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IN THIS ISSUE

The Trembling Himalayas

It was 6.5 million years ago, that the Indian Plate floating on the Tethys Sea like a Noah's Arc travelled northwestward from the southern hemisphere and 'docked' with the Eurasian Plate. This docking was something akin to the docking of the two space ships! But with a difference that the stresses generated in the womb of the earth were so much that they gave rise to the tallest, yet youngest mountains of the world-The Himalayas.

Since then, the Indian Plate continues to move under the Eurasian Plate, causing stress along the plate margin. Despite scientific and technological achievements in all fronts, man is a dwarf in front of the nature's fury. During the recent earthquake in Nepal on 25th April, 2015 more than 3000 people have died and the sheer magnitude of the death toll has shown the helplessness of the mankind. It may be mentioned here that the seismologists had warned of a massive earthquake in 2013, but the earthquake science is still in its infancy and it is not yet feasible to predict a time frame of the impending earthquake.

The last major earthquake (magnitude 8.4) occurred in 1934, killing an estimated 17,000 across both in Nepal and India. The Earth Scientists go by the dictum, 'present is a key to the past and the past is a window for the future.' Nepal has been shaken violently in the past too, in 1255, 1344, 1833, 1866 and 1934 and now. It is high time to take lessons from the past earthquakes.

Politically, we may be different countries, but for the Nature it is the same land. Thus, if Nepal is rocked the adjacent Ganga plains of Uttar Pradesh and Bihar and of course Delhi become vulnerable. Compared to Nepal, the region falling within Indian Territory is densely populated. The pressure of the population has been so much that now there is a shortage of land and there is a trend for high rise buildings. In Delhi, Lucknow, Patna etc. the skyline is now completely changed. The recent tremors shocked the people and brought them out of their houses and offices with lines of fear clearly discernible on their faces.

The seismologists like Roger Bilham and Padma Bhushan Prof K.S. Valdiya have been writing in various scientific forums about the possibility of a Great Earthquake in Central Kumaon/Nepal and or Shillong. Nepal had its share of temblors. If we go by their verdict Central Kumaon in Uttarakhand and Shillong in the Northeast should brace up for a violent shaking. But a million dollar question is, do these places have earthquake resistant houses/schools/hospitals? Are their roads and bridges Hospitals, earthquake resistant? If a serious survey is taken the answer will be No. It is high time to implement building codes to tolerate earthquakes of 7 and above magnitudes. It is also high time to retrofit all other vulnerable structures, where people gather *en-mass*.

After experiencing the recent Nepal Earthquake, one can say with confidence that earthquake resistant building codes need to be strictly implemented in large cities like Delhi, NOIDA, and Lucknow. Laxity on the part of the Government and the members of the society could be catastrophic.

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LETTERS

I'm Cornelia Schidu from the editorial team of Lambert Academic Publishing. We have read Ms. Afroz Ali's publication entitled "Role of Bacteria for Arsenic Detoxification in Rice" published in *EnviroNews* (Volume 21, No. 1; January 2015) with great interest. We believe this particular topic could be of interest to a wider audience and we would be glad to consider publishing it. We are especially interested in publishing a complete academic work of hers (a thesis, a dissertation or a monograph) as a printed book. Our services are free of charge for authors.

Cornelia Schidu
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I received a copy of your newsletter, *EnviroNews* today. Thank you so much for sharing it with us. I will keep it with me as a memento of the ICPEP-5 conference. I have framed the group photo of all the participants and it hangs in my office, to remind me of the good time we spent with you all during the conference. We are organizing a 2 day seminar on the 13th and 14th of May 2015 in remembrance of our beloved professor Dr. Mustafa Shameel. This seminar is to mark his second death anniversary. This was the professor, who was my mentor, he hailed from Lucknow.

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I'm very happy to receive the Special issue of *EnviroNews* on ICPEP-5. I have visited all sites and it has taken me great pleasure mainly the photo's gallery. See you again in another scientific meeting.

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The North East of India represented by the seven sister states of Assam, Meghalaya, Arunachal Pradesh, Manipur, Nagaland, Mizoram and Tripura with geographical extensions of the Himalayan state of Sikkim and the Darjeeling district of West Bengal constitutes an unique habitat in the subcontinent rich in the diversity of flora and fauna. The region is also enriched by the co-habitation by several tribes and aboriginal communities with their distinct ethnicities, languages, dresses, food habits, unique life style, socio-cultural and religious practices. Overall, the region represents one of the most biodiverse and culturally rich corner of this vast nation and has been a premier tourist destination for decades. In spite of the richness of the biodiversity and vast natural resources of the region with its rich cultural history and its proximity to international boundaries shared with Nepal, Bhutan, China, Myanmar and Bangladesh; the economic development of the region has been poor due to the lack of infrastructural development and connectivity. As a consequence the unique biodiversity of this region has stayed untouched since the days of the British Raj as also in post independent India.

The unique flora of this region is characterized by the evergreen forests adjoining gorgeous river valleys, broad leaf forests in the foothill regions, Himalayan and sub-Himalayan flora, the rich sub-alpine coniferous belt and the lush bamboo and pine forests of the Indo-Myanmar region. The region is the hot bed of rare and highly endangered as also endemic species of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. It is one of the most important biological sites in the subcontinent for wide diversity of different species of rhododendrons and orchids and several other plant and animal species including the great Indian hornbill, Bengal florican and the great one horned Indian rhinoceros respectively to name only a few. Recently the Government of India has rightly decided to introduce infrastructural development in this region for better connectivity within the nation as well as connecting road and railway networks reaching international boundaries for bringing in economic and industrial development in this much neglected region. However, owing to the unique biodiversity of the region and sensitivity of the local ecosystems; it will be extremely important to move ahead with the infrastructural project implementation with utmost care and constant monitoring and surveillance.

