVII/P-34 Phytoremediation of Air Pollution

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Industrialization and urbanization have resulted in a profound deterioration of India's air quality. Air pollutants like: SPM, SO_2, NO_X, HC, CO, Pb, from combustion fuel of automobiles, Cd, Mg, Cu, Cr, Ni, from brake, rubber tyre and organic catalysts of automobiles, and secondary pollutants like NO_2, O_3 and peroxyalkyl, can cause several types of dreaded diseases in human beings. The SPM of 0.1 to 10 mm in diameter can cause burning of eyes and nose, irritation in throat and trouble in breathing. SO_2 causes significant broncho-constriction in asthmatics. Sulfurous pollutants can discolor paints, corrode metals and cause organic fabrics to weaken. Prolonged exposure to sulfates causes serious damage to marble, limestone and mortar as the carbonates in these materials are replaced by sulfates. It is estimated that eye and nasal irritation starts as somebody is exposed to 15 ppm of NO_2 and pulmonary discomfort after brief exposure to 25 ppm of NO_2. Presence of Pb in blood may result in central nervous system defects, behavioral defects, anemia, irreversible brain damage, miscarriage, death of individuals.

Some suggestions put forward by Central Pollution Control Board to control the Air Pollutant levels in atmosphere are judicious use of fuel and energy, maintenance of vehicles and afforestation in surroundings. It is an established fact that vegetation plays an important role in cleaning the atmosphere by absorbing certain toxic pollutants from its surroundings. A novel strategy of Phytoremediation removal of toxic metals from the environment using plants was suggested by Salt *et al.* (1995). The roadside plants can utilize the pollutant gases like SO_2 and oxides of Nitrogen for the production of amino acids, proteins.Thus, they help in reducing the volumes of those gases from atmosphere. The exposed plants can also alter their physiological pathways to withstand that dreaded microclimate. The C_3 plants adopt C_4 pathway for photosysnthesis, the aerobic respiratory pathways sometimes is replaced by anaerobic pathway in plants due to poor gaseous exchange system which prevail due to stomatal clogging by carbon particles. The common weeds like *Boerhaavia, Cephalanda* and *Amaranthus* are better adopted against the automobile exhaust pollution. Even these naturally selected weeds are more efficient in filtering the polluted air. The municipalities and corporations uproot these weeds during their routine cleaning jobs. So, an awareness should be generated among common people in favour of these to allow them to grow near roadsides for our own survival.

Key words: Phytoremediation, air pollution

SVII/P-35 Relative Efficiency of Ethidium Bromide Staining Versus Dapi, Yoyo-1 Staining in Comet Assay as a Measure of Genotoxic Damage on Plant Test System

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We applied the Comet assay to tobacco seedlings or isolated tobacco leaf to (1) a genotoxic alkylating agent ethyl methanesulphonate, (2) hyperthermia inducing necrotic DNA fragmentation and (3) DNase-I, a nuclease that digests DNA to nucleosomal-sized fragments. The objectives were to compare the DNA damaging effects of these 3 different toxic stimuli in the Comet assay after staining with the different DNA binding dyes EtBr, DAPI and YOYO-1. The alkaline version of the Comet assay(Single Cell Gel Electrophoresis) was applied to *Nicotiana tabacum* var. *xanthi* plants. All 3 agents induced a dose-response increase in DNA damage, expressed by the % of Tail DNA. A comparison of the DNA binding fluorochrome dyes ethidium bromide, DAPI and YOYO-1 on nuclear DNA was conducted. The data demonstrate that for the alkaline version of the Comet assay, the less expensive and commonly used fluorescent dye ethidium bromide can be used with the same efficiency.

Key words: DNA damage, Single Cell Gel Electrophoresis (SCGE), genotoxicity, *Nicotiana tabacum* var. *xanthi*

SVII/P-36 Homobrassinolide Regulated Growth, Antioxidative Enzyme Activities and Protein Content in Maize Seedling under Salt Stress

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Brassinosteroids are recently explored group of phytohormones with significant growth promoting properties. With their pleiotropic effects brassinosteroids have been reported to confer resistance to plants against various abiotic/biotic stresses besides improving quality and yield of crops. Their stress protective properties in plants contribute greatly to agriculture systems. The present work deals with the effects of 28-homobrassinolide on seedling growth; antioxidative enzymes and protein content under the salinity stress in the seedlings of *Zea mays* L. var. Partap. The surface sterilized seeds of Zea *mays* were subjected to Petriplates containing different concentrations of 28-homobrassinolide (10^{-7}, 10^{-9} and 10^{-11} M) and NaCl (25, 50, 75 and 100 mM) in combination for 7-days. The activities of catalase (CAT), ascorbate peroxidase (APOX), superoxide dismutase (SOD) and guaiacol peroxidase (POD) of 7-days old seedlings were analyzed. It was observed that 28-homobrassinolide reduced the impact of salt stress on seedling growth considerably and also increased protein content. It was revealed that the activities of ascorbate peroxidase and catalase increased as compared to control, whereas activity of guaiacol

peroxidase significantly decreased by constant treatment of 28-homobrassinolide under salinity stress. On the other hand, the activity of superoxide dismutase did not show significant difference as compared to control.

Key words: Antioxidative enzymes, 28-Homobrassinolide, salt stress, maize, seedling growth

SVII/P-37 Germination and Growth Responses of *Cajanus cajan* L. in Fly-ash Amended Soil

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Disposal of fly-ash is one of the today's burning global-environmental problem. Fly-ash is coal combustion residue of thermal power plants. Fly-ash is a potential source of many macro and micro elements to the plants including many toxic metal. The alkaline nature of fly-ash has lead to its use in amendments of agricultural soils. However, non judious application of fly-ash to soil deteriorates soil quality as well as depresses crop growth. Fly-ash contains almost all the essentials plants nutrients, but it is deficient in nitrogen and available P. Utilization of fly-ash of eco-friendly purposes is now picking up fast including its forestry and agricultural utilization in our country.

The present study explores the possibility of growing leguminous crop *Cajanus cajan* L. on fly-ash amended soil. The performance of *Cajanus cajan* L. in soil amended by different concentrations of fly-ash has been studied. The parameters considered are seed germination, growth behaviour and nodulation frequency of the plant. Results revealed that while fly-ash amendment to the soil improved the growth performance at higher exposure concentrations, it delayed the nodulation as lesser number if nodules was recorded at higher amendments. But root nodules absent-in 100% fly-ash condition.

Key words: *Cajanus cajan* L., germination, fly-ash, utilization

SVII/P-38 Boron Toxicity in Wheat (*Triticum aestivum* L.) Involves Oxidative Damage and Upregulation of Enzymatic Defense

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To explore the involvement of oxidative status and antioxidant response in tolerance to boron toxicity, wheat (*Triticum aestivum* L.) vars. HD 2874 and DL 1532 were subjected to excess supply of B and investigated for oxidative damage attributable to reactive oxygen species. Excess B enhanced lipid peroxidation (MDA content), and reduced the concentrations of chlorophyll and carotenoids, more so in var. DL 1532 than in var. HD 2874. The latter also showed marked increase in ascorbate concentration. In both the varieties, activity of superoxide dismutase (SOD) was decreased but the activity of the other antioxidative enzymes catalase, peroxidase ascorbate peroxidase (APX) and glutathione reductase (GR) were increased, more so in var. DL 1532 than HD 2874. The decreased activity of SOD was in accordance with decrease in the level of hydrogen peroxide in plants exposed to B excess. Oxidative damage in response to excess supply of B is possibly an outcome of formation of hydroxyl radicals ($HO^{\cdot}$) to which superoxide ions might be converted (Haber-Weiss reaction) as a consequence of inappropriate dismutation to hydrogen peroxide.

Key words: Boron toxicity, wheat, oxidative damage

SVII/P-39 Nickel Toxicity Induces Changes in Fe Metabolism and Water Status of Green Gram

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A glass house experiment was conducted to study the effect of Ni supply (0.1, 10, 100, 200 ìM Ni) on the Fe metabolism and water status of green gram (*Vigna radiata L*. Wilczek syn. Var K-851). In plants supplied excess Ni growth was inhibited and young leaves developed chlorosis which intensified with duration of Ni supply. Excess supply of Ni significantly decreased the chlorophyll concentration and the activities of iron containing enzymes- catalase and aconitase, suggesting decreased availability of catalytic iron. This was substantiated by the decrease in the concentration of active Fe in leaves. The concentration of total Fe in leaf tissue was also decreased and found inversely related to Ni concentration. Additional supply of iron (200 µM Fe) to plants subjected to Ni excess partially reversed the changes induced by excess Ni. Toxic supply of Ni also affected the water status of the plant. The relative water content and water potential ($ø_L$) of the leaves were lowered with accumulation of proline.

Key words: Ni toxicity, green gram, iron metabolism, water status

SVII/P-40 Variability in Senescence Pattern of Flag Leaf and Effect of Temperature and Osmotic Stress on Membrane Stability in Wheat Genotypes under Normal and Late Sown Conditions

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At agriculture research farm of Institute of Agricultural Sciences B.H.U. Varanasi, a field experiment was conducted during *rabi* (winter, 2003-2004) to find out the senescence pattern and membrane stability of flag leaf (in terms of per cent electrolyte leaked) in three genotypes of wheat (HUW-234, HUW-468 and Chirya-3) at different growth stages under normal and late sown conditions. Changes in chlorophyll content of flag leaf of mother shoot was recorded after 5, 10, 15 and 20 days of anthesis. Changes in chlorophyll content in flag leaf and pattern of grain growth of ear indicated that probably under late sown condition, supply of assimilate to grain is not a limiting factor in grain growth. Membrane injury due to hyper thermal or hyper osmotic treatments of flag leaf generally increased when sowing was delayed. Effect of temperature stress on membrane stability showed significant differences with respect to genotype, date of sowing, stage and their interactions. Membrane injury was generally more when sowing was delayed. Effect of osmotic stress on membrane stability showed non-significant differences with respect to genotype, date of sowing and stage but their interaction were found to be significant. Under late sown condition, membrane injury due to osmotic stress, though increases but values did not differ significantly with normal sown crop.

Key words: Chlorophyll, membrane stability, osmotic stress, temperature stress, wheat

SVII/P-41 Disturbances in Brinjal Metabolism by Excess Lead

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An experiment with brinjal *(Solanum melongena* L.) cv. Hybrid PK 123 was conducted in glass house under controlled culture conditions, to determine the ill effects of lead on yield and some aspects of metabolism. Plants were raised in sand with complete nutrient solution for 53

days. On 54th day, lead was administered at nil, 0.1, 0.2, 0.4, 0.5 and 1.0 mM as lead nitrate. At 1.0 mM lead, symptoms of excess lead were: depression on growth and reduction in leaf size, no other foliar symptoms of lead were observed. At excess lead fruit number, their size and weight were markedly reduced. The elevated levels of lead reduced the biomass, concentration of chlorophylls (*a* and *b*), protein, reducing and non-reducing sugars and increased the activity of catalase, peroxidase and ribonuclease in leaves of brinjal.

Key words: Brinjal, lead, enzymes, carbohydrate metabolism, yield

SVII/P-42 Effect of Cadmium and Mercury on Growth and Metabolism of *Colocassia esculentum*

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Cadmium and mercury are non-essential heavy metals that can be harmful even at low concentrations to plants. *Colocassia esculentum* (Araceae) plant was studied to know its tolerance capability to potentially toxic heavy metals. The plants were analyzed for fresh weight and metal content. Cadmium and mercury both depressed dry matter production of the plant up to 33% and 2.1%, respectively. Plant accumulated larger portion of the heavy metals in the roots. Chlorophyll content of the plant declined on treatment with heavy metals while enzyme activities showed an increase. Mercury showed an increase in enzymatic and non-enzymatic antioxidants as compared to cadmium treated plants. *C. esculentum* showed an increase in total protein and lipid peroxidation. Changes observed in the anatomical structure of the metal treated roots of *C. esculentum* along with antioxidative response indicate the adaptive properties of this plant species to overcome cadmium and mercury stress.

Key words: Cadmium, *Colocassia esculentum*, heavy metals, mercury, tolerance

SVII/P-43 Changes in Salinity Impact Growth, Photochemistry and Photoinhibition in the Antarctic Psychrophile *Chlamydomonas raudensis* (UWO 241)

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Consensus has not been reached with respect to the direction of climate change but it is generally agreed that changes in local and global climates are occurring. Salinity is a major limiting factor for growth of both micro and macro algae and this is a contributing factor to ecosystem health and diversity in the oceans. The distribution of ocean salinity has changed in the last 5 decades. The North Atlantic has become fresher by approximately -0.03 p.s.u. The green alga chosen for this work, *Chlamydomonas raudensis* UWO 241 (referred to henceforth as UWO 241), is an extremophile that was isolated in 1995 by John Priscu and co-workers from the permanently ice-covered Lake Bonney, Antarctica. UWO 241 is an obligate psychrophile and is salt tolerant as the salinity in its natural habitat is 0.7M. Interestingly, the type strain for this species, *C. raudensis* Ettl SAG 49.72 (referred to henceforth as SAG 49.72), is a typical mesophile that was isolated from a meadow pond in Czeckoslovakia. Thus we have an unusual system where two genetically identical organisms display very different physiological and ecological capacities.

