ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

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IN THIS ISSUE

President ISEB's Message

International Society of Environmental Botanists (ISEB) was founded at the National Botanical Research Institute, Lucknow (NBRI) on 3rd December 1994. The Society has strong linkages with NBRI, where it has flourished over the years and the two maintain a symbiotic relationship.

During the past fourteen years, ISEB's growth and popularity has increased manifold. Its quarterly publication, ***Environews***, which aims to create awareness about various environmental issues and the role of plants in environmental protection and biodiversity conservation, in a semi-popular format, has succeeded in winning admirers all over the world. The first issue of ***Environews*** appeared on 1st January 1995 and since then it is being published regularly. Not only leading environmental scientists/plant scientists of India but many well known authorities from U.K., U.S.A., Germany, Canada, Switzerland, Spain etc. have been regularly contributing articles to this magazine. Some of the articles published in ***Environews*** have been cited in research papers published in leading foreign research journals.

250 odd membership of ISEB includes highly distinguished individuals like Fellows of Royal Society of London, Fellows of Indian National Science Academy, Bhatnagar awardees, past and present directors of National laboratories, vice-chancellors, professors, chief engineers and conservators. Some of the members, though not trained scientists, or researchers, are confirmed and committed environmentalists like High Court judges, civil servants, bureaucrats, journalists and members of the corporate sector. The membership of ISEB extends to countries like U.K., U.S.A., Spain, Canada, Sri Lanka, Bangladesh etc.

Besides organizing educational and awareness programmes for rural and urban masses, educational programmme, scientific lectures, film shows and training programmes were organized for students in collaboration with **NBRI** and **Indian National Science Academy**. ISEB also organized three International Conferences on Plants and Environmental Pollution in collaboration with NBRI during 1996, 2002 and 2005. These conferences were attended by distinguished scientists from over 30 countries of the world.

ISEB website (http://isebindia.com), which was set up five years back has become immensely popular. This site has received over 12500 hits from 62 countries. Fairly large amount of data is routinely down loaded from it.

The Fourth Conference to be held at the National Botanical Research Institute, Lucknow is being planned for February 2010.

I wish to record my deep appreciation for this flourishing symbiotic relationship between NBRI and ISEB.

I also extend my warmest greetings and best wishes to the members of ISEB and readers of ***Environews*** for the **New Year 2009**.

Dr. Rakesh Tuli
President ISEB & Director NBRI

Best wishes for

A Very Happy & Prosperous New Year 2009

From:
International Society of Environmental Botanists

LETTERS

Many thanks for this highly interesting newsletter - please keep sending them to me. Kindly find newsletter of the UNESCO Office in Doha attached, and feel free to circulate it to interested colleagues/persons.

Benno Boer
UNESCO, **Doha**
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Many thanks for your message and for your kind invitation regarding my participation in ICPEP-4. I will be very pleased to serve on the International Advisory Committee (IAC) and help in making ICPEP-4 another success.

I will step down from my full-time responsibilities at the University of Minnesota effective December 31, 2008, while maintaining my connections there. I will continue to be fully involved in research, editing Elsevier's Book Series: "Developments in Environmental Science" and participate in national and international committee activities. I will also continue my collaboration with colleagues in Mexico and Canada.

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The Nature Conservancy has so much to thank you for and so do I. This year, we made real progress in protecting and restoring Earth's irreplaceable habitats. This includes many notable successes in special places around the world, from the United States to Australia. One of our most notable conservation achievements in our worldwide conservation efforts this year was in Australia, where we've partnered with a leading in-country conservation organization to purchase a huge piece of land — nearly 1.7 million acres!

This acquisition will link two national parks and will protect more than 19 million contiguous acres in the Central Australian desert, recognized as one of the five great wilderness areas in the world. Yet, as we look ahead to 2009, we still have a long "To-Do" list of global conservation initiatives to tackle.

With your help, for instance, we can address unprecedented forces like climate change that threaten Earth's natural systems through our *Campaign for a Sustainable Planet* — the largest conservation campaign in history.

Thank you for everything you do to preserve the extraordinary natural heritage of our planet.

Mark Tercek
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I thank you kindly for your request that I serve on the ICPEP-4 International Advisory Committee scheduled for February, 2010. It is with humility and honor that I am pleased to accept the position with the conditions you have indicated. Furthermore, it is my fervent hope that I will be in a position to attend the meeting and participate in some capacity. While forthcoming conditions will determine that scenario, I will be happy to contribute what I can for the planned success of the meeting. I think that it is most important that we do all possible to contribute to public and political awareness the stated objectives of the Society. There has never been a greater need.