It will be important to follow the *Principles of Eco-Sociology* in maintaining a healthy balance in economic development while maintaining ecological integrity of this fragile region. The task is extremely challenging and delicate; however, if we are sincere and dedicated to both economic development and ecological conservation models integrated together, we may be able to achieve this unique balance and translate this into an international model for others to follow. However, if the economic interests would ride above the ecological priorities of this vastly biodiverse region it could also bring about rapid disintegration of the unique habitats of this region, natural disasters, loss of precious flora and fauna and complete disintegration of the socio-economic life of the people of this region. Hence, rigid environmental assessments and surveys are to be made honestly before each of the projects dealing with infrastructural, agricultural and industrial developments are implemented. Taking this issue lightly could mean long term disaster for this uniquely biodiverse region of the subcontinent.

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We are pleased to inform you that 'Indian Lichenological Society' and 'CSIR-National Botanical Research Institute' are jointly organizing a two day National Conference on **'Cryptogam Research in India: Progress and Prospects'** during 28 - 29th Sept. 2015 at CSIR-NBRI, Lucknow. This will be a unique conference dedicated to cryptogams research in India. As you are aware cryptogams are extremely diverse, widely distributed and very important component of biodiversity. India being a mega diversity country has a huge repository of cryptogam wealth but insufficiently explored due to several reasons. The cryptogams are meagerly represented in the biodiversity conferences that are frequently being organized everywhere. The conferences dedicated to cryptogams especially algae, lichen, bryophytes and pteridophytes are rare in India. Thus to cope with the lacuna in popularization of cryptogams knowledge the Indian Lichenological Society (ILS) attempts to bring together all cryptogam researchers of India under a single platform through this conference.

As you are a well known plant science researcher, with vast knowledge on the subject, it will be our privilege to have you as one of our Advisors. Therefore, we have placed your name in our 'Apex Advisory Committee' and I hope you will agree with us. We will be in contact with you to take your advice whenever needed.

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NEWS FLASH

Prof. S.B. Agrawal, Professor of Environmental Sciences, Banaras Hindu University and Editor of BHU Science magazine "Vigyan Ganga" was conferred Saraswat Samman Award by Hon'ble Governor of Uttar Pradesh on 18th April, 2015 during the centenary year celebration of Vigyan Parishad, Allahabad for popularizing science through Hindi language. Prof. Agrawal is Life Member of ISEB.

Dr. Mridul Shukla, Life member of ISEB and Technical Officer CSIR-NBRI has been conferred "Vigyan Shiromani Award" at a Science Awareness Fair organized by SNCSTC, D.S.T., Govt. of India and Pt. Jag Narayan Shukla Gramodaya Mahavidyalaya, Gonda (Dr. R.M.L. Avadh University, Faizabad) on 10th January 2015. Dr. Shukla has also been awarded "Lab to Land Award" at Vigyan Jagrukta Mela Gorakhpur organized by NCSTC, DST, Govt. of India and Martial Art Society and "Vigyan Samrasta Award" at Gonda Mahotsava organized by Science Club Gonda.

Arsenic: A dreaded threat to Environment

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Arsenic (As) is a toxic metalloid that is pervasive in the environment and causes numerous health problems. Arsenic exists in the environment with different oxidation states (-3, 0, +3, +5), dominantly present in two inorganic forms viz., pentavalent Arsenate [As (V)] and trivalent Arsenite [As (III)]. The volcanic activity is the original source of much of the arsenic in sedimentary rocks, however, in recent time, arsenic release from weathering has been approximately in balance with deposition of arsenic in sediments. Human activities, such as the use of arsenic pesticides, herbicides, crop desiccants, the burning of fossil fuel, the mining and processing of sulfide minerals, soil erosion and leaching have increased the amount of arsenic entering the oceans which have caused additional impacts. Arsenate is predominantly present in oxygen rich environments while As (III) is the dominant As species in reducing anaerobic environments such as flooded paddy soils. About 150 million people are exposed to As contamination in the World with the largest percentage coming from Asia especially Bangladesh and West Bengal (India). The ministry of water resource, Government of India in 2009 reported that ground water concentration of As in West Bengal, Bihar, Chhattisgarh and Uttar Pradesh was ranged from 0.05-3.773 mg/l, 0.05-1.810 mg/l, 0.05-1.89 mg/l, 0.05-1.31 mg/l respectively. About 30 million people in Bangladesh using Arsenic-contaminated shallow tube wells (STWs) water for drinking and approximately 2.4 million hectare out of 4 million hectare crop fields (mainly paddy fields) are irrigated by As contaminated ground water from 900,000 STWs. Arsenic contaminated ground water leads to the accumulation of As in paddy soils, which poses adverse effects on rice yield and quality.

The biological cycle of arsenic in the surface of ocean involves the uptake of arsenate by plankton, the conversion of arsenate to a number of, as yet unidentified, organic compounds, and the release of arsenite and methylated species into the seawater. Biological demethylation of the methylarsenicals and the oxidation of arsenite through unknown mechanisms serve to regenerate arsenate. Microorganisms play a central role in converting inorganically and organically bound metals to other chemical forms and transporting metals among various compartments of aquatic ecosystems as adsorbed or absorbed As species.

The pathway proceeds anaerobically by arsenate reduction to arsenite followed by several methylation steps producing dimethylarsine and trimethylarsine. Arsenic transformation by microbes may play a critical role in the fate and toxicity of As. Microorganisms are involved in the redistribution and global cycling of arsenic. Arsenic can accumulate and can be subject to various biotransformations including reduction, oxidation, and methylation processes. Methylation through bacteria of inorganic arsenic is coupled to the methane biosynthetic pathway in methanogenic bacteria under anaerobic conditions and this provides a mechanism for arsenic detoxification. The metabolism of As (V) has been studied in many organisms, including mammals, plants and microorganisms. Cyanobacteria, the free-living photosynthetic prokaryotes, are widely distributed in lakes, pond, springs, wetland, streams and rivers, and play a major role in the nitrogen, oxygen and carbon dynamics of many aquatic environments. Cyanobacteria form symbiotic association with more complex biota; for example, the nitrogen-fixing *Anabaena* species which forms a symbiotic association with the rice plants, is widely distributed in paddy fields. The paddy field ecosystem provides a favorable environment for the growth of cyanobacteria with respect to their requirements for light, water, high temperature and nutrient availability. This could be the reason for more abundant cyanobacterial growth in paddy soils than in upland soils.