Our results indicated that UWO 241 is not an obligate halophile although it tolerates growth under salinity levels up to 1.0 M. Its optimum growth rate was at 10 mM NaCl above and below which the division time increased. The same pattern was observed for maximum PSII photochemical efficiency, F_V/F_M, and PSII excitation pressure, 1- qp. F_V/F_M remained high during growth at low salinities and decreased when grown at higher salinities. PSII excitation pressure was low when UWO 241 was grown at lower salinities and this increased with increased salinity. Functionally this indicates that salinity alters PSII photochemistry and the reduction of the plastoquinone pool in this extremophile. Growth of UWO 241 under different salinities also affected susceptibility to photoinhibition and its capacity for recovery. Growth at 10 mM resulted in less susceptibility to high light stress with the fastest and fullest recovery. Photoinhibition and recovery of cells grown at higher salinities were comparable up until 0.85 M. The same trends were not observed in UWO 241's mesophilic counterpart, SAG 49.72. This latter strain was unable to tolerate growth at salinities above 80 mM. In addition, growth under varying salinities did not have any effect on maximum PSII photochemical efficiency or PSII excitation pressure. Furthermore, salinity did not modulate SAG 49.72's susceptibility to photoinhibition and recovery. Temperature is increasing in northern oceans, the interaction of high temperatures and changes in salinity on these parameters will also be discussed.

Key words: Antarctica, PSII excitation pressure, photoinhibition, photosystem II, salinity

SVII/P-44 Age-Dependent Differential Responses of *Eichhornia crassipes* (Mart.) Solms. Vegetative Organs under Cadmium Treatment

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Eichhornia crassipes (Mart.) Solms. plants grown in nutrient solutions with 0.05, 0.5, and 5.0 mg l^{-1} $CdCl_2$ for 1, 3 and 7 days exhibited insignificant effects in the morpho-physiological responses of its roots, stems, petioles, and laminae. The chlorophyll contents of young laminae increased on the 1st and 7th day of $CdCl_2$ exposure. The biomass and chlorophyll contents of laminae were significantly affected by both cadmium treatment levels and age of the leaf, while the leaf surface area was significantly affected by cadmium treatments only. The morpho-physiological responses of the laminae to cadmium treatments were age-dependent. Atomic absorption spectrophotometric analyses showed that significant levels of Cd were taken up by the various vegetative organs of *E. crassipes*. Linear regression analysis revealed that Cd levels increased with increasing concentration as well as prolonged Cd exposure. The highest Cd levels were detected in the roots, followed by those in the petioles and stems, while the least amounts were detected in the laminae. Generally, the mature vegetative organs took up the greater amounts of cadmium compared to younger organs. The response of *E. crassipes* to cadmium was a function of metal concentration in the nutrient medium, period of exposure, the kind of vegetative organs as well as the level of maturity of the organs. The data support the fact that *E. crassipes* is a hyperaccumulator and displays a high tolerance to Cd. The mechanism by which *E. crassipes* plants withstand high levels of cadmium is the subject of an on-going research.

Key words: AAS, cadmium, *Eichhornia crassipes,* heavy metals, uptake

SVII/P-45 Response of Different Varieties of Lentil (*Lens culinaris* M) to Different Concentrations of Mencozeb and Chlorpyrifos under Temperate Conditions

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Investigations have been carried out on some varieties of Lentil *(Lens culinaris* M) L-precoz, L-5194, L-4603, Red Masur treated with different concentrations of Mencozeb and Chlorpyrifos (0.1, 0.25 and 0.5 ppm). Seed germination trend was observed after 5, 10, 15, 20 days of sowing. Germination percentage varied vide treatments and varieties. Local variety Red Masur could not survive under temperate conditions of Shalimar University campus J&K while other varieties showed only 37-50.5% germination, treated with 0.1000ppm of Mencozeb, 25-28% germination was noticed in plants treated with 0.25 ppm Mencozeb and only 15- 18 % germination, treated with 0.5 ppm of Mencozeb. Same results were observed, with Chlorpyrifos treated varieties. The observations were compared with control, where germination was about 62-72%. Nodulation was studied at pre-flowering, flowering, post flowering stages of their growth and development. Mencozeb proved more toxic to N-fixers as compared with Chlorpyrifos. Nodulation was reduced in 0.1 ppm treated varieties and absent in 0.25 ppm and 0.5 ppm treated varieties but on other hand 0.1 ppm chlorpyrifos concentration enhanced nodulation in all the varieties. Soluble protein content, amino acid pool content and protein profiles of seeds were assessed at the harvesting. Protein profiles of all varieties showed expression of some new protein, in addition to new proteins over expression of some existing proteins was also noticed.

Key words: Mencozeb, chlorpyrifos, *Lentil culinaris*, germination, nodulation, soluble protein content, amino acid pool, protein profiles

SVII/P-46 Impact of Urban Dust Particles on Physico-Morphological Features of *Cineraria maritima* (Linn.)

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Dust particle is one of the important toxic pollutants released in the urban atmosphere from the natural and anthropogenic sources, which affect the plants and animals life adversely. The objective of the present work was to study the effect of urban dust with respect to selective physical (root-shoot length, no. of leaves, branches, flowers and leaf area) and micro-morphological (frequency and size of epidermal cells and stomata) parameters, on *Cineraria maritima* (Linn.). The cuticular and epidermal characters of leaf and also the dust particle size were studied under light (LM) and scanning electron microscope (SEM). However, decrease in root, shoot length, no. of leaves, branches, leaf areas and delayed flowering were observed in dust treated plants in comparison to control. The leaf samples of dust treated plant revealed, increase in frequency and decrease size of epidermal cells and stomata. Clogging of stomata and changes in structure of cuticle were also noticed, with fine particles (ranges from <2.5-10ì) and coarse particles (?10ì) respectively. The changes observed in leaf surface structure (cuticular and epidermal) of polluted population, underscores the significance of these micro-morphological parameters as indicator of urban dust pollution.

***Key words*:** Urban dust, micro morphology, cuticule, epidermis, root length

SVII/P-47 Assessment of Effect of Ambient Air Pollution on Wheat (*Triticum aestivum* cv. HUW-234)

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The problem of air pollution is progressively growing in India. Major air pollutants of concern are sulphur dioxide, nitrogen dioxide and secondary pollutant ozone. The present study deals with the evaluation of effects of ambient gaseous air pollution on wheat yield growing in a suburban area using open top chambers. Six open top chambers were installed at the experimental site with three receiving ambient air (non filtered air, NFs) and another three ventilated with filtered air (FCs). Eight hourly air monitoring was conducted at experimental site for analyzing the ambient concentration of SO_2, NO_2 and O_3. Wheat (*Triticum aestivum L*. cultivar HUW-234) was sown in open top chambers in the month of December 2004 and filteration continued till the maturity of the wheat crop i.e. March, 2005. Various morphological parameters were assessed at 40, 60 and 80 day ages. Finally the crop was harvested at 120 day age and grain weight per plant was quantified.

Gaseous pollutant concentrations were significantly higher in NFs as compared to FCs. During the experiment mean concentrations of SO_2, NO_2 and O_3 were 14.2, 25.93 and 51.46 ppb, respectively. The results on morphological parameters of wheat plants showed improvement in FCs as compared to those growing in NFs. There was no significant decrease in morphological parameters at 40 days. However, at 60 and 80 day ages significant reductions were observed for leaf area and root, shoot and leaf biomass. Yield per plant also reduced significantly in chambers ventilated with ambient air (NFs) in comparison to those with charcoal filtered air (FCs). At 80 days leaf area, root, shoot, and leaf biomass reduced by 32, 32, 26 and 12%, respectively in non-filtered chambers as compared to filtered ones.

The study clearly showed that O_3 was higher at the site as compared to other gaseous pollutants. Mean SO_2 concentration was quiet low. O_3 concentration was especially high during February and March, which was time for grain setting and filling. The study clearly concludes that O_3 is the main air pollutant causing significant growth and yield losses in wheat growing in the sub-urban areas of Varanasi.

Key words: Open top chambers, ozone, sulphur dioxide, nitrogen dioxide, biomass

SVII/P-48 Effect of Chromium on Growth and Secondary Metabolites of *Phyllanthus amarus* Schum. & Thonn.

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Phyllanthus amarus Schum & Thonn. is a very important medicinal plant having hepatoprotective, diuretic and stomachic properties. Current research has been focussed on *P. amarus* potential for the treatment of hepatitis B. It is effective in the treatment of infective hepatitis without any adverse effect. It is used in various indigenous ayurvedic formulations like Chyawanprash etc. In wastelands it grows abundantly during the rainy season. Due to its hepatoprotective property it is gaining importance not only in developing countries but throughout the world. In India, generally it is collected from the wild sources, mainly from wastelands. Due to industrialization, there is possibility that wastelands may be contaminated by heavy metals because many industrial units discharge their waste with high metal content in these lands where *P. amarus* grows abundantly. Therefore, it is evident that

quality of plant would be affected. In this paper an attempt has been made to see the effect of chromium on *P. amarus* through various parameters and found that Cr has deleterious effects on plant growth, concentration of chlorophyll, protein and sugars. Ultramorphological variations on leaf surfaces were also observed, for example stomatal size and wax deposition pattern changed in treated leaves. However, concentration of the secondary metabolite i.e. phyllanthin and hypophyllanthin increased due to increase of Cr but only upto a certain limit and after that it decreased.

Key words: Chromium, *Phyllanthus amarus,* wasteland, secondary metabolite

SVII/P-49 Cytotoxic Effect of Agrochemical Quinalphos (Agroquin) on Root Meristem of *Allium cepa*

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During the present study one of the very commonly used organophosphate insecticides, Quinalphos has been tested on *Allium cepa*. Quite a high percentage of abnormalities both at mitotic cell cycle as well as chromosomal level was observed. Significantly the percentage of total dividing cells gradually decreased with the increase of concentration of the drug. It induced genetic damage and caused cytotoxicity in the treated material.

Hence it may be concluded that in a continuous cell cycle less proportion of interphase cells enter into prophase whereas more proportion of cells become arrested at metaphase, anaphase and telophase with the increase of the concentration of the drug. Hence the drug might have inhibited the DNA synthesis at S-phase of the cell cycle and/or prolonged the duration of the metabolic activities during inter-phase of the cell cycle and/or prolonged and duration of the metabolic activities during inter-phase resulting in the decrease in the proportion of interphase cells entering into prophase. At the same time, the chemical might have suppressed normal spindle functioning in the later phase of cell cycle.

Key words: Quinalphos, *Allium cepa,* cytotoxic effect, root meristem

SVII/P-50 Heavy Metal Induced Stress in an Aquatic Insectivorous Plant, Bladderwort (*Utricularia aurea*)

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Response of an aquatic insectivorous plant, *Utricularia aurea* (bladderwort), towards three selected heavy metals *viz*. cobalt, copper and cadmium at four different concentrations have been investigated. The chosen metals were in environmentally relevant oxidation state (+2). The growth of bladderworts were monitored in water collected from their habitat. The chlorophyll content and bladdershed were monitored on a weekly basis. Significant increase in number of bladdershed was noticed in the 2-3 weeks. The morphological deformities were probed by light and Scanning Electron Microscopy (SEM). Prominent cellular eruptions, constriction of foliar filaments in the metal treated bladderworts indicated the stress.

Key words: Heavy metal, insectivorous plants, stress, toxicity, *Utricularia aurea*

SVII/P-51 Toxicity Assessment of Tannery Industry Effluent by Bioassay Technique

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To assess the potential toxicity of tannery industry effluent, percent phytotoxicity and root/shoot ratio were studied. With the tannery industry effluent, the percent phytotoxicity ranged between 10.54 to 25.6 among the different varieties of rice, pulses and oilseeds. The starchy seed-bearing plants being most sensitive to industrial effluents, whereas, fat and protein bearing seeds, also showed same type of sensitivity but to a lesser extent.

The average phytotoxicity was more in rice than oilseed and least in pulses. Root and shoot ratio ranged between 14.22, highest in rice variety (Pant-10) to 10.82, lowest in pulse variety (gram-Bahar) among different varieties of rice, pulses and oilseeds. It was observed that the value of co-efficient of correlation between percent phytotoxicity and root/shoot ratio was 0.667889, 0.822181 and 0.650553 in case of rice, pulse and oilseed varieties, respectively. The increased percent phytotoxicity and disturbed root/shoot growth may be due to the presence of chromium in tannery effluent. In case of Pb and Cd, these metals were found in traces in plant tissues as well as in soil. While other metals like Cu, Zn and Ni are essential metals for plant growth and do not exceed the normal concentration in plant tissues.

It may be said that percent phytotoxicity and root/shoot ratio are affected by each other. Root/shoot ratio and percent phytotoxicity may be considered as the important criterion in assessing the toxicity of industrial effluent due to a strong co-relation found between the two.