Richard F. E. Crang
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The last days of this exciting and sometimes distressing year have commenced, and I would like to take the opportunity to wish you some relaxing and peaceful holidays and a Happy and Prosperous New Year 2009! Hopefully, the next year will bring peace, good health, success and friendship to all of us, in spite of all the imminent threats to peace and welfare. I am looking forward keeping contact with you in the future

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WELCOME NEW LIFE MEMBERS

Prof. S.B. Chaphekar is a product of one of the oldest schools of Ecology in the country, established by late Prof. F.R. Bharucha, in early forties of twentieth century, at the Institute of Science, Bombay., Prof. Chaphekar studied Urban Ecological problems in Mumbai and researched for solutions. He coordinated national project on Air Pollution and Plants, sponsored by the Ministry of Environment and Forests, New Delhi. He evolved guidelines for development of Green Belts in the country, demonstrated methods for phytoremediation of polluted waters and showed that the toxic land of metal mines and fly ash from thermal power stations can be stabilized with plants possessing suitable characters. Dr. Chaphekar taught and successfully established multi-disciplinary approach to environmental research in his '*alma mater*', the Institute of Science, Mumbai. He also helped establish Salim Ali School of Ecology in Pondicherry University and introduced Environmental Botany course in Pune University from where he retired in 1995. He is presently involved in an NGO activity for propagation of the concept of optimization of water management ethic at all levels of the society, starting with school children.

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Dr. (Mrs.) Naheed Ahmad is a Reader in the Department of Botany University of Patna.

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Prof. Arun Arya is Professor and Head, Department of Botany and Coordinator, Environmental Science Program, The Maharaja Sayajirao University of Baroda. Prof. Arya is a Fellow of Indian Botanical Society and Indian Association for Air Pollution Control. He has published 105 research papers and 10 books. He presented his research findings in Japan in 1993 and Italy in 2008. Prof. Arya co-chaired a session on Eco-regions in 12th World Forestry Congress held in Canada in 2003.

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Prof. Yash Pal Kalra (FAOACI, FCSSS, FISAB, FISSS, FNAAS) is a Soil Chemist at Canadian Forest Service, Northern Forestry Centre, 5320-122 Street, Edmonton, Alberta T6H 3S5, Canada.

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Dr. (Mrs.) Alka Kumari obtained her Ph.D. degree in Botany from B.R.A. Bihar University, Muzaffarpur (Bihar) in 2002 on her thesis entitled "Morpho-taxonomy, Ecology and SEM Studies of spores of *Helminthostachys zeylanica* (L.) Hook. Of Bihar State". She joined Pteridology laboratory of National Botanical Research Institute as a Research Associate in DST sponsored project "Diversity and distribution of Pteridophyte flora of Kumaon Himalayan region with special reference to threatened taxa". Dr.Alka received Young Scientist award from DST on the project entitled "Screening of fern and fern allies for phytoremediation of noxious metals and metalloid loaded industrial wastes". During this period, she worked on metal uptake by Pteridophytes and biochemical changes due to metal stress of fly ash. She has recently been awarded a research project under DST, WOS-A scheme on" Prospecting of bioactive molecules from Pteridophytes and metabolic adaptations to metal loaded industrial wastes.

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NEWS FLASH

Dr. S.C. Sharma, Vice President, International Society of Environmental Botanists visited North Eastern Hill University (NEHU), Shillong from October 21 to November 4, 2008 on the invitation of Prof. Pramod Tandon, Vice-Chancellor, NEHU. Dr. Sharma to advised NEHU in the Bio-aesthetic Planning and Horticultural R&D programmes at the University Campus, which will be the venue of Indian Science Congress in January 2009.

Dr. M. L. Khan, Life Member of ISEB and Associate Professor and Head, Department of Forestry at North-Eastern Regional Institute of Science & Technology (Deemed University), Nirjuli, Arunachal Pradesh has been elected to the Fellowship of the National Academy of Agricultural Sciences (FNAAS) in recognition of his outstanding contribution in forest ecology, forestry, biodiversity conservation and agro-forestry with particular reference to evaluation of traditional agro-forestry systems and designing of suitable agro-forestry models. He is also engaged with the studies on the phylogeny and genetic diversity of plant species of Eastern Himalaya. Dr. Khan has done Ph.D. and postdoctoral research at North-Eastern Hill University, Shillong under the supervision of Prof. R.S. Tripathi, FNA.

Botanist in Urban Environment

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The Urbanization Process

While addressing the World Conference on Environment at San Fransisco in 2005, the then Secretary General of the U.N., Kofi Annan, stated that in the middle of the last century about a third of human population lived in cities, the number increased to 50% by the end of that century and that in another 20-odd years, 60% of humans will be urbanites. There were 1,022,400,000 people in big cities (more than a million population) in the year 2000. Since villages are gulped by towns, towns are rapidly getting converted into cities (population – > 100,000) and cities into big cities or metros (population > 1 million), it is reasonable to consider a habitat of over 100,000 population as an urban area. Considering the fact that the present human population is already six billion, the expanding frontiers of urban habitats invite concern.

A majority of these expanding cities is in developing countries. In Maharashtra for example, big towns with population exceeding one lakh increased from 12 in 1961 to 27 in 1991. Percentage of urban population of big towns also increased from 60.49 % to 77.83 % in the same period. Figures for cities, apart from Mumbai, also show a trend of increasing populations. The cumulative effect of meeting even the minimum needs of this population – food, shelter, clothing and employment, would cause a degradation of the environment, especially since development of infrastructure in these areas cannot keep pace with the rapidly swelling urban populations.