Arsenic contamination and toxicity

Arsenic is causing a worldwide epidemic of poisoning, with tens of

thousands of people having developed skin lesions, cancers, and other symptoms like cancer, cerebrovascular disease, diabetes mellitus, and kidney diseases. In seawater, the concentration of As is usually less than 2 $\mu g\ L^{-1}$. The levels of arsenic in unpolluted surface water and ground water are typically from 1-10 $\mu g\ L^{-1}$. In fresh water, the variation is in the range of 0.15-0.45 $\mu g\ L^{-1}$. in thermal water, concentrations of up to 8.5 mg L^{-1} and 1.8-6.4 mg L^{-1} has been reported from New Zealand and Japan, respectively. Natural geological sources of As in drinking water are one of the most significant causes of As contamination around the world. The World Health Organization has set a guideline of 10 $\mu g\ L^{-1}$ as the drinking water standard. The concentration of As in different parts of the world has been depicted in table 1.

Rice is the staple food of global population especially of the people in South-East Asian countries where it contributes over 70% of the energy and 50% of protein provided by their daily food intake. In some areas of Bangladesh and West Bengal, which are the worst-affected regions, groundwater As concentration has reached 2 mg l^{-1}, while the WHO provisional guideline value for drinking water is only 0.01 mg L^{-1}. Rice is particularly efficient in arsenic accumulation compared to other cereals as it is generally grown under flooded conditions where arsenic mobility is high. Grain baseline levels of arsenic are 10-fold higher than other cereal grains. A recent study indicated that the concentration of As in rice straw could be up to 92 $\mu g\ g^{-1}$ when rice plants were irrigated with As-contaminated groundwater. The large cultivated area of paddy fields is irrigated with As contaminated ground water. The As is easily taken up by rice plants when irrigated with As contaminated water. Excessive uptake of As by rice plant creates food safety problem as well as the problem of food chain contamination. Thus, being a staple crop worldwide, there is pressing need to develop eco-friendly, sustainable approach to minimize the problems caused by As contamination. The toxicity effects of chronic and acute exposures of arsenic may result in cancer, cardiovascular disease (hypertension and atherosclerosis), neurological disorders, gastrointestinal disturbances, liver disease and renal disease, reproductive health effects, dermal changes, skin lesions to cancer of the brain,

Table-1. Arsenic concentration in different continents of the world

Continent	Location	Arsenic source	Conc. h!M!	Period Sampling	Reference
Asia	Bangladesh	Well waters	< 1-> 1000	1996-1997	Dhar et al. (1997)
	Calcutta, India	Near pesticide production plant	< 50-23,080	1990-1997	Mandal et al. (1996)
	West Bangal, India	Arsenic-rich sediments	3-3700	1989-1996	Mandal et al. (1996)
	Nepal	Drinking water	8-2660	2001	Shrestha et al. (2003)
	Hanoi, Vietnam	Arsenic-rich sediments	1-3050	1999-2000	Berg et al. (2001)
	Xinjiang, PR China	Well water	0.05-850	1983	Yinlong (2001)
	Shanxi, PR China	Well water	0.03-1.41	Not stated	Yinlong (2001)
	Inner Mongolia, China	Drinking water; bores	1-2400	1990s	Guo et al. (2001)
	Ronpibool, Thailand	Water contaminated by tin mining waste	1-5000	1980s	Choprapwon and Porapakkham (2001)
	Nakhon Si Thammarat Province, Thailand	Shallow (alluvial) groundwater, mining	1.25–5114	1994	Williams et al. (1996)
	Fukuoka, Japan	Natural origin	0.001 –0.293	1994	Kondo et al. (1999)
	Mekong River floodplain, Cambodia	Groundwater	1–1340	2004–2006	Buschmann et al. (2007)
Europe	Hungary	Deep Groundwater	1-174	1974	Sancha and Castro (2001)
	Romania	Drinking water bores	1-176	2001	Gurzau and Gurzau (2001)
	South-west Finland	Well water; natural origin	17-980	1993-1994	Kurttio et al. (1998)
North America	Pampa, Cordoba, Argentina	2-15m	100-3810	Not stated	Nicolli et al. (1989)
	Cordoba, Argentina	-	> 100	-	Astolfi et al. (1981)
	Chile	-	470-770	-	United Nations (2001)
	Lagunera region, Mexico	Well waters	8-624	Not stated	Razo et al. (1990)
	Peru	Drinking water	500	1984	Sancha and Castro (2001)
	Northeastern Ohio	Natural origin	< 1-100	Not stated	Matisoff et al. (1982)
	Western USA	Drinking water	1-48, 000	1988	Welch et al. (1988)

liver, kidney and stomach. When air containing arsenic dusts is breathed in, the greater part of the dust particles settle onto the lining of the lungs. Colour pigments that are used in the cosmetic industry in the production of eye shadows frequently contain toxic elements, including arsenic. The skin of the eyelids is very delicate and the application of eye shadows may produce eczemas. Arsenic induced genotoxicity may involve an alteration of the integrity of the cellular genetic material by oxidants or free radical species. A wide range of arsenic toxicity has been determined that depends on As speciation. Generally inorganic arsenic species are more toxic than organic forms to living organisms, including human and other animals. Exposure to As trioxide by ingestion of 70-80 mg has been reported to be fatal for humans.

Arsenic contamination affects the plant growth and crop yield. Its accumulation in food is harmful to animals and humans. Arsenite [As(III)] and arsenate [As(V)] are the phytoavailable forms of inorganic As in soil solution. Arsenate is taken up by plants via phosphate transporters in the plasma membrane of root cells, and is rapidly reduced to arsenite once inside the cytoplasm. Since arsenate and phosphate behave as analogues with respect to their uptake, arsenate toxicity is linked to phosphorus nutrition, and high levels of phosphate can mitigate arsenate toxicity. Recent studies have provided experimental evidence that As induced generation of free radicals and oxidative stress can cause cell damage and cell death through activation of oxidative sensitive signaling pathways. Exposure to As causes reduced root elongation and branching, leaf chlorosis, and the shrinking and even necrosis of the aerial parts of plants. Arsenic can also induce the production of reactive oxygen species (ROS) in plants. The overproduction of reactive oxygen species (ROS) is commonly triggered by heavy metals in animal and plant tissues. ROS are produced basically in all cell compartments, associated with electron-transport chains in chloroplasts, mitochondria, and peroxisomes. Overproduction of ROS is very harmful because it can affect proteins, lipids, and DNA, giving rise to lipid peroxidation, membrane leakage, enzyme inactivation, and DNA breaks or mutations which can compromise cell viability.