Key words: Tannery effluent, rice, pulse, oilseed, root/shoot ratio

SVII/P-52 Radish Response to Distinct and Complex Exposure to Ozone and UV-B

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Research on radish response to distinct and complex effect of ozone and UV-B rays under phytotron conditions was carried out. The aim of this study was to determine the effect of such stress factors to radish biological indexes and adaptation possibilities to such exposure. The exposure to stress factors was divided into two main steps: adaptive and main. Ozone amounts of 80 µg m^{-3} for adaptive and 240 µg m^{-3} for main exposure were maintained 7 h per day, 5 days per week. UV-B dosage of 4 kJ m^{-2} day^{-1} for adaptive and 8 kJ m^{-2} day^{-1} for main exposure were maintained 5 days per week as well. Each step of exposure lasted for one week. A photoperiod of 16 h and temperature of 21/17°C (day/night) were maintained throughout the experiment. Radish height, biomass accumulation, amounts of photosynthetic pigments and sugars in leaves and amount of sugars in rhizocarp were being determined.

The lowermost radish was observed after the adaptive exposure to UV-B and after the main exposure to UV-B of UV-B pre-treated plants (UV+UV treatment). However, UV-B affected control plants (C+UV) reached the same height as untreated plants (C+C). Lower plants were observed in O_3+UV treatment compared to UV+O_3 treatment. Significant decrease in biomass accumulation was determined for radish after main exposure both to O_3 and UV-B, especially for UV-B pretreated plants as compared to control plants. Somewhat higher amounts of photosynthetic pigments were determined in radish leaves after adaptive exposure to O_3 and UV-B than in adaptively untreated plants. Later, such O_3 and UV-B pretreated plants accumulated more

pigments that plants without adaptive treatment. Fructose dominated in rhizocarp of control plants. Increased concentration of fructose and low amount of sucrose were determined in C+UV, O_3+O_3, O_3+UV plants. Radish rhizocarp accumulated 5-10 times more sugars than leaves. Though low amounts of glucose were determined in radish leaves as well. Various combinations of stressors had a tendency to increase the amounts of fructose in leaves. UV-B as the main stressor (C+UV) induced accumulation of galactose in plant leaves. O_3+UV combination resulted in increased amount of fructose (by a factor of 4 as compared to control plants) and accumulation of sucrose. In general, plant exposure to O_3 and UV-B induced homeostasis in plant and, consequently, signs of adaptation after main exposure were being evidenced.

Key words: Radish, ozone, UV-B, photosynthetic pigments, carbohydrates

SVII/P-53 Effect of Industrial Pollution at Sewri-Mumbai on the Rate of Pollen Tube Growth of Successive Flowers of *Cassia siamea*

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Present paper deals with the effect of industrial pollution at Sewri-Mumbai on the rate of pollen tube growth of successive flowers (viz. F, F-24, F-48, F-72 series i.e., open flowers and the flower buds which require 24, 48, 72 hours to open respectively.) of *Cassia siamea* Lamk. Successive flowers were plucked at the same time soon after the dehiscence of the anthers (in open flowers) from the plants growing at the botanical garden of the Institute of Science, Colaba-Mumbai (treated as control) and from the plants growing in the polluted zone of Sewri-Mumbai. They were stored at the room temperature in polluted zone of Sewri-Mumbai. Germination of pollen was studied by standing-drop technique in Brewbaker and Kwack's (1963) culture medium. The rate of pollen tube growth was determined by fixing the pollen cultures at one hour interval. Such preparations were continued for 10 hours. Observations were made 24 hours after incubation.

Potentiality of pollen germinability in *Cassia siamea* Lamk. was noted in F and F-24 series. Pollen of F series collected from the unpolluted area of Colaba-Mumbai germinated after one hour of sowing, while those collected from the polluted zone of Sewri-Mumbai took 5 hours to germinate. Pollen of F-24 series of unpolluted site and polluted site germinated after 6 and 9 hours of their sowing, respectively. This proves that the pollen of F-24 series are highly sensitive and acts as an ideal indicator of pollution. Industrial pollution at Sewri-Mumbai inhibited the pollen tube growth. It also inhibited the rate of pollen tube growth. Present investigation proves that Sewri-Mumbai is highly polluted.

Key words: Environmental pollution, indicators, palynology, toxicology

SVII/P-54 Effect of Municipal Waste Water in Agricultural Field

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The disposal of domestic sewage was the primary object in using sewage for irrigation. Sewage farming has assumed importance in several countries because of the economy of the process combined with proper disposal. Sewage farming is still in the experimental stage and many problems need to be solved in the field of bacteriology, biology, soil chemistry, hygiene and the physiology of plant for safe consumption of the product grown. Work on these lines assumes greater importance under Indian conditions due to its widespread use in agriculture. Due to scarcity of fresh water Indian farming have been using sewage water for irrigating agricultural lands in the vicinity of big cities. Sewage is used for irrigation due to its value as low priced fertilizers. It is rich in NPK and organic matters. Sewage supplies appreciable amount of phosphorous to crops. Municipal wastes usually contain high concentrations of heavy metals and their continuous application to soil may result in enrichment of heavy metal in the top soil.

Because of phytotoxicity to plants it has an adverse effect on growth and quality of plants. Since these metals have long biological half-life period their subsequent entry into the food chain can cause health hazards to animals and human beings. Long term application of sewage for irrigation may contaminate the crop product by *Salmonella*, *E. coli* and some other pathogenic organisms.

Therefore, in the present study agricultural fields being irrigated with sewage for past 2 and 5 years were selected and the level of accumulation of Na, K and Ca cations were estimated, so as to judge the level of sewage in the field. Other physico-chemical changes in soil due to sewage irrigation were also determined.

Key words: Soil chemistry, sewage disposal, hygiene, irrigation

SVII/P-55 Toxicity Effect of Nitrogenous Fertilizer Factory Effluent on Plant Physiology

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The effect of nitrogenous fertilizer factory effluent on chlorophyll, protein and sugar of *Croton banplandianum, Cassia tora, Leonourous sibricus* and *Amaranthus spinosous* was investigated. The effluent was alkaline in nature. It was dark brownish in colour with ammonia odour. The physico chemical parameters analysis of the effluent reveals that all the parameters are high and deliberate discharge of raw effluent in the soil induced physiological stress to the surrounding plant species and alters the biochemical characteristics.

Key words: Fertilizer, effluent, chlorophyll, protein, sugar

SVII/P-56 Impact of Pollution on the Vegetation

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Widespread damage to trees and crops is not a new phenomenon. Such natural causes as drought, unseasonal heat or cold, high winds, diseases and insects have long been known to injure and kill plants. It has also been recognized for many decades that air pollution can injure vegetation. Historically, smelters, power plants, and other large point sources of pollution have actually damaged vegetation downwind; usually high concentrations of sulfur dioxide or fluoride (generally as hydrogen fluoride) were at fault.

In the present study, we have studied the impact of air pollution on the vegetation mainly in vicinity of roads. It was found that the plant species were healthier as the distance from the road increases, and much affected by the disease or damaged/injured close to roads.

Key words: Plants, pollution injury, disease

SVII/P-57 Role of Road Side Planting in Mitigating Dust Pollution

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Atmospheric pollution, be it due to dust, noise, gases, plastics or industrial effluents, is increasing continuously. Among different pollut-

ants, dust pollution is of considerable importance, because it may cause many health hazards for human life and reduce productivity in plants. Mitigating dust pollution through a biological means finds a greater relevance, given the situation of increasing atmospheric pollution. This study is an attempt to identify plant species which can accumulate maximum dust particles, using some of the morphological characters of plants species. Leaf surface area seems to be most important character that facilitates plant to accumulate more dust. Leaf shape is another morphological character. Because, *Dhurantha plumeria* with only 20 cm^2 leaf area could accumulate highest quantity of dust particles, which was second highest among ten species studied. All the species that accumulated more dust particles had smooth leaf texture. Therefore, leaf texture also seems to have some influence. In the light of such a results it is important to emphasise on such tree species for urban and avenue plantation using which, dust pollution can be reduced.

Key words: Dust pollution, leaf texture, leaf shape, road side planting

SVII/P-58 Impact of Nitrate Seed Treatment on Seedling Vigor, Biochemical and Yield Attributes of Wheat (*Triticum aestivum* L.) Growing in Non Saline and Saline Soils

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The use of seed hardening treatment for increasing yield and dry matter production play significant role. The objective of this study was to investigate the effect of seed hardening with nitrates (15mM) salts viz., Mg $(NO_3)_2$ and KNO_3 in non saline (pH 7.6, E.C. 0.28 d Sm^{-1}) and saline (pH 9.3,E.C. 1.28 d Sm^{-1}) soil conditions on the seedling vigor, biochemical and yield attributes of wheat.

An increase in seedling emergence was noticed in Mg $(NO_3)_2$ and KNO_3 hardened seeds in respect to non harden (control) one and that was 83.33, 81.66 and 66.66 for non saline and 76.60, 78.83 and 58.66 per cent for saline soil conditions respectively at 25 days of sowing (DAS). Traits like leaf number, leaf area, plant height were found to be improved in Mg $(NO_3)_2$ treated sets whereas, root number, root length and root dry weight increased in KNO_3 treatment in both soil conditions ; the trend of these experimental sets were found as per seedling emergence. Proline and carotenoid contents were noted to increase with the application of nitrate seed treatment in both i.e., in non saline and saline soils but in later one the levels of these were more in each and every set. Plants hardened with Mg $(NO_3)_2$ showed more nitrate reductase activity (NRase) and chlorophyll content in both soil condition which followed by KNO_3 hardened sets.

Straw yield, grain weight, number of grains as well as test weight per plant found to increase with the use of nitrate salts for hardening treatment in respect to control one. Results of the work are to be discussed on the basis of the mechanism of action of nitrate salts during the process of hardening.

Key words: Hardening, nitrate salts, seedling vigour, yield, salinity

SVII/P-59 Heavy Metal Stress-Protective Properties of 24-Epibrassinolide in *Brassica juncea* L. Seedlings

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Brassinosteroids are a class of plant polyhydroxysteroids that are ubiquitously distributed in plant kingdom. In addition to their role in plant development, they are also implicated in many physiological responses, including effects on carbon metabolism, stimulation of xylem formation and modulation of stress responses particularly with respect to thermal stress, salt stress, pathogen infection and heavy metals stress. With their stress-protective properties, it gets important to study their role in oxidative defence system of plants. Keeping in view, the present study was designed, to observe the effect of 24-epibrassinolide on seedling growth, metal uptake and antioxidative defence system in the seedlings of *Brassica juncea* L. cv. PBR 91. Seeds of *B. juncea* treated with different concentrations (10^{-7}, 10^{-9} and 10^{-11} M) of 24-epibrassinolide for 12 h were subjected to different concentrations (25, 50 and 100 mg dm^{-3}) of heavy metal (Ni). The seedling growth of *B. juncea* was improved by 24-epibrassinolide treatments under nickel metal stress. In addition, 24-epiBL at the concentrations of 10^{-9} and 10^{-11} M blocked heavy metal uptake and accumulation. Similarly, it was found that protein content and activities of guaiacol peroxidase and ascorbate peroxidase increased whereas the antioxidative enzyme activities decreased for catalase, gluatathione reductase and superoxide dismutase under the influence of epibrassinolide in higher concentration of nickel metal. The decrease in antioxidative enzyme activities by 24-epibrassinolide treatments was associated with the blockage of nickel metal uptake in plants.

Key words: Brassinosteroids, 24-Epibrassinolide, antioxidative enzymes, *Brassica juncea*

SVII/P-60 Effects of Clean Water Irrigation on Heavy Metal Accumulation in Palak grown in Area having Long Term Uses of Sewage Water Irrigation

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Vegetables produced under wastewater irrigation practices may pose health hazard to human being due to chances of heavy metal contamination. An extensive field study was conducted at Lohta and Dinapur sites, regularly irrigated by treated and/or untreated wastewater since last two decades at suburban areas of Varanasi, India. This study aimed to investigate the effects of clean water irrigation on heavy metal accumulation in edible portion of Palak (*Beta vulgaris* L. var. allgreen H1) plants grown in the area. Six field plots were prepared by following agronomic practices commonly used by the farmers in the area. Half of the field plots were irrigated by clean water and other half was irrigated by wastewater. Irrigation schedule was common for all plots to keep the uniformity in soil moisture status. Soil samples were collected before sowing and just after harvest from 0 – 15 cm soil layer. Plant samples were collected after 60 days of seed germination. Heavy metal concentrations for Cd, Cu, Zn, Pb, Ni, Cr and Mn were determined using Atomic Absorption Spectrophotometer. The results showed that there were no significant difference between biomass accumulation in root and shoot of plants grown under clean or wastewater irrigation system. The phytoavailability of heavy metals in soil decreased due to clean water irrigation. Maximum decrease in phytoavailability was found for Ni (75%) followed by Cr (50%), Cu (46%), Cd (45%), Mn (38%), Pb (36%) and Zn (28%). Clean water irrigation reduced the concentration of heavy metals in palak. Maximum reduction was observed for Cd (48%), followed by Cu (42%), Mn (37%), Cr (29%), Pb (29%), Ni (27%) and Zn (16%). The study suggests that clean water irrigation of heavy metal contaminated soil has potential to reduce heavy metal contamination in edible portion of palak. This may be recommended that in areas having long term uses of wastewater irrigation, intermittent use of clean water regime may be applied to reduce the risk of heavy metal contamination of the food chain.