Healthy Tree Cover, The key to good environment

The World Conference dwelt extensively on this problem and suggested that some fifty-odd selected big cities in the world should be developed as "ecologically sustainable, economically dynamic and socially equitable" cities for future urban citizens. Twenty-one action points were suggested to put these cities on path to greener, healthier environments for the current residents and to the approximately one million people that migrate globally to cities each week. The goal for development of green cities is to have public parks within half a mile of every city resident by the year 2015, to reduce green house emissions by 25 % by the year 2030, and zero % waste going to landfills and incinerators by 2040. For achieving these goals, one has to study the urban habitats for their environmental problems and look for solutions. Since environment is often assessed on the basis of green cover it has, a botanist cannot afford to remain aloof from urban problems. In this context, many cities in the country should use the expertise of botanists.

Mumbai – The *Urbs Prima* of India

If anyone wishes to look deeper into the urban environmental problems, one does not have to go far. A metropolitan city like Mumbai provides an example where environmental problems are calling for urgent corrective steps. Horizontal and vertical expansion, adverse changes in land use, degradation of land,

**Formerly Professor of Botany, Institute of Science Mumbai & Professor of Environmental Science, Pune University*

pollution of air and water, including coastal waters, noise pollution, increasing built up area at the cost of virgin and agricultural land, mountains of municipal solid waste – you name the problem and it is there staring at you. Heat island effect is perceived for decades and frequency of atmospheric brown clouds is on an increase affecting health of people, especially children.

The Biotic (Human) Factor

Since humans are always (and most justifiably) blamed for degrading the environment, let us look at an important aspect (the mere existence of numbers) of this biotic factor closely as it exists in Mumbai. With minor variations and modifications, lessons from this city should be applicable to other rapidly growing cities in the country.

The administrative area of the city has increased significantly since 1957, when Bombay became Greater Bombay (now Bruhan-Mumbai). The population of Bombay was estimated to be 13 million in 2005, on a land area of 438 sq. km. This works out to an overall population density of 29,680 per sq. km. More than 60% of inhabitants of the city live without proper houses, they live in slums and on pavements.

For more than a million vehicles, there is hardly any parking space, their movement on roads is also at a snail's pace. Measures are taken and or planned in the form of high-rises for pavement and slum dwellers, sky-walks and subways for pedestrians, construction of fly-overs and vestibules to supplement roads for vehicular traffic and subterranean (metro-rail) and aerial (monorail) railways as additional means of mass transport. An organized water transport along coastal areas of the city is also under consideration.

Urban Greenery – Is Anyone Serious?

Trees are recommended for pollution abatement in urban-industrial areas, for aesthetic improvement, beautification of urban settings; improvising pattern in urban landscape; complement to urban design; softening of microclimate - radiations, temperature, relative humidity; sorption of air pollutants; indication of pollution; habitat for avifauna; shelter for poor humans; barriers, fences to mark boundary. Pollution-sensitive plants are also recommended for indication of pollution as an early warning system for protecting human health.

The tree census carried out in the year 2000 revealed that there were 5,00,024 trees in the city, compared to 11,914,398 humans (as per 2001 census) returning a ratio of one tree per 24 humans. No standard has been suggested for this ratio so far, but the proportion appears to be too low to be acceptable for any environmental norm.

Area-wise, there were 312 trees per sq.km. There are several municipal wards in the city, where the number of trees per sq. km is less than 1000, but in some other wards that are a part of the old city there are more than 15,000 trees per sq. km. Just as human population density varies greatly in different areas, tree density also varies tremendously, giving tree: humans ratios of 1: 10 at the highest, to 1: 134 at the lowest end.

Land – A Scarce Resource in Big Cities

In Mumbai, where an acre of land sells for tens of crores of rupees, value of land need not be overemphasized. With multiple demands on space, it is not easy to spare land for plantation. It therefore becomes necessary to ensure that optimal utilization of land is planned in cities and that every tree planted survives to maturity and carries out its ecological functions to the maximum. Just as norms have been developed for green belts around industries at the instance of Central Pollution Control Board, it is necessary to develop norms for development of greenery in urban areas, corresponding to different types of urban land-use.

Urban Stresses Affecting Trees

There are several stresses operating in urban habitats that affect plants adversely. These are: excessive compaction, presence of rubble, cement and construction waste, municipal solid wastes, presence of industrial solid waste, presence of leachates from industrial liquid waste, quantity and quality of water available, chopping, illegal trimming, mutilation of trunk, branches, canopy, change of land use, road excavation, road widening, pollution of air, urban amenities, underground - drains, cables, etc., salt spray along coastal areas, perception of tree as traffic hazard, perception of tree as a source of allergens, perception of tree as a source of litter, perception of tree as a habitat for insects, mosquitoes and rodents.