Bioremediation of As

Mitigation of environmental As contamination is a vital requirement in many parts of the world. Various technologies are in place to clean up arsenic or to reduce arsenic exposure from contact with arsenic contaminated soil and water. At the present time, there appears to be no cost-effective method for the in situ cleaning of arsenic contaminated soils and groundwater. Besides, the physicochemical technologies such as chemical precipitation, activated alumina, reverse osmosis, etc. are currently used for the ex-situ clean-up of arsenic contaminated water (groundwater, drinking water, industrial wastewater etc). But these technologies have significant drawbacks such as high cost, generation of high volumes of toxic sludge and brine and low water recovery. Bioremediation is the process of environmental biotechnology which uses microorganisms and plants to clean the environment. Bioremediation strategies have been proposed as an attractive alternative owing to their low cost and high efficiency. Recent studies show that the strains of organisms like algae, cyanobacteria, bacteria, fungi and yeast isolated from contaminated soils, water and contaminated sludge have excellent capability of removing significant amounts of metals. It is reported that microbes accumulate high concentration of As and also detoxify As through methylation process and convert inorganic As (iAs) to organic As (oAs) in methylated form of As which is less toxic and volatile form. Microorganisms such as *Pseudomonas* sp., *Synechocysis* sp., Ostreococcus *tauri, Bacillus* Sp., *Chlorella* sp and cyanobacteria play an important role in As remediation. These microorganisms breakdown the toxins during their metabolic activity. Cyanobacteria occur naturally in such places where toxins are abundant and they can be removed through methylation and any other detoxification method. Toxins are just like their food and these microbes are able to remove toxins in large quantity. In addition, cyanobacteria have As detoxification mechanism through methylation to produce organic arsenicals, which are less toxic than inorganic As i.e., methylarsenate [MAs(V)], dimethylarsenate [DMAs(V) or cacodylate], trimethylarsine oxide [TMAsO(V)], and the final product of the methylation pathway, volatile trimethylarsine [TMAs (III)]. As methylation is supposed to play an important role in As cycling among terrestrial, aquatic and atmospheric surroundings.

Phytoremediation, a plant-based green technology, has received attention as an effective, low cost, eco-friendly clean-up option for As-contaminated areas. The Chinese brake fern (*Pteris vittata*) has been reported to hyper-accumulate arsenic to extremely high concentrations, up to 23,000 μg arsenic/g, in its shoots (fronds). This fern actually thrives on arsenic, doubling its biomass in one week when subjected to 100 ppm arsenic. The striking feature of *P. vittata* is its remarkable capacity to transport arsenic from roots to shoots. It can accumulate up to 95% of the arsenic in the above-ground tissue. A number of other fern species of the family *Pteridaceae* have also been identified as As hyper-accumulators. Arsenic hyper-accumulation appears to involve enhanced arsenate uptake by the phosphate transporters. Recent studies have shown that the duckweed *Spirodela polyrrhiza*, *Hydrilla verticillata* and several *Azolla* species have moderate amount of As accumulation and tolerance. A number of duckweeds e.g. *Wolffia globosa* is a strong accumulator of As and submerged macrophyte *Hydrilla verticillata* is also reported to be a good As accumulator. Some species of submerged macrophytes, such as *Callitriche stagnalis* and *Myriophyllum propinquum*, which play important structural and functional roles in aquatic ecosystems have shown tremendous potential to accumulate As and are therefore potential phytofiltrators of As-contaminated water.

Syngonium podophyllum 'Maza Red', as Indoor Phytomonitor

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Indoor pollution is defined as "The presence into air indoors the physical, chemical and biological contaminants not normally present in outdoor air of high quality system" The factors of pollution are confined indoors where the ventilation is generally poor. The individual spends almost all of 24 hours in the building (80-90%), breathing approximately 22.000 times.

The sources of Indoor air pollutants include asbestos, pesticides, fibers from clothing, curtains, carpets, insulation, etc., fungi and bacteria, human coughs, sneezes, sweat, etc., tobacco smoke, ozone, chemicals from detergents, solvents, and cleaning fluids, etc. Different types of Indoor Pollutants and their sources are: D.Trans-Elthrin and CO – mosquito repellents, paradichlorobenzene and napthalene – room freshners, paints, NO_2 and CO – smoke in the kitchen, alcohol and acetone - cosmetics, formaldehyde - grocery bags, paper towels, paints, floor coverings, air freshners ,xylene - computer and video screens, ammonia - cleaning products, trichloroethelene – perfumes.

In today's world people spend more than 90% of their time inside their houses or office places, where levels of a dozen common organic pollutants can be two to five times higher than outside. Indoor pollution is now considered by many experts to be one of the major threats to human health. In early 1950s Dr T. G. Randolf became one of the first medical doctors to associate indoor pollution with allergies and other chronic illness. The US Environmental Protection Agency (EPA) currently ranks indoor pollution as one of the top five threats to public health. While researching on the problem of Indoor pollutants it was thought to test known phytomonitor against indoor pollutants released from some household sources.

In this article, the efficacy of *Syngonium odophyllum* as phytomonitor has been reported against indoor pollution caused by mosquito coil that is generally burnt in the houses as mosquito repellant.

Mosquito coil is mosquito-repelling incense, usually shaped into a spiral, and typically made from a dried paste of pyrethrum powder. A typical mosquito coil can measure around 15 cm in diameter and lasts up to 8 hours. Mosquito coils are widely used in Asia, Africa, and South America. Smoke emitted from one mosquito repellant coil is equivalent to those of 100 cigarettes, thus causing harm to a large number of people in India. D-Trans Allthrines from Mosquito coil is dangerous to health. The main site of action of the pyrethroids is the sodium channel, which is kept open for long periods of time, causing prolonged sodium current to flow, leading to hyper-excitation of the nervous system. Synthetic pyrethroids, e.g. allethrin cause subnormal or super-normal excitability.