Key words: Heavy metals, contamination, wastewater, irrigation, accumulation, phytoavailability

SVII/P-61 Cadmium Phytotoxicity in Brinjal

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To elucidate the deleterious effects of excess Cd on brinjal *(Solanum melongena* L.) cv. Hybrid PK 123, plants were grown in refined sand in complete nutrient solution for 52 days in glass house at ambient temperature. Cadmium sulphate was superimposed on day 53 at variable levels - nil, 0.05, 0.1, 0.2, 0.4 and 0.5 mM. Influence of excess cadmium was discernable after 5 days of metal supply at 0.4 and 0.5mM Cd as depression in growth. At these levels, foliar symptoms were initiated as paling of young leaves at the base progressed towards apex. With increase in age, affected leaves turned golden yellow and these effects spread to lower leaves. Leaf size and floral initiation was very much restricted. Excess Cd reduced the fresh and dry weight of plants and fruit yield of plants. At higher levels (> 0.1mM) of Cd, fruit formation was completely inhibited and fruits formed at 0.05 and 0.1 Cd were smaller in size. Besides this excess Cd disturbed the metabolism of brinjal by reducing the concentration of chlorophyll (*a* and *b*), protein, Hill reaction activity and activity of an antioxidant enzyme catalase whereas the activity of peroxidase and ribonuclease were increased in leaves of brinjal. Cadmium excess lead to an accumulation of phenols and reducing sugars in leaves.

Key words: Brinjal, cadmium, phytotoxicity, enzymes, chlorophylls

SVII/P-62 Phytotoxicity of Nickel in Rice

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In order to study the ill effects of excess nickel on rice (*Oryza sativa* L.) cv. Swarna Mansoori, plants were grown in refined sand with complete nutrient solution for 43 days under control conditions. On 44th day, pots with plants were separated into six lots, one lot was allowed to grow as such and treated as control. In other lots nickel was superimposed at 0.05, 0.1, 0.2, 0.4, 0.5 mM nickel sulphate. At 0.5 mM nickel toxicity symptoms were observed 5 to 10 days after treatment, expressed as interveinal chlorosis in the form of bands in the central portion of middle leaves accompanied by reduced number of tillers. The upper end of affected lamina remained green, these symptoms were also present at 0.2 and 0.1 mM Ni but were mild. Panicle formation was inhibited at > 0.05 mM Ni. Excess nickel in rice reduced growth, biomass, concentration of chlorophyll (*a* and *b*), protein, iron, zinc and phosphorus, Hill reaction activity and activity of catalase in leaves and increased the activity of peroxidase, acid phosphatase and ribonuclease. The concentration of Ni and S increased with increase in nickel supply in various plant parts. The accumulation of nickel was high in roots as compared to other plant parts.

Key words: Nickel toxicity, rice (*Oryza sativa* L.), metabolism, tissue, P, S, Fe, Zn

SVII/P-63 Physiological Response in Lichen Species, *Phaeophyscia hispidula* (Ach.) Essl., in Relation to Bioaccumulation of Heavy Metals

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The study is designed with an aim to determine the impact of pollutants emitted by vehicular activity in Dehra Dun city as well as other urban and rural areas of Garhwal Himalayas. Six heavy metals (Pb, Zn, Ni, Fe, Cu and Cr) were estimated in the lichens collected from both urban and rural sites. The effect of heavy metal stress on the physiology of *P. hispidula* is investigated based on the chlorophyll degradation, carotenoid and protein content. *P. hispidula*, common foliose lichen found growing on different substrates in four localities of Dehra Dun city was analysed for six metals. All the four localities exhibit an enhanced level of metals analysed. The Clock Tower area of the city has maximum accumulation of most of the metals. The vehicular emission seems to be the main cause of pollution in the city. *P. hispidula* collected from Clock Tower area exhibits maximum concentration of all the metals analysed, followed by Rajpur Road. The concentration of Cu, Pb, Zn, Fe, Ni, and Cr at Clock Tower area were 31.36, 17.42, 198.78, 11759.58, 14.81 and 320.56 µg g^{-1} dw, respectively. The maximum accumulation of almost all of the metal at Clock Tower area may be attributed to the high traffic density, because of its location in the centre of the city and roads from six different directions meet at this point. The Old Mussoorie road has less vehicular activity, thus showed least concentration of metals among the studied sites. Levels of Pb, Cu, Cr, Zn, Fe, and Ni were <0.01, 23.46, 103.79, 116.97, 8348.37 and 7.22 µg g^{-1} dw. The physiological responses due to heavy metal stress are also investigated. The sample from non polluted sites were studied for OD ratios at 435nm and 415 nm which showed high ratio of chlorophyll degradation indicating high levels in integrity of the chlorophyll. Levels of heavy metals were significantly correlated with total carotenoid and total protein content.

Key words: Lichen, bioaccumulation, heavy metal, physiology, Garhwal Himalayas

SVII/P-64 Physiological Effects of Cadmium Pollution on the Growth and Yield of *Solanum melongena* L. (Egg Plant)

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Cadmium owes its name from '*Cadmia fornacum'* the 'zinc flower'. It is non-degradable component and found in water (Ni-Cd batteries), air (fossil fuel), soil (phosphate-fertilizers). Heavy metals enter the food chain from industrial sources, natural resource and geochemical cycles, once these incorporated into the soil, they remain for very long period of time, upto of several thousand years which bioaccumulated in tropic lavels of food chain after mobilization and posed biological time bomb problems in megaecosystems and caused Itai-Itai (ouch-ouch or byo disease) and cancer in man and widely induced 'Hormosis' in plants. Therefore, a knowledge on the physiological and biochemical mechanisam of plants for tolerance and accumulation of cadmium might provide alternative strategy to adopt measures for purification from soil environment.

Cadmium chloride ($CdCl_2$) conc. (10^{-2}, 10^{-4}, 10^{-5} and 10^{-8} M) were prepared in Hoagland's nutrient solution. Seeds of *Solanum melongena* L.cv. Pusa uttam, a vegetable crop of 120 days were sterilized with 0.1% $HgCl_2$ than placed in petriplate and polythene bags in triplicate after the presoaking treatment. It is observed that higher conc. (10^{-2} M) initiated early germination after 48 hrs. of sowing, however, decreased germination relative index (GRI), seedling growth, chlorophyll stability index (CSI) and yield. Moreover, lower conc. (10^{-8} M) revealed slightly enhanced growth over control. Magnitude of physiological effects of Cd had been assessed and discussed as phytoremediation through egg plant. Antagonistic effect of $CaCO_3$ on Cd has also been discussed.

Key words: Cadmium chloride, calcium carbonate, *Solanum melongena,* chlorophyll, phytoremediation

SVII/P-65 Utilization of Fly-ash for Biomass Production: A Case Study on *Jatropha curcas* L.

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Coal fed thermal power plants account for more than one-third of power generation in India, which results in generation of about 13 million tonnes of fly-ash as solid wastes per annum. Proper utilization

and management of fly-ash waste has become a major environmental problem for a country like India. In comparison to other countries the value added fly-ash utilization in India is only 3-5 percent. Rest is being used for landfilling as fly-ash dykes. Further, increasing demand of energy, ever increasing pollution and depletion of conventional energy sources exert pressure for harnessing safer, cheaper alternative sources of energy. The fly ash dykes can be rehabilitated by growing hardy plants. Cultivation of promising bio-diesel crops like *Jatropha curcas* is a double term environmental benefit. The present work was aimed to evaluate the growth performance of *J. curcas* in fly-ash contaminated soil. The pot experiments were conducted at different levels of fly-ash as 0, 50 and 100 % by w/w ratio. At the same time different fly-ash pots were treated with varying combinations of *Jatropha* cake, *Neem* cake and garden soil. The data on germination, growth rate, root shoot morphology, leaf size, biomass etc were collected for 60 days. The study revealed that best growth performance was observed in plants grown in fly-ash treated with garden soil, *Jatropha* and *Neem* cake followed by the plants grown in fly-ash or garden soil alone. In the case of fly-ash treated with *Jatropha* cake, maximum growth was observed in a combination of 50 % fly-ash + 10 % garden soil + 40 % *Jatropha* cake.

Key words: Fly-ash, *Jatropha curcas*, thermal power plants, biomass, neem cake, *Jatropha* cake

SVII/P-66 Study of Cadmium Tolerance in *Vallisneria spiralis* : An Aquatic Submerged Macrophyte

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Cadmium from various anthropogenic sources finds its way to water bodies and often proves very toxic to aquatic plants, as it is a non-essential metal. Hence, in order to test the tolerance level of the aquatic submerged macrophyte *Vallisneria spiralis* commonly growing in water bodies, this study was carried out. The plants were treated with different concentrations of Cd (0.1, 1, 10, 25, 50, and 100 mM) for different exposure durations (24, 48, 72, 96 hr).The plant treated with 10% Hoagland solution without any metal treatment served as control. The harvested plant materials were subjected to analysis of various biochemical parameters like chlorophyll, protein, cystein, and non-protein thiol (NPSH).

The results revealed that Cd exposure for 24hr did not affect the chlorophyll (*a, b*) content at 0.1mM concentration. However, the pigment content decreased in a concentration and duration dependent manner at higher concentrations. Similar trend was also observed in the case of protein content. But in contrast to chlorophyll and protein, the cystein and NPSH contents enhanced with increasing concentration till 10 mM and then decreased. This trend was observed till 72hr exposure. However, at 96hr exposure, there was a decrease in their contents even at concentration <10 mM Cd. At higher concentrations of Cd (>10 mM), both cystein and NPSH decreased in a concentration and duration dependent manner. It seems that plants of *Vallisneria spiralis* are tolerant to moderate Cd concentration and may be useful for phytoremediation studies.

Key words: Cadmium, *Vallisneria spiralis*, protein, chlorophyll, cystein, NPSH

SVII/P-67 Effect of Sewage Sludge Amendment on Yield and Heavy Metal Accumulation in *Beta vulgaris* Plants

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Use of sewage sludge, a biological residue produced from sewage treatment processes in agriculture field is an alternative disposal technique. Sewage sludge contains organic carbon and inorganic nutrients responsible for ameliorating soil characteristics. However, heavy metals present in the sewage sludge restrict its uses in land application due to risk associated with food chain contamination. To study the usefulness of sewage sludge amendment for Palak (Beta *vulgaris* L var allgreen H-1) and consequent heavy metal contamination, a pot experiment was conducted by mixing sewage from sewage treatment plant (S.T.P.), Dinapur, Varanasi at 20 and 40 % (w/w) amendment to the garden soil. Mean concentration of Cd and Cu in the sewage sludge was found to be above the permissible limit recommended by Ministry of Environment and Forest, whereas Zn, Cr, Pb and Ni were below the permissible limits. Sewage sludge amendment had no impact on root biomass at both the ratios, whereas shoot biomass decreased significantly at 40% sludge amendment. Leaf area and root length decreased significantly with increasing sludge amendment ratio.

Heavy metal accumulation in shoot varied with different heavy metals and amendment ratios. Zn and Cu were highest at 20 % sludge amendment, whereas Cd was highest at 40% amendment. Pb and Ni concentrations in shoot also increased with the increasing sludge amendment ratio in the soil. In root heavy metal accumulation increased with increasing sludge amendment ratio. The Cd and Ni concentration in the edible portion of palak was found to be above the Indian Standard. The study concludes that sewage sludge amendment in soil for palak may not be a good option due to risk of contamination of Cd and Ni in higher amounts and also due to consequent decline in biomass accumulation at mixing ratios used during the present study. Since yield was not significantly reduced at 20 % amendment and a lower accumulation of heavy metals was also observed, lower application rates may be tried for palak if grown on sludge-amended soils.

Key words: Sewage sludge; heavy metals; accumulation; growth; biomass

SVII/P-68 Phytoremediation of Radionuclides by Vetiver Grass

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The long half life of some of the radionuclides and the biological availability through food chain pose potential threat to all living organisms including humans. Hence, it is essential to effectively remove the radionuclides from contaminated soil and solutions. Strontium-90 (^{90}Sr) and Cesium-137 (^{137}Cs) are the major fission products present in the low level radioactive waste. Phytoremediation is one of the methods for concentration of radionuclides and toxic metals from soil/water and is gaining importance due to its ecofriendly nature. Vetiver grass (*Vetiveria zizanoides* L. Nash), known for its high biomass with deep penetrating massive root system, has been used for soil conservation and environmental remediation, recommended by World Bank. *In vitro* grown *V. zizanoides* plantlets when tested for their potential to remove ^{90}Sr (3×10^3 KBq/L) and ^{137}Cs (1×10^4 KBq/L) from solutions spiked with individual radionuclide showed that significant amounts of ^{90}Sr and ^{137}Cs could be removed from solutions within a period of 7 days. When both ^{90}Sr and ^{137}Cs were supplemented together to the solution, uptake was slightly reduced. The presence of K^+ and NH_4^+ ions reduced the uptake of ^{137}Cs, while ^{90}Sr accumulation was found to decrease in the presence of Ca^{2+} ions. Naturally grown (large sized) plants were subjected to low level radioactive waste (Gross â,ã activity = 66 KBq/L) and found effective in remediation of radioactive elements from it after 15 days of exposure. The results of the present study indicate that *V. zizanoides* may be good candidate plant for phytoremediation of ^{90}Sr and ^{137}Cs. Based on the outcome of the present study, field experiments have been planned to evaluate the performance of the plant in real conditions.