Recommendation about planting indigenous tree species is easy to make, but difficult to practice. Propagation of several indigenous tree species is not standardized; domestication of trees found only in wilderness is still a far cry. Professional horticulturists design and maintain beautiful gardens even in small patches of land, as is evident from several traffic island gardens. It is felt however, that these are mainly islands of beauty, maintained at great cost, paid by industrial / commercial interests. They hardly answer the demand for urban trees contributing ecologically sustainable environs.

Architect's Vision of Trees

Normally town-planners reserve places for trees in the development designs of areas. Architects also include green spaces in their designs for institutional or residential areas. In both the cases however, the emphasis is on aesthetics; ecological sustenance against urban stresses, if present, is incidental. During a scrutiny of proposals for development of residential/commercial estate in the State of Maharashtra, it became evident that most planning was done taking for granted, existence of ideal conditions for tree growth. Selection of tree species was based on ease of growth. It is generally ignored that trees with horizontal buttresses, planted near compound or other building walls create instability to those structures. Trees with deep roots ruin underground water tanks and other services. While planning plantation of trees on footpaths, less than a sq. meter opening is marked per tree, as a result of which hardly any space is left around a mature tree, for entry of water in the ground for roots to absorb, or that the compactness of ground prevents roots from breathing freely. Trees producing abundant pollen, carried on air currents, are looked at with hostility by many citizens fearing allergic reactions and they would chop off flowering branches at first available chance.

Transplantation of existing trees is recommended without consideration about possible success of the costly exercise. It is a fact that all tree species can't be transplanted with success; either can not inherent character of the species concerned, or the level of maturity of the individual tree, apart from managerial pitfalls. Plantation on municipal waste dumps is recommended forgetting the need for proper waste treatment. Management of water for irrigation also needs to be meticulously planned.

Roadside Trees

Sustainable roadside trees have to be able to tolerate auto-exhaust; at the same time, their branches should not affect vehicular traffic. Seasonal phenomena like leaf-fall and fruit-fall may create traffic hazard with incalculable harm. Along wide roads with high-speed traffic, trees and bushy perennials have to be planted carefully, taking their canopy shapes and sizes into account, especially on inner arc of bends and medians.

Trees on the Waterfront

Trees along waterfronts, especially along coastline, need to be tolerant to salt-sprays, high soil salinity and capable of blooming effectively in high humidity conditions.

Role of a Botanist

Under the conditions discussed above, a botanist has his / her role already cut out. There are many botanists who are experts in identifying and describing wild, indigenous as well as urban trees, along with their natural distribution regions. What is necessary is to understand the ecological amplitude of the indigenous species for their successful introduction in urban areas. Methods of their propagation also need to be standardized, for their conservation, if they are anywhere near Red-Data books. Biological information in all possible detail, from root shape, size and growth behavior, to branching pattern of stem, size and shape of shoot and canopy, season and abundance of bloom, pollen and fruit production, etc. is necessary for selection of tree species in human activity-dominated habitats.

Much of this information is available in literature, but is rarely accessed by architects and town planners, as they have other priorities. They look at trained botanists for ready information about growth habits of trees, their pollution tolerance and absorption potential, their reaction to subterranean structures and service facilities, their benefits and nuisance values, etc. A conventional trained botanist is hardly equipped at present, to answer several queries posed by development planners. It is time that botanists collect and compile the relevant information, useful in varied urban situations. Like wildlife botanists and naturalists and agricultural botanists, the time now has come for 'urban botanists' to take up the challenge to make urban areas hospitable and ecologically sustainable, as suggested in the 2005 U.N. World Conference on Environment.

A Vignette of Four Decades of Air Quality and Plant Response Research

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Introduction

In the early days of air pollution science, the major emphasis of terrestrial vegetation effects research had been on emissions from point sources, visible foliar injury on native and cultivated plants and forest damage caused by primary pollutants such as sulfur dioxide (SO_2). Initially, I too followed that path. However, as urban complexes and mega cities (population >10 million) grew in numbers (from 2 to 32 in the last 50 years) and as photochemical smog (ozone, O_3) and long-range transport and deposition (both wet and dry) of secondary air pollutants such as sulfate and nitrate aerosols became an

increasing concern, emphasis shifted from local to regional scale studies. Currently, tropospheric O_3 is clearly the most important phytotoxic air pollutant worldwide. Visible O_3-induced foliar injury has been reported on cultivated and/or native vegetation from some 38 countries globally and from some 22 states in the US including Minnesota, where we were the first to identify such injury. In addition to field surveys for assessing the visible effects, hundreds of studies (includes our own experiments) have been conducted under laboratory conditions in controlled environment fumigation chambers to characterize dose-response relationships with both primary (e.g., SO_2) and secondary (e.g., O_3) air pollutants. Those were univariate, in those experiments all growth regulating variables were maintained at relatively constant levels, except for the pollutant [e.g., SO_2, O_3] of interest, studies that mainly consisted of acute exposures (relatively high pollutant concentrations from a few to several hours on one or more successive days). As our knowledge of air pollutant-induced changes in plant biology and functional eco-physiology increased, the importance of chronic or whole growth season exposures (e.g., with O_3) and responses became the focus of numerous studies requiring the use of greenhouse and field exposure chambers (from small cuvettes or gas exchange chambers and Continuous Stir Tank Reactors, CSTRs to large open-top chambers, OTCs), although many of them continued to represent univariate experiments. In that context, we were the first to develop a computerized field fumigation open-top chamber system to mimic the ambient conditions with the inclusion of both SO_2 and O_3, but we abandoned that approach after tornadoes destroyed our facilities two years in a row (half a million $ each year X 2) and I realized that chambers do not represent the real world.