Eco-friendly approach for controlling Indoor Pollution: Phytoremediation

Growing plants in the indoor as well as outdoor environment is widely accepted as a means of retaining our connection with the nature. Because green plants not only beautify the place along with other uses but they improve the air which is the very essence of our lives. Green plants even have capacity to relieve stress. They form a surface capable of absorbing air pollutants. It is a proven fact that plants effectively reduce the concentration of pollutants in the indoor as well as outdoor environment. Phytoremediation is the direct use of living green plants for *in situ* (in-place or on-site) risk reduction for contaminated environment. Phytoremediation warrants consideration for cleaning up environments at which there are relatively low concentrations of contaminants. Phytoremediation technologies represent active processes that are designed and implemented to control and eliminate contamination.

Monitor chosen : Syngonium podophyllum**'Maza Red'**

Syngonium podophyllum 'Maza Red' is the most commonly cultivated species of genus Syngonium, being used as a houseplant since the late 19th century. It is also called as Arrowhead plant. The monitor was chosen due to its easy growth in all types of mediums tested in the laboratory. Plant requires less maintenance, it is fast growing and their lamina is broad to show injury symptoms. Leaves are alternate, three-lobed and arrow-shaped, up to 30cm long, 2-8cm wide. Juvenile leaves are entire with silvery-white veins or centre, bounded by green. Mature leaves are dark green and segmented into three leaflets, the central leaflet being the longest. Roots are profusely well developed to absorb nutrients from the medium.

Research

Factors important in the selection of phytoremediation as a technique, were decided. The factors such as selection of plants for remediation, local growing conditions, easy availability and inexpensive nutrients, location and type of contaminants to be treated, were studied. The study illustrated how those factors can be potential advantages (or limitations) in the selection of phytomonitor for the indoor environment. The research also illustrated the field applications of phytoremonitor at the selected sites to get the social response so that a tone, appropriate for audiences who have only a limited technical background is set.

Several common houseplants are studied, with which practically everyone is familiar, has seen them in the office or in the house, on a co-worker's desk, or for sale in the nursery. Each plant is studied for its suitable substratum for growth, growth factors and sensitivity to indoor pollution. Finally a system is set with selected indoor plants which are considered as air quality monitors.

Experimental Design and Technology used

The selection of Known Indoor Plants such as Syngonium (*Syngonium podophyllum* 'Maza Red), Green spider plant (*Chlorphytum comosum*), Chinese

evergreen (*Aglonema commutatum*), Peperomia (*Peperomia meridiana*), Ficus (*Ficus benjamina*) was done. Amongst these selected plants *Syngonium podophyllum* 'Maza Red' was selected to test its ability to remove some poisonous gases. A vacuum dessicator with temperature and humidity control was used to understand the ability of *Syngonium podophyllum* 'Maza Red', to be used as phytoindicator for poisonous gases released from different household source like mosquito coils. exposure experiments with all five selected plants was done. Three sets were exposed.

Monitoring was based on the visible injury, PII and GLC analysis. Extract of the leaves of the plants exposed were analysed on G LC. Response of the selected plants at two different sites, where these pollutants are used, was recorded. The response is compared with the exposure experiments.

Results

Syngonium podophyllum 'Maza Red' proved most effective in absorbing poisonous gases released from mosquito coil, amongst all selected plants. It did not show any visible injury when exposed for 4 hours to gases released from a mosquito coil. Different parameters used were number of leaves exposed, number of leaves affected, visible injury to the leaves, colour of the leaves. When exposed to gases released from a mosquito coil for four hours, the PII value calculated was zero. When *Syngonium podophyllum* 'Maza Red' was exposed to gases released from a mosquito coil for four hours and analyzed on GLC, it was observed that new compounds were absorbed by the plant as compared to the control. New peaks of compounds were seen at RT 7.268, 15.750, 16.880. The new peaks may be the indicative of the poisonous gases absorbed by the plant. But further confirmation on GCMS is required.

Possible applications for human health

Burning mosquito coils indoors generates smoke that can control mosquitoes effectively. This practice is currently used in numerous households due to the fear of different severe diseases like chickenguniya, dengue, malaria etc. Pollutant concentrations resulting from burning mosquito coils could substantially exceed health-based air quality standards or guidelines. Burning one mosquito coil would release the same amount of PM2.5 mass as burning 75-137 cigarettes. The emission of formaldehyde from burning one coil can be as high as that released from burning 51 cigarettes.

Unlike cigarettes, mosquito coils do not contain tobacco but harmful chemicals are released from burning them used in many bug sprays. These are formaldehyde, octachlorodipropyl ether and bischloromethyl ether. The active ingredient in mosquito coils is Pyrethroid insecticides, used in many bug sprays mostly harmless to humans, but can irritate the skin and eyes. Some people are allergic to them too.

Formaldehyde is a colourless, flammable and strong smelling gas. Inhaling it could cause watery eyes, throat discomfort, coughing, wheezing, nausea and skin irritation. Also, it can cause nasal or sinus cancer and even leukaemia Formaldehyde is not an ingredient of mosquito coils but a by-product of burning them.

The research done with the help of *Syngonium podophyllum* 'Maza Red' may prove promising where use of mosquito repellent is unavoidable. Instead of affecting our health due to poisonous gases from mosquito repellents use of such indoor phytomonitor may be advised. It is already researched that two to three 8-10" plants in 6-8″ diameter container for every 100 square feet of floor space can do the job.

Conclusion

Syngonium podophyllum 'Maza Red' is best suited to absorb gases released from mosquito coil and so, it can effectively act as a phytomonitor. This conclusion is based on its ability to grow in easily available nutrient medium, visible injury, PII and GLC analysis. Our preliminary research indicates that the identification of specific plants for Visual Injury Symptoms of pollutants is possible. It is also encouraging that GLC analysis further confirmed some of our findings. Future research is still needed for advancing phytoremediation as a technology. This includes studying how to screen and harvest plants, choosing an assortment of plants for particular pollutants of concern, understanding mechanisms for nutrient and heavy metal removal, and ideal environments for maximum plant uptake etc.