Key words: Phytoremediation, ^{137}Cs, ^{90}Sr, *Vetiveria zizanoides*, nuclear waste

SVII/P-69 Effect of Ozone on Some Medicinal Plants

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Effect of ground level ozone was first observed on tobacco, a medicinal plant. Subsequently, lot of studies have been carried out using crop plants. Except tobacco and eucalyptus, information on the effect of ozone on medicinal plants is not available. Medicinal plants are distinct from others plants in terms of their secondary metabolites and in possessing unique range of alkaloids. This study was taken up to evaluate the effect of ozone on four medicinal plants, namely, *Ocimum sanctum* var. green, *O. santum* var. shyama, *Mirabilis jalapa* and *Lantana camara.* Plants of these species were raised in the nursery and were fumigated with 150 mg m^{-3} of ozone for 2 h each for 12 days (3600 mg m^{-3} of ozone) in dynamic glass chambers. Ethylene diurea (EDU), a specific ozone protectant, was used as a tool to assess ozone stress on these medicinal plants. Aqueous solution of 400 ppm EDU was applied three times, using soil drench method. Plants were kept in ambient environment where ambient ozone concentration varied between 29.22 to 40.06 mg m^{-3}. Plants of all the four species were adversely affected. Ozone adversely affected shoot length, number of leaves, leaf area, biomass, membrane permeability, chlorophyll and ascorbic acid content. *O. sanctum* var shyama was most adversely affected and *L. camara* was least affected. EDU being an ozone protectant is supposed to have beneficial effect on plants in the presence of ozone. This was observed in case of *M. jalapa* and *L. camara*. However, contrary to this popular belief EDU had negative impact on the vegetative growth of both *O. sanctum* var green and shyama. Such anomalous response of EDU treatment, though not common, but has been reported in literature. Response of both the varieties of *O. sanctum* to the combined treatment of ozone exposure and EDU application was same though the response of *O. sanctum* var. shyama was more severe.

Key words: Ozone, medicinal plants, EDU, *Ocimum sanctum*, *Mirabilis jalapa*, *Lantana camara*

SVII/P-70 Metabolic Effects of Boron Stress in Cultured Zygotic Embryos of Maize

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Zygotic embryos of maize (*Zea mays* L.) cv. Satha, excised from imbibed mature seeds, were cultured *in vitro* at variable boron in MS medium devoid of growth regulators. Plantlets, developed after 7 days in culture, showed best growth at 0.1 mM B that was treated as control. Compared to the control, growth of the embryos was decreased both by deficiency (0.01 mM) and excess (0.5 mM) B stress. The decreased growth at deficient B was accompanied by increased activity of starch phosphorylase and proteinase in shoots with marked decrease in protein content. Excess B however, decreased their protein content and starch phosphorylase activity but caused no change in proteinase activity.

Key words: B stress, maize, metabolic effects, proteinase, starch phosphorylase

SVII/P-71 Impact of Sugar Mill Effluent on Germination of Six Varieties of Cowpea (*Vigna ungiculata* L.) Seeds

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Sugar factory is one of the largest industry and it ranks fourth in the world. It causes greater amount of water pollution by discharging a large amount of wastewater as effluent. These effluents are usually disposed into nearby water bodies and make them polluted. Due to scarcity of water for irrigation, these polluted water is being irrigate their crops. So, the present investigation has been carried out to find out the suitable variety for tolerance to sugar mill effluent.

In the present study, the six varieties of cowpea were screened for their tolerance to sugar mill effluent. Studies were also conducted to find out the variation in morphological and chlorophyll content of tolerant variety. The higher concentrations of sugar mill effluent decreased the germination, growth, dry weight, chlorophyll content of cowpea. However, the lower concentrations of effluent promoted these parameters.

Key words: Sugar factory, wastewater, effluent, cowpea, tolerant variety

SVII/P-72 Response of Crops and Their Varieties for Tolerance to Dyeing Industry Effluent

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Tiruppur, a textile city in Coimbatore district of Tamil Nadu, is famous for the productions of Banians and T-shirts. It produces 90% of knit wear in India and contributes 52,000 million Indian rupees every year as foreign exchange. There are 800 bleaching and dyeing units in Tiruppur. Most of them are located on the banks of the river Noyyal. A large volume of waste water (49,00,000 liters per day) discharged into the Noyyal river. An average of 150 to 175 liters of waste water released for every kg. of fabrics produced. The polluted river water is being used for irrigation. So, the present research work was conducted to study the response of same crop plants and their varieties for tolerance to Textile dye industry effluent. The germination percentage, seedling growth and dry weight of crops such as Blackgram *(Vigna mungo),* cowpea *(Vigna unguiculata),* paddy *(Oryza sativa* L.*),* groundnut *(Arachis hypogaea* L.*),* and greengram *(Vigna radiata. L),* were examined and recorded. In addition to the response of their varieties for tolerance to textile dyeing industry effluent were also tested and recorded.

Key words: Bleaching, dyeing units, Noyyal river, *Vigna, Oryza*, *Arachis*, industry effluent

SVII/P-73 Growth and Yield Response of Blackgram Varieties for Tolerance to Chromium Toxicity

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Pollution of our water environment is increasing tremendously due to discharge of large quantities of effluents from various industries. Heavy metals present in the industrial effluent play an important role in polluting the environment. Among heavy metals, Chromium occupies prominent position and it is released from various industries such as chemical fertilizers, tanneries, electroplating and textile industries. The

industrial wastewater containing chromium is being used for irrigation. So, the present research work has been carried out to find out the growth response of blackgram varieties to chromium toxicity.

A germination study was conducted with ten varieties (ADT.5, C0.2, C0.5, C0.593, LBG.20, T.9, TMV. 1, TMV. 942, Vamban 2 and VBG. 28) of blackgram treated with different concentrations chromium. The seed germination percentage, seedling growth fresh weight and dry weight are taken into consideration and they decreased with increase of chromium concentration. In field experiments shoot length, root length, total leaf area, dry weight and yield were also recorded and these parameters are found to be reduced due to chromium treatment. Among the varieties studied, the variety T.9 showed the better performance in germination, growth and yield than registering their tolerance to chromium toxicity.

Key words: Chromium, black gram, seed germination, yield

SVII/P-74 Physiological Aspect, Biochemical Changes, Yield Production and Quality of Blackgram under Chromium Stress

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Due to its wide industrial use chromium is considered as a serious environmental contamination. Pollution of soil and water by Cr (VI) is of global concern. Blackgram (*Vigna munga L.* cv. PU 19), grown in refined sand, was studied to evaluate the interactive effect of Cr(VI) on physiological and biochemical responses. The plants were maintained in control nutrient solution for 40 d and them Cr as dichromate was added at concentrations of 0.05, 0.10, and 0.25 mM. A control set of plants was grown in the same nutrient solution without Cr. Plant showed smaller leaves which appeared diffusely chlorotic, and wilted with a loss of turgor and later hung down from the petiole. The leaves appeared faded and the newly emerged leaves showed chlorotic mottling. The affected leaves were reduced in size and leaf margins were dissected.

Increase in Cr concentration, caused deleterious effects on physiological and biochemical processes, relative water content and essential mineral nutrition concentration of chlorophyll *a, b* and total chlorophyll, Hill reaction activities, protein, starch, non protein nitrogen and sugars were as reduced, whereas the concentration of phenol and protein nitrogen increased on exposure to Cr. The Cr treatment increased the activity of ribonuclease while decreased that of catalase, peroxidase and acid phosphatase in leaves of blackgram. The translocation and uptake of S, P, Fe, Mn, Cu and Zn from root to tops were affected most significant by Cr (VI). The uptake of Cr in different parts of blackgram plants were found to be variable in response to its exposure. Importance of these findings will be discussed in relation to safe use of Cr polluted effluent / water in agricultural fields.

Key words: Blackgram, chromium, nutrients, enzymes, uptake, translocation

SVII/P-75 Physiological and Biochemical Responses of Paddy (*Oryza sativa* cv. IR-36) to Coal Wishery Effluent

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Coal mining activity has resulted in the generation of huge quantities of waste containing elevated concentration of trace elements. The discharge of untreated effluent contaminate the ground water and also affects agricultural lands and vegetation. Since the rice is one of the main crops growing in the vicinity of coal mines, the effluent is likely to have adverse impact on its productivity and quality. Therefore the present study was undertaken with the objective to generate a baseline data on phytotoxic effects of coal washery effluent (CWE) Jharia, Jharkhand on agriculturally importance crop, Paddy (*Oryza sativa* cv. IR-36). The plants were cultivated in refined sand with pH about 6.8-7.0, at ambient temperature, in a controlled glasshouse condition. The plants were grown in control nutrient solution for 25 d and then after treated with CWE at 10, 30, 50, 75, and 100% concentrations. A control set of plants was grown in the same nutrient solution without CWE. The physico-chemical characteristics of the CWE were analyzed and it was found that the value of pH, chloride, nitrates, hardness, sulphate, phosphate, Fe, Mn, Cu, Zn, Cr, Cd, Co, Ni, S, and P were much higher than the recommended limits. The impacts of CWE were studied on physiological and biochemical parameters of paddy plants. Increase in the concentration of CWE decreased plant growth, dry matter, and relative water contents (RWC). The plants showed visible effects within 12 d of CWE treatment, young expanding leaves showed moderate pale yellow colour with interveinal chlorosis that appeared initially in basal portion of expanding leaflets. The number and size of leaves reduced, development of tillers restricted, and ultimately formation of inflorescence was slightly retarded. The poor development of roots in excess CWE treated rice is substantiated by decrease in root weight at all stages of determinations. High CWE concentration decreased the concentration of chlorophyll, catalase, ribonuclease, protein, S, Mn, Zn, Cu, and Fe, while the concentration of peroxidase, acid phosphatase, P, Cr, Cd, Ni, Co, and Pb increased. The formation and development of grains were inhibited by excess CWE as most of the glumes were empty due to poor grain filling. Importance of these findings will be discussed in relation to safe use of CWE in agriculture. The results clearly indicate the use of CWE for irrigation of agricultural crops poses considerable risk.

Key words: CWE, *Oryza sativa*, heavy metals, metabolism, accumulation, yield quality

SVII/P-76 Detrimental Effects of Chromium Toxicity on Growth, Yield and Metabolism of Rapeseed

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Chromium accumulation and its effect on certain metabolic activities of rapeseed (*Brassica campestris* L.; yellow mustard) were investigated under controlled glasshouse conditions. Initially, plants were maintained in all essential macro and micro nutrients for 38 d and then after chromium was added at 0.05, 0.10, 0.20, 0.30 and 0.40 mM concentration as dichromate. One set was allowed to grow as such, which served as control. Chromium caused visible phytotoxic lesion of interveinal chlorosis. At chromium levels >0.2 mM plants were permanently wilted and dry followed by premature leaf fall, the affected leaves were reduced in size and leaf margins were dissected. The development of chlorosis in the leaves was comparatively delayed in plants growing at low level of Cr supply. In contrast, excess Cr significantly decreased the plant height, leaf area, fresh weight, dry weight and yield production. Excess Cr also decreased the relative water content (RWC) in leaves of rapeseed. The higher accumulation of Cr in root than shoot was recorded at all the levels of chromium. Concentration of chlorophyll *a, b* and protein were reduced by exposure to Cr. The activity of catalase and Hill activity in leaves were decreased. Concentration of Fe decreased in seed, husk, leaves and stem and increased in root. Increase in the concentration of S and P were observed in all plant part. With increase in Cr supply, the number of mature pods decreased and there was reduction in grain quality and production. Results showed that Cr accumulation is inhibitory to me-

tabolism and a contributory factor in phytotoxic lesion of the plant. It is concluded that this plant may be useful in combating low Cr stress and to serve as an early indicator system for predicting Cr toxicity of the environment.