Nevertheless, yield data generated from field chamber studies in large national or continental scale networks respectively in the US (EPA's National Crop Loss Assessment Network, NCLAN) and Europe (European Open-Top Chambers Programme, EOTC) were used to formulate ambient air quality regulations or standards and objectives to protect crops and forests against the adverse effects of O_3. However, those efforts continued to generate an ongoing debate about the validity of using chamber-based univariate data for regional scale crop loss assessment under ambient conditions (see the discussion below). Nevertheless, the current view is that in the US, ambient O_3 causes 5 to 15% yield loss in important agronomic and horticultural crops. Because of the debate associated with the use of chambers, most recently, a few scientists have begun to use chamber-less, free air, trace gas exposure systems for studying the effects of O_3 (e.g., FACE technology). In contrast, during the last ten years, I have directed my efforts to developing numerical methods to account or apportion the contributions of individual pollutants (e.g., O_3, NO_x) in ambient air (pollutant mixtures) and individual climate variables such as air temperature and precipitation to the overall growth and productivity of a perennial crop such as alfalfa under field conditions (a total of 72 real world exposure treatments were involved in our study). Such studies require intensive measurements of the independent variables and multi-point measurements of the crop growth rate prior to harvest at multiple locations to account for the spatial and temporal variability. Many consider that approach daunting, but it represents the real world. Meanwhile, in Europe, emphasis changed from the use of air concentrations to modeling pollutant fluxes from the atmosphere on to the plant canopy for uptake through the stomata or for computing the actual absorbed dose. However, results from such modeling have also been the subject of some argument, since they have not been fully validated with independent sets of data.

In addition to changes in the growth and yield of crops, as we and others have shown, exposure to ambient air pollution can negatively alter the nutritive quality and the relative food value of forage species such as alfalfa to ruminant animals in production agriculture. This is an area that requires significant attention.

As noted previously, ambient atmosphere is composed of combinations of multiple pollutants that vary significantly in their concentrations in time and in space and therefore, any observed effect(s) on vegetation is the result of exposure to those pollutant mixtures. However, a particular pollutant, because of its greater phytotoxicity at its prevalent dose (concentration X exposure duration, on one or on repeated occasions) may have a bigger impact at a given time and location (e.g., occurrence of typical visible foliar injury). Nevertheless, presence of two or more pollutants can result in additive, more than additive or less than additive effects. That makes it very difficult to conduct artificial field exposure studies that are both realistic and can explain the stochastic (random) relationships between cause and effect. Further, such studies can only define a portion of the total response surface. They are frequently limited by small number of treatments due to logistic and financial considerations. That is one of the major reasons for the approach that we have taken in our alfalfa studies described previously.

There is a very important need to examine the entire response surface, because many non-essential chemicals (e.g., O_3, heavy metals) stimulate plant growth and other biological processes at low doses, but inhibit

such processes at higher levels. That phenomenon known as "hormesis" represents an advantage gained by the individual species from the overall resources and energy initially allocated for detoxification and repair, but in excess of that needed to repair the immediate damage. As hormetic effects vary with the plant species, it can result in selective advantage for certain members over others in mixed communities.

Although some air pollutant-induced hormetic plant effects have been reported in the literature, so far experimental designs have mostly been constructed to optimize exposure doses above an accepted or perceived level to demonstrate adverse effects and thus, show insufficient potential for detecting or describing "hormesis" and its impacts on the traditional dose–response functions. That would require a change in the use of traditional experimental designs to include cleaner air treatments. Such a shift is also critical in examining interactive effects of multiple plant-growth-regulating variables (both air pollutants and climate parameters such as air temperature, soil moisture etc., that are required for normal growth and development) in the ambient environment and in the context of climate change.

Compared to O_3, sulfur is an essential plant nutrient, with soil being its main source of supply. The stimulatory effects of atmospheric S on plants growing on soils that have marginal sulfur content (farmers in Minnesota could see it during the 1970s, near a new point source), is not considered to be an "hormetic" effect by classical definition. Nevertheless, sulfurous air pollutants can act as both stressors and as nutrients for plants. However, it is unclear as to what extent metabolism contributes to the detoxification of absorbed sulfur gases, as there is no clear-cut transition in the level or rate of metabolism of the absorbed sulfur gases and their phytotoxicity. Moreover, the effects of sulfurous air pollutants on plant functioning are strongly dependent on the sulfur status of the soil.