Growing one or two house plants on the desk at the office may not completely protect a person from indoor pollution. There are many reasons people keep plants around though. Unrelated studies have shown they have the power to lift people's spirits. Phytoremediation may work effectively on indoor pollution when implemented on a large scale. In future it might be common to have a garden or small forest inside the house but at the present time a compromise between phytoremediation and conventional methods works best and satisfies both public acceptance and scientific criticism.

Butchart Gardens: An Example for Positive Socio-Environmental Transformation

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The Butchart Gardens is a National Historic site of Canada with majestic floral display established as early as 1904, in the Saanich peninsula of the Vancouver Island of the province of British Columbia. The garden was established by an industrialist couple named Mr. Robert Butchart and Ms. Jennie Butchart after they moved from eastern Canada in pursuit for adequate supply of limestone for their thriving Portland cement industry. They bought and started operating an open cast limestone mine here for supplying raw materials for their cement factories. However, when the mine was exhausted and abandoned after repeated quarrying for the industrial pursuit the couple decided to transform it into an exquisite garden. They also hired several internationally reputed landscape designers from the early 20th century period for designing different parts of the mine-garden commonly called *Sunken Garden* and further expanding and beautifying it. Till date, the Butchart family operates and manages the garden that has stood the test of time for almost over a century. The garden is a major tourist attraction for Vancouver Island, British Columbia. The Butchart couple is duly credited for transforming a degraded and abandoned limestone quarry into a beautiful Sunken Garden, over the years. Other family members have continued in further expansion and maintenance of the garden after their death. The garden has a collection of both local and exotic collection of colorful ornamentals, herbs, shrubs, trees, small meadows, bushes and grooves intricately designed within a span of 55 acres. The garden is an example of human ingenuity in converting a polluted and abandoned mining site into a place of beauty, knowledge and recreation.

Highly experienced group over 50 specially trained gardeners maintain the garden and are responsible for the global reputation of this floral paradise. The garden remains operational all round the year round with flowers, foliages and blooms changing color over the five local seasons giving spectacular hue and diversity to the garden and mesmerizing million plus annual, local and foreign visitors to the park alike. It has been designed through intelligent and aesthetic landscaping into a central Sunken Garden with concentric lawns from an abandoned limestone mine. Inside the gardens other specialized gardens that are admired by plant lovers and enthusiasts include the Mediterranean Garden, Rose Garden, Perennial borders, the Italian Gardena complete with a gelato stand and the Japanese Garden with cross shaped pond. Additional attractions include Children's Pavilion, Rose Carousel, the colossal 70 ft Ross Fountain and several internationally reputed art works from across the world such as bronze Sturgeon Fountain cast, statue of Mercury, Piazza and the statue of boar and aboriginal Canadian art forms. The mini-boat ride in summer for the kids around the Todd inlet along with tour of the greenhouse, evening entertainment, exquisite night illuminations, photo gallery, the Saturday firework show and eco-friendly and electrically operated boat tours are some of the delights for the visitors. The garden stands as a hallmark of human ingenuity and aesthetics for transforming their polluted local environment into a positive *socio-environmental* (positive changes contributed to the society through environmental transformation) contribution.

Crop Productivity, Environmental Stress and Global Climate Change: the Next Green Revolution?

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A major goal of agriculture has been to maximize the investment of plant vegetative biomass into seed yield.Since the 'Green Revolution' of the 1950s and 1960s, the seed yield of the major staple cereal crops such as rice, wheat and corn more than tripled globally (FAOSTAT, 2014). At the heart of the major successes of the Green Revolution was the introduction of dwarfing genes into the world's leading cereals, rice and wheat (Peng et al., 1999; Hedden, 2003). These new semi-dwarf genotypes were characterized by a combination of improved lodging resistance, and responsiveness to fertilizer and irrigation inputs which resulted in enhanced harvest index, defined as the ratio of seed dry mass to plant dry weight (Khush, 1995; Matson et al., 1997; Murchie et al., 2009). The yield of these major staple cereal crops increased more than 3-fold since 1960 and despite a continuing increase in the human population by about 4 billion over this period, the per-capita availability of calories from these crops increased by about 1.5-fold (FAOSTAT, 2014). However, despite this impressive success in agronomic yields over the past 60 years, world hunger remains a major and persistent issue (Borlaug, 2000; Porter et al., 2014). A major challenge for the future will be to

feed the estimated 9-12 billion people on earth by 2050 when future climate change senarios predict decreases in crop production over much of the globe due to environmental stress(Porter et al., 2014).

Abiotic Stress and Crop Yield

A significant yield gap exists between the average attained crop yields and the maximal yields possible for the major cereal crops. As illustrated in Table 1, the yield gaps for the major cereal crops vary from a low of 34% for oat to a high of 89% for sorghum with an average yield gap of 63.3% for the 7 crops listed. Thus, the yield gaps indicate that most of the major cereals generated by classical plant breeding are underperforming with respect to actual attained grain yields in the field. Clearly, susceptibility to changes in the abiotic environment is a crucial limitation to crop yield. Such limitations will most likely be exacerbated as a consequence of future climate change. Consequently, the generation of improved genetic stocks must involve minimizing the limitations imposed on crop yield by the environment, which will vary not only on a daily as well as a seasonal basis, but also as a function of geography (Porter et al., 2014).