Key words: Rapeseed, chromium, phytotoxicity, RWC, metabolism, catalase

SVII/P-77 Heavy Metal Removal from Secondary Treated Municipal Wastewater using Aquatic Macrophytes

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Traditional sewage treatment plants with secondary treatment facilities are not able to remove heavy metals from the wastewater. In Varanasi sewage is mixed with industrial effluents containing high concentration of heavy metals such as Cr 1.2±0.019, Cd 0.09±0.04, Cu 0.11±0.02, Zn 0.920.025, Fe 1.8±0.030 and Ni 0.053±0.004 mgL^{-1}. *E. crassipes, P. stratiotes, L. minor, A. pinnata* and *S. polyrhiza* were tested for their heavy metal removal capacity from the secondary treated municipal wastewater. The preferential sequence of percent removal by the selected aquatic macrophytes was Fe > Cr > Cu > Cd > Zn > Ni. *E. crassipes* was recorded most efficient plant among the selected plant species. *Eichhornia* removed 70.5±4.4, 69.1±3.9, 67.9±1.4, 66.4±3.45, 65.3±2.4 and 55.4±2.9 percent Fe, Cr, Cu, Cd, Zn and Ni respectively. Statistical analysis revealed positive and significant correlation between percent removal of heavy metals from the wastewater and increase in the plant tissues.

Key words: Municipal wastewater, heavy metal, macrophytes, phytoremediation

SVII/P-78 Physico-Chemical and Microbial Studies of Sugar Mill Effluent and Their Impact on Ground Water Quality

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By the physico-chemical and microbial investigations of sugar mill effluent it is indicated that it's effluent is regularly polluting the ground water content near the industrial area of Balrampur. Balrampur Chini Mill (BCM Ltd., U.P.) is the largest sugar factory of India with the production point of view; its effluents carry a huge load of various pollutants including organic and inorganic pollutants and after percolation into soil disturbing the ground water qualities and soil properties. This is indicated through ES, TDS, total hardness in terms of $CaCO_3$, BOD, COD, ions such as calcium, potassium, bicarbonate, chloride and nitrate level values, which are on the higher side of permissible limits of WHO standards. Microbial studies revealed the presence of specific fungal species such as *Aspergillus erythrocephalus, Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Fusarium solani* and *Trichothecium roseum* which are capable of growing in higher concentration of bicarbonate and nitrates and in turn serve as indicator for different types of pollutants. MPN test is positive in all the water samples tested for the present study.

Key words: Sugar mill effluent, organic, inorganic, fungi, MPN test

SVII/P-79 Effect of Nutrients on Post-Drought Recovery in Clonal Varieties of Tea [*Camellia sinensis* L. (O) Kuntze]

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Effect of various nutrients (K, Ca, Mn and B) on the post –drought recovering tea cultivars was tested. Once new foliage appeared on rehydration preceded by drought imposition, they were sprayed with nutrient once in a week for four weeks. Leaves were sampled after every 10d for 30d. Foliar spray of nutrients on post –drought recovering clonal varieties of tea suggested an increased potential of plants to recover and resume growth after rehydration preceded by 20d of imposed drought stress. The rehydration recovery process was found to be enhanced with nutrient treatments in terms of increased antioxidants, both enzymic (SOD, CAT, GR, POX, PPO etc.) and non enzymic (ascorbate, glutathione, total phenolics etc.). Increased recovery potential due to nutrient treatments was also supported by decrease in H_2O_2 content and lipid peroxidation. Thus, it can be suggested that antioxidant efficiency and biochemical potential of rehydration recovering tea cultivars was improved by the tested nutrients. Based on the individual response of the nutrients in improving recovery potential, their effectiveness can be arranged as – Ca>K>Mn>B. The interactive effect of these nutrients needs to be tested.

Key words: *Camellia sinensis*, post-drought recovery, nutrients, antioxidants

SVII/P-80 Cytotoxic Effect of *Chromolena odorata* Leaf Lechates on *Allium cepa* L.

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Chromolena odorata L. syn. *Eupatorium adenophorum* Spreng locally known as "Banmara" or "Kalijhar" is an exotic weed species growing predominantly in the forest of Western Ghats. It causes chronic pulmonary disease in horses and hapatotoxicity in mice. Hence, the present investigation was undertaken to study the cytotoxic effect in onion (*Allium cepa* L.) using *Allium* test. This test is used as a standard test in environmental monitoring. In present study, the parameters like per cent seed germination, seedling survival, root and shoot length, mitotic index were studied. The overall results indicated that the allelochemicals present in the leaf lechates of *Chromolena odorata* L., were able to induce various types of abnormalities.

Key words: *Chromolena odorata, Allium* test, cytotoxicity

SVII/P-81 Cadmium Induced Oxidative Stress and DNA Damage in *Bacopa monnieri* L.

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Wastewaters containing hazardous metals and genotoxicants, contaminate wetlands. Cadmium (Cd), a non-essential metal, is a carcinogen and major contaminant of wetlands. Certain aquatic plants accumulate toxic metals. Metal accumulation could modify some vital activities of plants. These plant responses could be instrumental in detection of eco- toxicity of metal pollutants. In the present study, a common wetland plant, *Bacopa monnieri*, was exposed to 0.01-500 ìM cadmium for 18h to determine the cadmium induced responses including

DNA damage. Cadmium was observed to accumulate in tissues (roots>stem >leaves) of *B. monnieri*

Cd induced lipid peroxidation, loss in membrane permeability and decline in catalase and guaicol peroxidase activities in leaves and roots of *B. monnieri*. Comet assay revealed, a concentration dependent DNA damage (ANOVA, p> 0.05) as indicated by increased Olive tail moment, tail DNA and tail length in nuclei of leaves and roots of *B. monnieri* exposed to Cd. DNA damage was more prominent in nuclei of roots than leaves. DNA damage in *B. monnieri* might be attributed to the oxidative damage caused by reactive ion species generated by cadmium. These observations suggest that *B. monneri* could serve both as a model organism for ecogenotoxicity studies as well as bio-indicator for environmental risk assessment.

Key words: Wetland, *Bacopa monneri,* cadmium, oxidative stress, comet assay, DNA damage

SVII/P-82 Changes of Photosynthetic Pigment Concentration and Specific Leaf Area by Applying Bio-Fertilizers

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Environmental protection is attributed an increasingly important role for the mankind towards sustainable environment. Artificial fertilizers may influence the structure and composition of natural plant communities that are to be strictly protected and preserved. Nevertheless, the incorrect application of artificial fertilizers does not only cause environmental and conservational problems, but raises health issues, as well. Bio-fertilizers have the potential to decrease environmental impacts by means of exercising positive effects on plant production. Bio-fertilizers containing less artificial compounds and plant growth promoting bacteria are proper means to reduce or prevent environmental damages.

The effects of three bio-fertilizers (Phylazonit MC®, BioNitroPhos®, Bioplasma®) and different reduced nitrogen concentrations were examined on the photosynthetic pigment concentration and changing of specific leaf area (SLA) in corn seedlings under controlled conditions. Every bio-fertilizer had an increasing effect on the level of photosynthetic pigments. The applied bio-fertilizers were more effective when the treatments were started on the first day of the experiments. Chlorophyll-a/chlorophyll-b ratios decreased under the effect of bio-fertilizers due to the increased level of chlorophyll-b concentration. The amount of carotenoids did not change significantly. In the case of Phylazonit MC® and BioNitroPhos®, the specific leaf area increased by 10% with the respects to the fact that the applied time of treatment did not cause significant differences, except for BioNitroPhos. In this latter case, the SLA value of later treatments was higher by 13% than when the treatments were started on the first day of experiment. Bio-fertilizer can compensate for the nitrogen deficiency in both nitrogen concentrations used. According to this foregoing, these bio-fertilizers can enhance production by increasing the photosynthetic pigment concentration and the efficiency of photosynthesis.

Key words: Photosynthetic pigments, chlorophyll, carotenoid, SLA, bio-fertilizer

SVII/P-83 Phytoremediation Modeling for Heavy Metal Contaminated Soils

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Phytoremediation is an emerging low cost technology, which involves plants and their rhizospheric microorganisms to remove, degrade or contain pollutants located in the contaminated sites. Progress in this field is hindered due to complex interactions in the rhizosphere and plant-based mechanisms that allow contaminant translocation and accumulation in plants. In this study, a numerical model is developed to investigate the fate and transport of contaminants in vegetated soils. The model comprises three modules. The first module simulates the spatial and temporal distribution of soil-moisture pressure heads under the influence of water extraction by the plants roots. Moisture content distribution and pore water velocity are obtained from the soil-moister pressure heads. The second module predicts the fate organic matter, biomass, and heavy metal contaminants by using mass transport equation. Finally, the third module forecasts the time required to restore the contaminated sites under different field conditions. The model yields a set of partial differential equations, when solved numerically could provide vital information towards sustainable land development strategies.

Key words: Phytoremediation, mathematical modeling, soil remediation, rhizosphere, heavy metals

SVII/P-84 Physiological Response of *Chlorella* Isolate to Chromate from Paper Effluents

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The unicellular, non motile green alga obtained from the effluent disposal site of paper-pulp industry (Pune), was growing in presence of 30 µM chromate. The morphological and 18S rDNA (NS 12 region) analysis confirmed that it belonged to *Chlorella*. This isolate was causing decrease in chromate concentration in the medium. It was due to the presence of chromate reductase activity in the live cells. The uptake studies with radioactive ^{51}chromate showed that only 12% of the total chromium was associated with cells. The chromate was not affecting the rate of photosynthesis, these cells when observed under TEM (200 µM for 24 hrs.) showed large starch granules but it was drastically affected when the cells were exposed to 200 µM chromate concentration for 96 hrs. The overall studies revealed that this isolate of *Chlorella* had the capacity of uptaking and reducing the chromium. However, very higher concentration of chromate was having the adverse impact on its physiology. Further studies regarding its application in phyto-remediation are in progress.

Key words: *Chlorella*, chromate, chromate reductase, paper effluents

SVII/P-85 Growth and Yield of Paddy Crop under Fly-ash Stress: Role of BGA Biofertilizer Application

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Fly-ash is an amorphous ferro alumino silicate having toxic metals like Pb, As, Co, Zn and B etc. Fly ash contains many nutrients elements essential for plant growth but it is deficient in nitrogen and available phosphorous contains. Various nitrogen fixing cyanobacterial strains have been found to increase the available nitrogen and phosphorous content of fly ash which can permit subsequent growth and development of the paddy crop. During the field experiment the rice variety Saryu-52 treated with different doses of fly-ash (FA), showed marked difference in growth parameters and yield attributing characters of paddy e.g., maximum number of tillers (tillers per hill), plant height (cm), root biomass (g per hill), grain weight (g per hill) and straw weight (g per hill) have been enhanced in fly-ash @ 10 t ha^{-1} along with BGA. Higher doses of fly-ash (@ 100 t ha^{-1}) resulted in toxicity to

paddy *vis-à-vis* various crop parameters. During the biochemical analysis of paddy it was observed that chlorophyll, carotenoid and protein content increased at lower doses of fly-ash (10 t ha^{-1}) application, while decreased at higher doses (100 t ha^{-1}), however, at both these FA doses, application of BGA biofertilizer increased these parameters. Certain parameters which were associated with FA/metal tolerance such as cystein and non protein thiol (NPSH), were increased at various FA application. In fact, toxicity at 100 t ha^{-1} was ameliorated by BGA application in various combinations like FA@ 100 t ha^{-1} +12.5 kg ha^{-1} BGA and 100 t FA ha^{-1} +90 kg NPK ha^{-1} +12.5 kg ha^{-1} BGA. Thus, fly-ash treatment with BGA application resulted in enhanced Fe in seeds of Saryu-52 variety of rice. This would help in improving the Fe malnutrition/deficiency particularly in women, which is a matter of high concern.

Key worlds: Blue green algae, fly ash, rice crop SESSION VIII: CLIMATE CHANGE – PLANT PRODUCTIVITY and FOOD SECURITY

SESSION-VIII

Climate Change-Plant Productivity & Food Security

SVIII/L-1 The Biotron and Climate Change Research

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The impact of global climate change on the biosphere is difficult to assess scientifically with respect to cause and effect. This continues to lead to uncertainties and significant political and scientific debates concerning the validity of the phenomenon of global climate change. In part, these uncertainties arise as a consequence of the complexity of the spatial and temporal scales which characterize our biosphere as well as its inherent biodiversity. This complexity precludes the use of control experiments with which to establish cause and effect relationships on a global scale. Experimental climate change research attempts to overcome this limitation. This lecture will describe a new research facility located on the campus of the University of Western Ontario called 'The Biotron'. This international research facility has been established jointly by the University of Western Ontario and the University of Guelph and is dedicated to experimental climate change research on organisms as diverse as plants, micro-organisms and insects. A unique feature of 'The Biotron' is its central data storage and image analyses facility which allows for remote access to experimental data in real time. The capacity to perform controlled experiments from the molecular scale to the mini-ecosystem scale will be described.

Key words: Climate change, microorganisms, ecosystem

SVIII/L-2 Global Climate Change and Food Security in a Growing World

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Clearly the chemical and the physical climates of the earth have changed during the last millennium. Human generated air pollution has become a global problem. During this century, shifts in population, industrial and urban growth and consequently pollutant emissions will increase in the developing countries (e.g., Asia). Air quality and its impacts on human health and the environment will be key factors. In addition, increasing human consumption of food and changes in water resource availability will shape our future.