On a global scale, fossil fuel combustion is the main source for both atmospheric SO_2 and NO_x. As with S, nitrogen is an essential element and a fertilizer. Although there are reasons to believe that at low concentrations gaseous N can be stimulatory, there are no specific studies conducted to address that issue. With the exception of ammonia, in general ambient concentrations of gaseous N species do not exist at phytotoxic concentrations. Aside from its critical role in photochemistry and in the generation of O_3 and other oxidants, excess bulk (wet and dry) deposition of total nitrogen is known to adversely alter native plant population structure by allowing the invasion of grasses into perennial, herbaceous plant communities, as in Europe.

Relating Source Emissions to Receptor Sites

As indicated previously, early studies on air quality and terrestrial vegetation effects were directed to single or specific point sources. As secondary air pollutants and area or regional scale emissions from multiple sources became increasingly important, source apportionment methods were developed for air quality management (control strategies). Source apportionment is the estimation of the contributions of elemental emissions from specific natural and anthropogenic sources to the airborne concentrations at a given location. Integrating source apportionment methods to ecological effects studies would represent a major step in establishing source - effect relationships under ambient condition, but would require very close collaboration between plant and atmospheric scientists, as in our current efforts in Minnesota. In the overall context, receptor models are applied to elicit information on the sources of air pollutants from the measured constituent air concentrations. Typically, receptor models use the chemical composition data from repeated sampling and analysis of airborne particulate matter at a given location. In such cases, the outcome is the identification of the pollution source types (e.g., power plant, petroleum extraction plant, mobile sources, vegetation) and estimates of the contribution of each source type to the observed air concentrations at the receptor location.

Elemental Tracers of Source Emissions and their Accumulation in Receptors

Under ambient conditions responses of sensitive plant species can be used to assess relative air quality. Development of pollutant specific foliar injury symptoms on sensitive plant species has been used as a biological indication of the relative air quality at a given location and time (for example, at more than 20,000 sites in the UK during 1990). In some cases progressive disappearance of a particular species in a given geographic area has also been used as an indication of deteriorating air quality. Another indicator is shifts in the plant populations within a community.

Traditionally, in addition to foliar injury surveys, a number of investigators (including our group) have used sulfur accumulation in plant tissues at various distances along directional transects from a point source (e.g., coal-fired power plant, metal smelter, petroleum refinery, natural gas extraction plant) to map zones of impact or no impact in predominant upwind and downwind areas. We have used differences in the concentrations and ratios of total (absorbed), inorganic (stored) and organic

(assimilated) S in the plant tissue to differentiate the relative point source plume impacts versus the contribution of the soil. We have also used an Elemental Enrichment Analysis (EEA) to separate the contributions of the atmosphere from those of the soil to Austrian pine *(Pinus nigra)* foliar concentrations of total S and other elements. Based on the least amount of variance between several elemental concentrations in *P. nigra* needles and the corresponding soils in the plots, aluminium was chosen as the normalization element for computing Elemental Enrichment Factors. Those results identifying sites with various levels of impacts were in close agreement with the results of measured plume transport and deposition in the complex terrain of the study area, before and after the installation of a SO_2 control system. Those results were verified independently by plume tracking over a number of years using ground-based, but mobile Correlation Spectroscopy (CoSpec) and a fast response pulse fluorescence SO_2 analyzer. Thus, EEA offers a significant advancement in the traditional application of S accumulation in plant tissues to map plume impacts.

With a different, but a more sophisticated, highly successful approach, in the West White Court Case Study in Alberta, Canada, abundance of stable S isotopes (^{32}S: ^{34}S) was used as plume tracers and S deposition into the ecosystem. However, caution is warranted in using single elemental isotopes as tracers in impact assessment. For example, the ^{32}S: ^{34}S in the emission must be distinctly different from the background value as was the case in the studies at West White Court. In contrast, we were unable to find a similar differentiation regarding a coal-fired power plant plume in Minnesota, USA. The probability of success is increased with the application of multi-element stable isotopes. Dual elemental isotopes of ^{13}C and ^{18}O in stem cellulose have been used to examine the stress responses of tress to air pollution in an urban corridor in Quebec, Canada. Another step in the application of stable elemental isotopes in environmental research is the use of three elements, for example S, N and O (i.e., SO_4^{2-} and NO_3^-). In addition to the West White Court Case Study with S, recently the stable isotope ^{17}O signal of NO_3^- has been used as a tracer of atmospheric NO_3^- and was found to be a more robust tracer of atmospheric NO_3^- than ^{15}N and ^{18}O methods. ^{17}O can also be used as a tracer of fresh (local) versus aged (transported) O_3. Certainly the use of stable elemental isotopes allows the separation of anthropogenic from the influence of natural sources. It also allows the tracing of the fate of the element through the ecosystem components and consequently its impacts. However, where multiple source plumes are involved with not so distinctly different stable isotopic signals, other source signatures must be used.