Photoautotrophs must constantly adjust to fluctuations in ambient irradiance, temperature, nutrient and water availability, which result in an imbalance in cellular energy budget, quantified *in vivo* as excitation pressure (Huner et al., 2003). Any limitation in the ability of a plant species to respond appropriately to high excitation pressure conditions to re-establish an energy balance, that is, photostasis, leads to photoinhibitionof photosynthesis and decreased productivity (Huner et al., 1993). Overwintering plants which are characterized by a dwarf phenotype exhibit an exceptional capacity to acclimate to high excitation pressure generated during the process of cold acclimation (Huner et al., 1993; Huner et al., 1998). Rather than exhibiting an inhibition of photosynthesis, cold-acclimated winter cereals exhibit light-saturated rates of CO_2 assimilation that are 20 to 35% greater than those of non-acclimated controls, irrespective of measuring temperature. This is due to a co-ordinated feed-forward stimulation of photosynthetic CO_2 fixation and readjustments in photosynthetic and respiratory carbon metabolism coupled to an increased capacity for long-distance translocation between source and sink which results in an increased resistance to photoinhibition(Huner et al., 1993), increased water-use efficiency (WUE) and minimal reliance on photoprotection through non-photochemical quenching (NPQ). This is translated into a 60% higher seed yield per plant in cold acclimated winter wheat under controlled environmental conditions (Dahal et al., 2014). Furthermore, cold acclimated winter wheat not only exhibits enhanced photosynthetic performance but also the potential for increased resistance to biotic stress (Kane et al., 2013).However, the ability to exhibit such system-wide adjustments in plant phenotype, and photosynthetic performance is cultivar-specific. In contrast to winter cultivars, spring cereals do not exhibit a dwarf phenotype upon cold acclimation and are also not able to up-regulate photosynthetic capacity and carbon metabolism but rather exhibit a significant inhibition in photosynthetic capacity and a decrease in biomass compared to cold acclimated winter cereals(Dahal et al., 2012).

Winter cereals exhibit the capacity for system-wide modifications in plant architecture, photosynthetic performance, enhanced WUE, and seed yield, coupled with increased resistance to abiotic and biotic stress when assessed under controlled environment conditions. Is this enhanced yield potential realized under natural field conditions? According to Stastistics Canada, the average yield of winter wheat in Canada was about 30% greater than for spring wheat over the 52 year period from 1961-2013(Statistics Canada, 2013). Thus, it appears that the enhanced photosynthetic capacity, WUE and resistance to photoinhibition assessed under controlled environment conditions is translated into increased seed yield under natural field conditions. Thus, the process of cold acclimation in cereals may be exploited to reduce the yield gap of major crops in response to environmental stress. Winter varieties of cereals appear to represent an untapped genetic potential to provide a significant increase in grain yield which could be translated into enhanced food production for a growing human population.

CBFs Govern Photosynthetic Response and Phenotypic Plasticity

How are the system-wide alterations in plant phenotype, photosynthetic performance, resistance to abiotic stress and seed yield in winter cultivars regulated? *CBFs* (C-repeat binding factors) are members of the Apetela2/Ethylene Response Binding Protein (AP2/EREBP) family of transcription factors in *Arabidopsis thaliana (Medina et al., 1999; Licausi et al., 2013)* known to regulate the expression of *COR* genes necessary for the acquisition of freezing tolerance as well as the induction of the dwarf phenotype (Thomashow, 2010 ; Medina et al., 2011). However, in addition, growth at 25°C of a *Brassica napusCBF* overexpressor, *BnCBF*17, induces increased light-saturated rates of photosynthesis, respiration, plant biomass, and WUE typically observed during coldacclimation (Savitch et al., 2005; Dahal et al., 2012). Remarkably, overexpression of *BnCBF*17 in *Brassica napus* circumvents the requirement for cold acclimation to co-ordinate the system-wide adjustments in plant phenotype, photosynthetic performance, and source-sink relationships.

Recently, global transcriptome analyses of *Arabidopsis thaliana* showed that *AtCBF*3 previously assumed to be regulated by low temperature is in fact governed through intracellular retrograde regulation by the chloroplast redox status measured as excitation pressure (Kurepin et al., 2013; Bode et al., 2015). As a consequence, chloroplast redox poise governs *CBF* expression through retrograde regulation, which initiates a

system-wide cascade of molecular events that not only up-regulates photosynthesis, respiration, and carbon metabolism, but also the accumulation of growth-inactive gibberellic acid (GA) and the accumulation of DELLA proteins to suppress growth and generate a dwarf phenotype (Kurepin et al., 2013; Bode et al., 2015). In wheat, this is coupled to a 30-40% enhancement of seed yield under controlled environment conditions (Dahal et al., 2014) as well as natural field conditions (Statistics Canada, 2013). This is reminiscent of the pleiotropic effects observed for semi-dwarf cereal cultivars that spearheaded the Green Revolution of the 1950s and 1960s (Peng et al., 1999; Hedden, 2003). Thus, exploitation of winter cereal cultivars combined with standard plant biotechnological approaches to modulate the expression of *CBFs* may represent an important methodology for the generation of the next green revolution needed to maintain crop productivity at a level sufficient to feed the growing human population under projected increases in the severity and frequency of abiotic and biotic stress due to global climate change (Porter et al., 2014).

Table 1. Global average attained yields and maximal yields for major cereal crops. All data are based on FAOSTAT (2014) and the US Department of Agriculture (2014). Yield Gap was calculated as maximal yield – average yield / maximal yield x 100%. Superscript letter indicates the country which attained the maximal yield: a, Australia; b, New Zealand; c, USA; d, Jordan; e, Germany; f, Canada.

Global Average		Maximal Yield	
Crop	Attained Yield (T/ha)	(T/ha)	Yield Gap (%)
Rice	4.3	10.8[a]	60.2
Wheat	3.1	15.6[b]	80.1
Corn	5.0	10.0	50.0
Sorghum	1.4	12.7[d]	89.0
Oats	3.5	5.3[c]	34.0
Rye	1.8	5.5[e]	67.2
Barley	3.0	8.0[e,f]	62.5