Some developing countries are producing food per capita that is only 25% of the corresponding amount in the developed countries. By the year 2030, the populations of India, the US and the world are expected to increase by roughly similar numbers (25-30%). Currently, one half of the global population is in rural communities and one third of the population is associated with agriculture. However, by the year 2030, only one tenth of the change in total global population is expected to be associated with agriculture.

In the last 50 years mega-cities (>10 million population) have grown from two to twenty eight and that trend is expected to continue. While the US ranks first in the area of land under cultivation of crops developed through biotechnology, India ranks seventh. At present, the US, Canada and the Oceania are the wealthiest by the region and in contrast Sweden is the best in giving to others.

These are some examples of the present and the forecasted future world and food security. In that context, deteriorating air quality and changing climate will play a critical superimposing influence on how our future will be shaped.

Key words: Climate change, food security, pollutants

SVIII/O-1 Physiological Response of Some Conifers to Environmental Changes

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Conifers are the evergreen trees capable of growing under wide range of climatic conditions. Present investigation was carried out to know the physiological responses of conifers when they are growing under conserved natural habitat of Botanic Gardens in North West Part of India. The environment of this part of India is not suitable for gymnosperms and particularly for conifers to grow and flourish well. So present study is carried out to keep this in mind that what physiological changes occur in these conifers so that they grow and reproduce very well in present habitat. For this, four conifer species viz. *Thuja orientalis, Juniperus chinensis, J. prostrata* and *J. variegata* has been selected. Pronounced Bud Extension Rate (BER) has been observed during spring and late summer in all these species. Chlorophyll content has found to be highest in spring when environmental conditions are very much favourable for any plant to grow. At biomass production level favourable season found to be from July to September when some of these species have shown transfer of vegetative phase to reproductive phase. The period ending with bud burst in September has been characterized with pronounced chlorophyll degradation with rise in biomass, whereas starch has been hydrolysed during fall and dormant conditions imparting cyclic adjustments and readjustments during extreme environmental conditions of winters in these conifers.

Key words: Conifers, temperature stress, total chlorophyll, bud extension rate

SVIII/O-2 Effects of Supplementary UV-B Radiation on Growth, Physiology and Gentiopicroside Content of *Gentiana macrophylla* Pall., a Chinese Herbal Drug

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Gentiana macrophylla has been used as a herbal drug for about 1000 years in Chinese traditional medicine and gentiopicroside is regarded as its effective components. To improve the industrialization of *Gentiana macrophylla* Pall. in Shaanxi province, we tested the impacts of appropriate supplement of UV-B radiation on physiology, growth and quality of *Gentiana macrophylla* Pall. under field condition.

The UV-B supplementary dose was 2.18 $kJ.m^{-2}.d^{-1}$ and 3.36 $kJ.m^{-2}.d^{-1}$ respectively from 9:00 to 17:00 everyday during growing season (from May to Oct). The results showed that supplementary UV-B radiation had a little effect on growth but positive effects on quality of biennial *Gentiana macrophylla* Pall. The height, root weight, total biomass, content of total chlorophyll and chlorophyll *a* decreased slightly but not significantly ($P>0.05$) when compared to ambient controls in growing season. The growth of two treatment groups were less influenced especially with the continuance of UV-B radiation. In addition, the content of UV absorbing compounds and soluble protein and PAL enzyme activity of the both treatments were increased as compared with controls. Those positive effects which should be a defense way of plant to the supplementary radiation, had guaranteed the growth of *Gentiana macrophylla* Pall in a certain degree and had increased content of gentiopicroside. The reason of reduction of soluble sugar content may be that resource allocated more to secondary metabolism under supplementary UV-B radiation. In a word, we can promote the content of gentiopicroside in *Gentiana macrophylla* Pall. by supplementing proper UV-B radiation.

Key words: UV-B radiation, *Gentiana macrophylla*, growth, physiology, gentiopicroside

SVIII/O-3 Simulating and Upscaling Greenhouse Gas Emissions from Indian Rice Fields Using the DNDC Model

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The Denitrification and Decomposition (DNDC) model was evaluated for its ability to simulate methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2) emissions from Indian rice fields with various management practices. The model was calibrated and validated for field experiments in New Delhi, India. The observed yield, N uptake and greenhouse gas (GHG) emissions were in good agreement with the values predicted by the model. The model was then applied for estimation of GHG emissions from rice fields in India using a newly compiled soil/climate/land use database. Continuous flooding of rice fields (42.25 million ha) resulted in annual net emissions of 1.07-1.10, 0.04-0.05 and 21.16-60.96 Tg of CH_4-C, N_2O-N and CO_2-C, respectively, with a cumulated global warming potential (GWP) of 130.93-272.83 Tg CO_2 equivalent. Intermittent flooding of rice fields reduced annual net emissions to 0.12-0.13 Tg CH_4-C and 16.66-48.80 Tg CO_2-C while N_2O emission increased to 0.05-0.06 Tg N_2O-N. The GWP, however, reduced to 91.73-211.80 Tg CO_2 equivalent. The study suggested that the model could be applied for estimating the GHG emissions and the influences of agronomic management, soil and climatic parameters from rice fields in India.

Key words: Global warming potential, methane, nitrous oxide, carbon dioxide, agriculture

SVIII/O-4 Rising Atmospheric CO_2 and Crop Response Study; Technology and Research; South Asian Efforts

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Global climate changes are unique challenges to agriculture. Anthropogenic accumulation of carbon dioxide is an important global issue of present time which effectively influences the productivity of crops. South Asian region, including India, depends on agriculture particularly crops for their food security. Author started impact assessment analysis of crop responses to the rising atmospheric CO_2 under a National Fellow Project of Indian Council of Agricultural Research New Delhi, India.

Open Top Chambers were designed and made for South Asian Climate conditions at Indian Agricultural Research Institute, New Delhi. Author has also contributed significantly to establish a simple cost effective **MID FACE** facility at Indian Agricultural Research Institute, New Delhi, India for South Asian region along with a neighbouring Institute, National Physical Laboratory, New Delhi and Italian group of scientists. This facility is developed to meet the needs of the agriculture science community of the South Asian countries. The addition of this facility has brought India on the GCTE CO_2 research Network of IGBP, which is active in technology vulnerability issues and adaptation strategies for meeting rising global food demand in the face of global environmental changes.

Crops, (*Brassica* and Rice) responded to elevated CO_2 significantly under water stress conditions ameliorating the adverse stress effect on growth and water relation in *Brassica* species. It increased the rate of photosynthesis, stomatal resistance, promoted greater foliage, more number of silique and increased root growth. It also helped to develop defense system of anti-oxidative enzymes to combat the oxidative stress caused by drought. Stress induced adverse effect on grain weight, its carbohydrate and oil contents in *Brassica* seeds were significantly ameliorated by elevated CO_2 due to sequestration of carbon and improved water status. Anatomical studies, using transmission electron microscopy, showed a significant increase in the thickness of epidermis, size of chloroplast and number of starch granules per chloroplast bringing enhancement in storage site for excessive starch, avoiding the disruption of chloroplast ultra structures by starch overloading. Genetic transfer of CO_2 responsive characters such as photosynthesis and productivity in *Brassica oxyucamp* hybrid from *B. campestris* was done using embryo rescue technique. Studies on the response of rice cultivar Basmati and P. 677 to the elevated CO_2 showed increase in the growth, leaf area, tillering and root growth. The increase was also observed in the process of photosynthesis and seed yield. The international programme in India on global climate change research provided an inter-disciplinary framework for global change science and in training scientists from various South Asian countries and research centers from India, and conducting multi-country multi-disciplinary CO_2 crop response experimental studies at various locations in different South Asian countries.

Key words: MID FACE facility, GCTE, IGBP, *Brassica* species, silique, defense system

SVIII/P-1 Stomatal Conductance and Stomatal Density of Three Poplar Species at the End of and after Six Years of CO_2 Fumigation

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In EuroFACE facility in Tuscania, Italy, we measured *in situ* stomatal conductance (g_s) and stomatal density (SD) of *Populus alba*, *P. nigra* and *P.* x *euramericana* in the end of the sixth year of CO_2 fumigation (2004) and after the fumigation had ceased (2005). During the fumigation, trees of all three species grown under elevated CO_2 exhibited about 40% lower g_s. The effect of elevated CO_2 on stomatal density was much weaker; only the fertilised trees of *P.* x *euramericana* had slightly reduced total SD, mainly at their abaxial side. There was a steep vertical gradient in both g_s and SD for all species regardless of treatment, with higher canopy positions showing higher conductances and densities.

In first spring after the CO_2 fumigation had ceased, we attempted to find carryover effects on stomatal conductance by comparing gs and SD of early and late leaves, i. e. leaves originated from primordia already formed during fumigation and leaves which had entirely formed after fumigation, respectively. The overall values of both g_s and more notably SD were lower than previous autumn but with much less pronounced vertical gradients. Both g_s and SD were slightly but consistently lower on early than on late leaves. Regardless of changed absolute values, the reduction of g_s of about 40%, present last autumn, had been maintained. Again, we found no (previous-year) fumigation effect on stomatal density: patterns in g_s were closely reflected by the ratio g_s/SD. We conclude that the post-fumigation carryover of reduced stomatal conductance was due to factors which did not reside in leaves, suggesting reduced whole-tree liquid phase conductivity under elevated CO_2.

Key words: Carryover, free-air CO_2 enrichment, poplar, stomatal conductance, stomatal density

SVIII/P-2 Wood Properties of Aspen and Birch after Five Years of Exposure to Elevated CO_2 and O_3

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The aim of this study was to investigate the interactive effects of elevated CO_2 and O_3 on wood chemistry and structure of 5-year-old trembling aspen (*Populus tremuloides* Michx.) clones and paper birch (*Betula papyrifera* Marsh.) saplings. We had earlier studied juvenile wood properties after three years of exposure to atmospheric gas concentrations predicted for the year 2050, and had found that the wood properties of broadleaved trees were altered. In the present study, we examined if the changes observed were maintained over five years. Material for the study was collected from a FACE (Free-Air CO_2 Enrichment) experiment in Rhinelander, Wisconsin, USA, where the saplings had been exposed to four treatments: control, elevated carbon dioxide (560 ppm), elevated ozone (1.5x ambient) and their combination for five growing seasons.

Changes in stem wood structure and chemistry were observed under the exposure. In aspen, exposure to CO_2 induced a decrease in uronic acids (in hemicellulose) and an increase in stem diameter. Responses of acetone-soluble extractives and soluble sugars to elevated CO_2 were dependent on clone. Under ozone exposure, decreases of acid-soluble lignin, acetone-soluble extractives and vessel lumen diameter were detected. Effect of elevated O_3 on soluble sugars, fibre lumen diameter and cell wall percentage was depended on clone. In wood chemistry of paper birch, elevated CO_2 increased acetone-soluble extractives and decreased starch, while both were increased under elevated O_3. After five years of treatments, the responses of wood properties were changed especially in stem wood chemistry compared to results after three years of fumigation.

Key words: *Betula papyrifera*, climate change, *Populus tremuloides*, wood chemistry, wood structure

SVIII/P-3 Ozone and Crops in Mediterranean Climatic Conditions

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Ozone concentrations in the Mediterranean Basin are high enough to potentially harm crops, and they persist for periods up to 6 to 7 months above EU Ozone Daughter directive thresholds to protect vegetation. Exposures of different crops to low, ambient and enhanced ozone concentrations are being carried out in the East Coast of Spain since the beginning of the 90s. Some of the most important crops like watermelon, tomato and potato are being more deeply studied, and significant decreases in production, fruit quality, and above biomass and below biomass reductions, are being documented many times, accompanied of visible injury that in parallel was frequently observed in commercial fields. In particular, tomato and potato are being studied not only by means of OTCs exposures but also in field condition experiments (chamber less) taking into account how possible crop management practices can reduce the ozone effect in commercial fields in the Valencia Regions. Data from 3 years of ozone exposure experiments on different varieties of Potato including parallel chamber less and surveys to identify injury in larges areas are presented here. Results show that visible injury can frequently be recorded in the field, some of the most common varieties show injury every year (up to 20 varieties, including surveys in the south of Spain, showed injury with different intensities). When some of the varieties were exposed to different ozone concentrations (or regimes), low, ambient and enhanced ozone; significant reductions in above ground biomass and below ground biomass potato production were observed, as well as a change in the size distribution of the potatoes produced in each of the treatments (which can have important consequences in the commercialization). Since it is very unlikely that the ozone concentrations will be decreased to non harmful levels in the near future in the area, certain practices in the crop management is suggested and tested in order to protect the crop or reduced the observed effects. In that regard, results showed that the increments of compost additions in commercial farms may be a promising tool to reduce crop losses in the area were ozone concentrations are high.