One aspect of receptor modeling involves the use of US EPA's "Speciate" source finger print library (available on the Internet) on inorganic elemental composition of emissions from various types of sources. Here elements such as As, Be, Cd, Cr, Hg, Ni, Pb, Rb, Se, Sr, Ti,V and others are included in the source apportionment methodology. Many of these and other elements (both essential and non-essential) accumulate in plant tissues, particularly in lower plants such as the lichens.

The concept of source apportionment and receptor modeling are based on data gathered separately on the chemical composition of fine ($<$ 2.5 μm) and coarse ($>$2.5 μm) particles. Where opportunities for those types of data collection do not exist, because of logistic and financial restrictions, accumulation of elements in plant tissues (receptor accumulation) can be used in source apportionment. An excellent example relates to the use of spatial variability in the elemental composition of lichens throughout the Netherlands to map air quality as influenced through source apportionment.

Relating Elemental Accumulation to Vegetation Effects

With the exception of O_3, many other air pollutants such as SO_2 (S), NO_x - NO_y (N), HF hydrogen fluoride (F) and trace metals accumulate in foliar tissues. As noted previously, normally soil is the predominant source for many of the elements measured in plants. As discussed previously, we have used the Elemental Enrichment Analysis (EEA) to separate the role of the soil from the atmosphere. But in receptor modeling, patterns and variability of multi-elemental accumulation in plants over a region, can be used in source apportionment. Here, the key is the use of multiple elements as source fingerprints (predominantly source specific spectral patterns of elements) and not a single element such as S. The critical requirement here is, to demonstrate co-linearity between the occurrences of the phytotoxic element such as S (SO_2) and the elements (trace metals) used in the receptor modeling.

At this time, there are many studies for example, on the accumulation of S or its metabolic products and plant physiological responses such as changes in photosynthesis.

However, to my knowledge there are no studies relating the dynamics of atmospheric deposition, tissue elemental accumulation and irreversible effects such as yield reductions. Such studies will involve repeated measurements (time series of relating tissue elemental accumulation to growth or yield) and multi-point modeling of chronic relationships of cause and effect. On the other hand, repeated measurements are one of the backbones of atmospheric receptor

modeling. In air pollution – plant biomass effects literature, virtually all of the studies relate to single point, season end harvests and their correlations with some exposure statistic, making it scientifically unsound in attempting to account for the random relationships of cause and effect.

Lower plants such as bryophytes and lichens are excellent accumulators of various elements and can be used in receptor modeling. Particularly species that are epiphytic or those that are representative of ombotrophic plant communities derive virtually their entire tissue elemental signature through atmospheric uptake. The major limitation here is a need for repeated measurements over multiple years to establish a recurring or changing patterns of multiple source contributions to the receptor.

5. Conclusions

While elemental accumulation in biological receptors such as in the lichens, can be used in source apportionment, there are issues associated with biodiversity [loss of sensitive lichen species themselves, as with nitrophobic or SO_2 sensitive species]. A major objective should include long-term impacts on the primary producers (the starting point of energy flow) in the ecosystem. There is evidence that patterns of pollutant accumulation in epiphytic lichens and in their higher plant associates are comparable. Under various SO_2 exposure regimes, tissue S accumulation rates in lichens and strawberry and white pine foliage was found to be similar. Comparison of the S uptake with concentration (*c*) and exposure time (*t*) under similar products of *c* and *t* showed that pollutant uptake of lichens was more dependent on the exposure time than on concentration. A main difference between the lichens and the higher plants is the lack of ability of lichens to dilute the absorbed pollutants through the formation of significant amounts of new plant material with low natural levels of the particular element in question. Thus, lichens are more sensitive and can be used as an early warning system in spatial mapping of impact and no impact zones to assist in the assessment of long-term air pollutant effects on the growth and productivity of the primary producers in the ecosystem.

In the context of the primary producers, even repeated measurements of tissue elemental concentrations by themselves are not likely to account satisfactorily for the stochastic behavior of growth and biomass relationships under ambient conditions, because the combined effects of more than one or multiple growth regulating factors (air pollutant mixtures, air temperature, precipitation, diseases etc.) are in effect. Few scientists have addressed this complex problem of the ambient environment, although there are ways to do so. Many mechanistic or process models have been developed, but most of them have not been validated with independent sets of data. Most recently we offered potential approaches to addressing this issue. Although those are first order efforts, they represent general time series methods that are multi-variant models that can accommodate repeated measurements of tissue elemental accumulation rates. That is in addition to other independent variables such as air temperature, precipitation depth etc. that effect changes in plant growth and biomass under ambient (not experimental) conditions. Thus, repeated measurements of biological responses can be coupled to repeated measurements of elemental deposition/accumulation in receptor modeling in deriving great benefits in source apportionment studies that have so far eluded plant scientists. Equally importantly, such efforts can allow an assessment of the efficacy of air quality regulatory policies (data from before and after the implementation of control strategies).

NEWS AND VIEWS

ICE-FREE ARCTIC?

Soot is darkening ice in the Arctic and speeding a melt that could make the ocean around the North Pole ice-free in summer well before 2050, according to experts. Soot or black carbon darkens the ice and makes it soak up more heat, accelerating a melt compared to reflective snow and ice.