NEWS AND VIEWS

Trees in urban areas may improve mental health

Doctors prescribe fewer antidepressants in urban areas with more trees on the street, according to recent UK research. The study examined the link between mental health and wellbeing and the presence of trees in London neighbourhoods. Its findings support the idea that maintaining a link to nature, even in an urban area, may help provide a healthy living environment. Natural features and green spaces in urban environments provide a variety of ecosystem services, such as reducing air pollution and supporting urban biodiversity. Previous studies have also shown that people with access to urban green spaces benefit from positive impacts on mental health and wellbeing. Much of this previous work has used self-reported surveys of mental health, and tends to look at the overall amount of greenery in an area, instead of examining specific aspects of the natural environment in cities. To approach the topic from a different angle, the researchers identified a quantitative indicator for mental health service provision: the number of prescriptions issued for antidepressants. Using freely available government data, they could establish the number of antidepressant prescriptions per 1000 people living in 33 boroughs of London, during 2009–10. They also looked at the number of trees growing along streets in the boroughs, again using comprehensive publicly available government data. This excluded trees planted in parks, gardens and other urban green spaces. Their analysis took account of various confounding factors that may also influence mental health, such as socio-economic status, employment levels, number of smokers and average age in each borough. The average street tree density in London boroughs was 40.2 trees per kilometre, with figures ranging from 15.7 to 81.3. Antidepressant prescription rates per 1000 people varied between 357.9 and 577.8. Statistical analysis of the results found that a higher street tree density of one tree per kilometre was associated with 1.18 fewer antidepressant prescriptions per 1000 people. However, the study did not attempt to identify a mechanism for this association. The researchers suggest that this should be the goal of further research, which could also examine seasonal variations in prescription rates, gender differences, or make analyses at a more detailed geographical scale. The researchers noted several limitations of their study. For instance, although the statistical methods used can help control for confounding factors, there may be some effects that were not identified or adequately controlled for. Nonetheless, the study's authors suggest that their findings provide evidence that maintaining or planting urban trees could form a part of public projects that include stress reduction and improved mental health for urban populations in their aims. Examples of such projects include the UK's 'Big Tree Plant', which planted one million trees in cities, towns and neighbourhoods during 2010–2015.

Source: Science & Environment Policy,

Smart phones cause cervical problem

Imagine carrying a 10-year old child around the neck for several hours a day. That's what smart phone users are doing to themselves for two – four hours every day. The result is a hunch that

strains the neck and causes degeneration of the spine to such an extent that the patient may even need surgery. Dubbed as 'text neck' the phenomenon has emerged as a leading cause of cervical problems in the state. Spine specialists from different districts of U.P. who gathered in Lucknow for a training workshop estimated that about 30% of all cervical problems were linked to text neck.

Source: From Times of India

Cooking fires poisoning air we breathe

Every year, one million people – among them at least 100,000 children – die prematurely in India because of the simple act of cooking, the Institute of Health Metrics and Evaluation's latest study says. Ambient air pollution kills 627,426, road accidents 273,835 and complications from inadequate sanitation cause 111,624 deaths. Cooking with polluting fuel constitutes a significant health and environmental hazard, indoor air pollution affecting more Indians than residents of any other country.

Source: Times of India, Lucknow

Latest emission control technology could eradicate harmful air pollution hotspots

Switching to the best available emission control technologies could eliminate 99% of particulate matter pollution 'hotspots', a new study suggests. The researchers reached this conclusion by expanding the local-scale capabilities of an existing computer model that estimates the effects of air pollution policies and control measures.

Particulate matter (PM) pollution has been linked to a wide range of health problems in humans, from heart disease to lung cancer and diabetes. In the EU, the Air Quality Directive1 (AQD) sets limits on the airborne concentrations of several pollutants, including PM. However, many Member States have found it difficult to keep all areas below the limit values set by the AQD, particularly in densely populated urban areas. The recent Commission Clean Air Policy Package proposes new emission limits for PM and its precursors, so it is important to assess the possible effects of different emission mitigation and policy scenarios on pollutant concentrations.

Computer modelling offers a way of doing this, by allowing the estimated effectiveness of different policies and control measures to be compared. One such model is GAINS, a Europe-wide model. It has a resolution of seven by seven kilometres, which means it can underestimate PM concentrations in smaller towns and settlements, and at local hotspots, such as streets lined with buildings.

This study addresses this limitation by providing a more accurate estimation of PM10 (PM with a diameter of less than 10 micrometres) concentrations over smaller scales, to the level of streets. It adapted GAINS to include past PM10 monitoring data, including street-level data, from the European Air Quality Database (AirBase) with a new way of estimating PM10 levels based on how and where they are produced. This allowed areas with higher traffic levels, and therefore higher PM10 emissions, to be better accounted for.

The researchers modelled two scenarios and estimated their effect on PM10 levels by 2030. The first scenario used only currently approved legislation ('CLE'), while the second assumed that the most efficient control technologies currently available are used (maximum technically feasible reductions scenario or 'MTFR'), but without any behavioural changes, fuel switches or local measures. The modelling covered more than 1850 monitoring stations, including those in over 700 European cities and towns. This included 80% of the stations which had exceeded EU limit values in 2009.

Exceedances on PM10 levels are mainly related to daily limit value, while the model is designed to work with annual mean concentrations. To deal with this discrepancy, the authors used an 'equivalent annual mean concentration limit' of 30 $\mu g/m^3$ (micrograms per cubic metre). This was used as the equivalent annual standard above which daily AQD limits would be exceeded with a statistical uncertainty of ± 5 $\mu g/m^3$. Therefore, if levels were 25 $\mu g/m^3$ or below, a station was considered 'safe' from non-compliance with AQD limits.

Under the CLE scenario, 80 stations (4%) remained above 30 $\mu g/m^3$ PM10, compared with 17% in 2009. More than 10% were estimated to be higher than 25 $\mu g/m^3$. Areas in southern Poland, the Czech Republic, Slovakia, northern Italy and Bulgaria were still at risk of noncompliance by 2030. Under the MTFR scenario, compliance by 2030 was much improved, with 99% of stations below the 25 $\mu g/m^3$ limit, although several stations were still close to the 30 $\mu g/m^3$ limit. However, even under the MTFR scenario the authors concluded that some hotspots may persist due to one-off events, such as forest fires. An additional problem noted by the authors, for which there is currently no simple solution, is the resuspension of road dust by passing traffic.

These results suggest that if current legislation is successfully implemented, average PM10 values can be expected to fall by 2030. However, a large proportion of the European population, particularly in Eastern Europe, is likely to continue to be exposed to PM10 concentrations exceeding AQD standards unless further action is taken.

Source: Science for Environment Policy

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8 -10 Sepember 2015; Hamburg, Germany
Local Organizer Gerlinde Löbkens TuTech Innovation GmbH
Harburger Schlossstrasse 6-12 21079 Hamburg, Germany T
Website: http://ramiran2015.de
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11-13 November 2015, Lucknow, India
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