Key words: Air pollution, ozone, plants, plant production, crops, visible injury

SVIII/P-4 Fossil Fuel Based Vehicular Emission Inventory for Delhi

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The unprecedented increase in the vehicular density, within the confines of NCR region of Delhi, has contributed towards the increase in the concentrations of criteria and no-criteria air pollutants in the ambient lower atmosphere. It has been estimated that almost 70 % of air pollution load is contributed to the consumption of vehicular fossil fuel. Keeping in view the impact of air pollutants on human health, plants and amenities it is essential to have their quantitative estimates to evolve abatement strategies. In general, to monitor the state of variability of ambient concentration of pollutants in lower atmosphere requires sophisticated online instruments located at strategically selected locations within the city; an expensive proposition indeed. However, the gross estimates of the pollution load emitted on account of the vehicular fossil fuel consumption by using the respective emission factors can provide a broad understanding about the likely load of pollutants. Adopting this approach we have quantified the estimates of yearly pollution load in Delhi. Further, by using box model concept the yearly estimates were used to quantify hourly pollution load by including the effects of average vehicular speed, city traffic pattern and meteorological factors. The estimates compare well with the concentrations measured by online monitoring equipments. Our calculations also infer that the changes in local meteorological parameters and diurnal change in the traffic flow pattern will significantly impact the ambient concentrations of air pollutants.

Key words: Vehicular emissions, fossil fuel, emission factor, Delhi, mixing height, traffic flow

SVIII/P-5 Impact of Elevated CO_2 on Two Selected Invasive Species: *Lantana camara* and *Parthenium hysterophorus*

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Concentration of CO_2 in atmosphere is increasing at an alarming rate in the present world. It has increased from 280 ppm to 365 ppm since the industrialization started (nearly 230 years ago). According to IPCC, CO_2 concentration will further increase upto 700 ppm within a century. This enhancement in CO_2 adversely affects the ecosystem by either affecting plant growth or due to climatic change. Plant response to CO_2 increase is not uniform and will be dependent on C_3/C_4 metabolism and many other factors. We investigated impact of enhanced atmo-

spheric CO_2 levels (700-760 ppm) on two invasive species *Lantana camara* and *Parthenium hysterophorus*. Compared with ambient levels, after 60 days of exposure to elevated CO_2 leaf number, leaf area and leaf weight of *L camara* increased by 83%, 260% and 251% respectively; whereas increase in the same parameters for *P. hysterophorus* was 171%, 105% and 525% respectively. Net assimilation rate (NAR) of CO_2 decreased for *L. camara* and *P. hysterophorus* by 30% and 25% respectively. There was no change in specific leaf area (SLA) due to elevated CO_2 in *L. camara* but it showed 54% decrease in *P. hysterophorus* while leaf weight ratio (LWR) showed just opposite pattern in both the species; it decreased by 12% in *L. camara* and an increase of 32% was found in *P. hysterophorus.* Leaf area ratio (LAR) decreased by 14% in *L camara* and 33% in *P. hysterophorus* whereas root: shoot ratio increased by 7% and 115% for *L camara* and *P. hysterophorus* respectively. Relative growth rate (RGR) for both the invasive species decreased in the elevated CO_2. It was 20% and 17% lesser in *L camara* and *P. hysterophorus* respectively. Elevated CO_2 caused reduction in rate of biomass gain as compared with ambient levels due to decreased LAR, which may be attributed to decreased LWR in *L camara* and decreased SLA in *P. hysterophorus.*

Key words: Elevated CO_2, growth response, invasive species, *Lantana camara, Parthenium hysterophorus*

SVIII/P-6 A Study of Carbonaceous Aerosols – Measurement Tailored to Climate Studies

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Evidence has been accumulating that the global mobilization of black carbon from natural and anthropogenic sources is responsible for significant chemical and physical effects in our atmosphere. These effects include participation in tropospheric chemistry, light scattering/ absorption (thus affecting earth's radiation balance), and human pulmonary health (as a constituent of respirable particles). While its quantitative impacts have not been fully delineated but increase in the concentration of carbonaceous aerosols has enhanced the heat trapping capability of earth atmosphere has been evidently proved. Combustion of fossil fuels and other human activities are the primary reason for increased concentration of carbonaceous aerosols (the magnitude of the direct Radiative forcing from black carbon itself exceeds that due to CH_4).

Through our study we have developed reliable methodology for the estimation of black carbon. With this methodology we will be able to detect black carbon concentration on any ambient sample by studying its spectral behavior. In the study spectral variation of the optical properties of the soot particles of different fuel types is determined. The implication of the wavelength dependence of black carbon absorption for the spectral behavior of the aerosol is discussed. The change in the absorption coefficient of pure black carbon and other mixture of BC and ambient aerosols is studied so that variation in absorption coefficient can be used to distinguish soot spectral behavior and aerosol type. Study also highlights the importance of measurement of spectral variation and absorption coefficient for the analysis of aerosol particles and determining its behavior in the atmosphere.

Key words: Carbonaceous aerosols, black carbon, climate change, spectral behavior

SVIII/P-7 Tree-Ring Studies in Tropical Trees in Relation to Climate Change in India

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The formation of growth rings in many of the Indian trees growing in subalpine, temperate and even in some of the tropical forests of Indian regions was known since long back (Gamble, 1902 Chaudhary, 1939). However datability of these growth rings to calendar year of their formation and their temporal relationship to climatic changes has been done mostly from the Himalayan conifers. These conifers are found mostly sensitive to variability pre monsoon temperature. Broad-leaved tropical trees, which occupy the major part of the Indian forest, seem to be potential for the analyses of monsoon variability. Several tree-ring samples from several broad-leaved species are collected from the diversified geographical region of India and among them so far only two taxa viz. *Tectona grandis* and *Cedrela toona* are found promising for tree growth climatic analysis. Temporal analysis of tree growth climatic relationship of tropical trees would also be useful in the management of forest especially to understand forest productivity.

Key words: Broad-leaved taxa, tree-ring, climate change

SVIII/P-8 Statistical Analysis of Stratospheric Ozone Column from 1957-2005 over Five Locations in India

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Ultra violet component of incoming solar irradiance reaching the ground is associated with adverse effects on human health and plants. UV-B component, if present, are absorbed by proteins and nucleic acids and consequently have adverse implications for all life forms. The amount of UV-B reaching the ground is closely coupled with the stratospheric ozone column. The spatial and temporal variability in ozone column, to a great extent, determines the extent of irradiance received on the ground. In this regard, the ability to predict the ozone column and consequently the UVB-irradiance reaching the ground is an important step. In this work we present the analysis of ozone column data, 1957-2005, in details to gain insight into the variability of ozone column. The analysis was done for five different stations in India [Srinagar ($34^0$05'N), New Delhi ($28^0$34'N), Varanasi ($25^0$18'N), Pune ($18^0$032'N), Kodaikanal ($10^0$14'N)]. Results from time series analysis indicate an overall increasing trend from the year 1957-2005. Results also show periodicity in ozone column data which can be correlated to the solar cycle.

Key words: Stratospheric ozone column, time series analysis, UV-B

LATE ABSTRACTS

LAVI/P-1 Watershed Management: A Key for Bio-Resource Conservation

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Indian soil base is facing a great pressure of human and live stock with the advancement of time. Because of non judicious and indiscriminate use of nature's gift i.e., land and water, they both have undergone deteriorating day by day. Arresting and reversing the process of ecological degradation and increasing production and income from arable lands on sustainable basis and preservation of agricultural and forest ecosystem should be given the top most priority in all programmes undergoing in the region. This would require collective thinking and joint efforts of planner, policy makers, research institution, NGOs and above all by the people.

Natural resource conservation should be at the core of land use planning in the Himalayas. The common property resource management, joint management of forests, equity issues and empowerment of women and landless are important issues, which should be interwoven in natural resource management programme.

Water shed approach emphasized to use the land according to its capability and maximize the infiltration and downward movement of precipitation to the place where it falls and allows the runoff to safe velocity.

The watershed management provides a systematic approach to manage our land, water, crops, livestock and livelihood in sustained manner. By adopting the watershed approach our natural resource base abd bio resource base can be conserved well which allows us a sustainable eco friendly biological production system.

Key words: Watershed management, conservation, sustainable

LAVI/P-2 Organic Farming: An Eco-friendly and Non-chemical Approach

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Indian agriculture has undergone a drastic change with the advent of green revolution in mid sixties, transforming the country from a food scarce to a food surplus nation. The major thrust of the green revolution was to ensure maximizing food grain production through a package of practices viz., ensuring assured irrigation and application of higher doses of chemical fertilizers to tap the potential of high yielding crop varieties under a constant plant protection umberella. The food grain production increased from 50.82 million tones in 1950-51 to 209.8 million tones in 1999-2000 but these achievements have been made by an intensive use of chemicals and chemical fertilizers. The fertilizers consumption shot up from 69.8 thousands in 1950-51 to 18,372 thousands tones in 1999-2000 and consumption of chemicals like pesticides went up to the level of 80,659 MT in 2000-2001 from a mere 2,330 MT during 1950s.

As a result the intensive use of chemical fertilizers in post green revolution era led to growing ill effects on human health, degradation and fluctuation in ground water, land and various other ecological threats. The overuse of chemicals to intensify crop production led to poisoning people and animals as well as polluting the soil, air and ultimately the entire eco-system. These concerns have led to the need forsome alternative form of agriculture i.e., organic farming which rely more on approaches of chemical free technologies. Organic farming approach aims to create integrated, humane, environmental friendly and economically viable sustainable agricultural production system.

Key words: Organic farming, chemicals, sustainable

LAVII/P-3 Phytotoxic Effects of Chromium on *Bacopa monnieri* L.

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Aquatic plants have tremendous capacity to concentrate and accumulate toxic metals from ambient water. They are ideal for environmental clean up. For the present study an aquatic macrophyte namely *Bacopa monnieri* L. has been selected. Plants of *B. monnieri* acclimatized in 10% nutrient medium under laboratory condition were subjected to six different concentrations (0.01, 0.1, 1.0, 2.5, 5.0 and 10.0 µg ml^{-1}) of Chromium. Plants cultured in the nutrient medium without metal served as control.

The accumulation of the toxic metals by the plants is often accompanied by an indication of variety of cellular changes some of that directly or indirectly contributes to metal tolerance capacity of the plant. In the present investigation *B. monnieri* also resulted in accumulation of different concentration of Cr and exhibited phytotoxic responses. Thus the plant can be in great use in planning monitoring and phytoremediation strategies of heavy metals polluted water bodies.

Key words: *Bacopa monnieri*, chromium, phytoremediation

LAVII/P-4 Effect of Magnesium Compounds on the Growth Rate of *Allium cepa*

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The mixture of Magnesium Chloride, Magnesium nitrate and Magnesium sulphate shows better root growth and young shoot emergence of onion bulb than any other solution and control when treated with prepared solutions for 96 hours. In this experiment effect of $MgCl_2$, $MgNO_3$ and $MgSO_4$ separately and jointly studied on the mitotic index of the root of *Allium cepa*. The maximum root growth, young shoot emergence and highest mitotic index are shown in M5 concentration of $MgCl_2$, $MgNO_3$ and $MgSO_4$ mixture than any other solutions of compound of any concentration and mixture. Biostatistical analysis also proves that compound and mixture are not significant but concentration is highly significant.

Key words: *Allium cepa*, magnisium, mitotic index

LAIV/P-5 Toxic Heavy Metal Concentration in the Brass City of India

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Monitoring of lead, cadmium, zinc and copper in ambient air was undertaken in the city of Moradabad, which is also known as Brass City of India. Samples were collected from ten sampling sites over a period of one year i.e., since Aug, 2004 to July, 2005, and analysed by Atomic Absorption Spectrophotometer.. The highest concentrations were recorded in Mughalpura and industrial area compared to MDA, which is a residential area. Experimental results obtained show that the Brassware and Steel industries are the prominent source for Air pollution in the city. The concentration follow a log normal distribution at most of the sites.

Key words: Toxic heavy metals, air samples,, brass industries

LAV/P-6 Biodegradation of Textile Waste using Fungi

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Azo dyes are the most important group of synthetic colorants. They are generally considered as xenobiotic compounds that are very recalcitrant against biodegradative processes. The batch and the continuous scale experiment studies were conducted for the degradation of textile waste water containing harmful toxic waste. In the Batch mode the efficiency of the two species of white rot fungi – *Phanerchaete chrysosporium* and *Trametes versicolor*in degrading reactive dyes were tested. Two set of experiments consisting of (four cycles each of 7 days) experiments were conducted with the same fungi in the first set and a fresh fungi in the second set. The decolorization rate was higher in *P. chrysosporium* in the first two cycles (80% and 85%) while *T. versicolor* showed better decolorization in 3rd and 4th cycles (92% and 95%). The COD reduction was approximately 50% of the dye decolorization. This result was consistent in the two sets. In the continuous scale experiments three similar columns with different species (*P. chrysosporiuml; Coriolus versicolor;* unidentified indigenous species) where experimented for the degradation of the reactive dye Remazol Brilliant violet 5R with an effluent dye concentration of 100 mg l^{-1}. Column were optimized for some parameters that were affecting the reactors like flow rate, dye concentration and COD. Dye colour removal was 93% and COD reduction was up to 45%.

Key words: Azo dyes, biodegradation, textile waste

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