According to experts, the fight against warming of Arctic should be re-directed to focus more on cutting the industrial pollution from soot, ozone and methane in Europe, North America and Russia than any other factor. Reductions in these pollutants would have a greater impact in the next two decades than curbing emissions of the main greenhouse gas – carbon dioxide. The three pollutants – soot, ozone and methane - linger in the atmosphere far less time than carbon dioxide, meaning cuts in emissions would have a quicker impact in cleaning the air.

The Arctic is warming at twice the rate of the rest of the world and ice shrank to a record low in 2007, leading to worries that it could pass a point of no return.

This is not just a climate issue for the Arctic but for the globe as a whole. A thaw would threaten indigenous peoples and wildlife such as polar bears and seals. A melt of the Arctic ice would warm the top of the globe and lead to warming further south. An ice-free Arctic would also make the region more accessible to oil and gas exploration and shipping.

Source: Reuters

BIOFUEL FROM FUNGUS

It was recently discovered that a fungus, *Gliocladium roseus* found in the Patagonian Rain Forest in South America could potentially be used to fuel vehicles in the future. Researchers claim that the fungus has the ability to produce a plethora of unique combinations of hydrogen and carbon molecules unlike any organism in the world, and the product is remarkably similar to the diesel we use to fuel our cars. And, according to a recent report published in Microbiology, scientists are currently working to develop its fuel producing potential.

The fungus is reported to hold several properties that far exceeded current biofuel sources. Current biofuel sources have to be refined before being connected into biofuel, a painstaking and not always environmentally friendly process. The fungus has a clear advantage over these biofuels because it produces mycodiesel directly from cellulose. The shortened production process means a reduction in costs and carbon dioxide released into the atmosphere.

Because current biofuels are derived mostly from food crops that are required to be grown and harvested on a farmland, they have a substantial impact on food supply and prices. The fungus can, however, be grown in factories, eliminating any such impacts.

Source: Clean Energy Nepal

ALUMINIUM ALSO RESPONSIBLE FOR ALZHEIMER'S DISEASE

Aluminium, the third most abundant element on the Earth's crust and most common in our houses, has been found responsible for provoking Alzheimer's disease and speeding aging process, according to researches carried out by the scientists of Biochemistry department at CSM Medical University Lucknow by a team of researchers led by Prof. Abbas Mahdi. Aluminium can be linked with alteration in neuro-behaviour activity. These changes may be responsible for development of age-related disorders, including Alzheimer's disease.

Since Aluminium is mixed with the soil, it comes naturally in the food we eat and in the drinking water as a natural component. It is also used by civic bodies for water treatment. The metal is added to many food products during the manufacturing process. It is also used in some drugs to increase their effectiveness or to make them less irritating.

Source: Gaurav Saigal in Hindustan Times

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CONFERENCES

National Conference on Biofunctions, Biodiversity & Plant Resource Utilization
30 & 31 January 2009; Gorakhpur, U.P., India
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Climate Change: Global Risks, Challenges, and Decisions
10–12 March 2009, Copenhagen, Denmark.
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E-mail: jsha@adm.ku.dk, Internet: http://climatecongress.ku.dk/

5th World Environmental Education Congress
10 - 14 May 2009; Montreal, Canada
Congress Secretariat – JPdL 1555 Peel St., Suite 500 Montréal, Quebec, H3A 3L8, CANADA
www.5weec.uqam.ca; 5weec@jpdl.com

Air Pollution 2009
Seventeenth International Conference on Modelling, Monitoring and Management of Air Pollution
20 - 22 July 2009; Tallinn, Estonia
Claire Shiell, Conference Secretariat, Air Pollution 2009
Wessex Institute of Technology, Ashurst Lodge, Ashurst Southampton, SO40 7AA, **U.K.**
Email: cshiell@wessex.ac.uk
http://www.wessex.ac.uk/air2009rem2.html

First International Conference on Disaster Management and Human Health Risk: Reducing Risk, Improving Outcomes
23 - 25 September 2009; New Forest, UK
Contact: Rachel Swinburn, Conference Manager, Environmental Health Risk 2009
Wessex Institute of Technology, Ashurst Lodge, Ashurst Southampton, SO40 7AA, U.K.
Email: rswinburn@wessex.ac.uk

22nd Asian Pacific Weed Science Conference of Asian-Pacific Weed Science Society
THEME: *Judicious Weed Management- Road To Sustainability*
October 19-23, 2009; G.C. University, Lahore, Pakistan
Contact: Prof. Dr. Gul Hassan
General Secretary APWSS
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E-mail: secretarywssp@yahoo.com

9th International Plant Molecular Biology Congress
25-30 October 2009; St. Louis, MO – USA
Contact: IPMB 2009
MU Conference Office
348 Hearnes Center, Columbia, Missouri, USA
E-mail: ipmb2009@missouri.edu

BOOKS

Perspectives in Plant Ecology and Environmental Biology
Edited by Prithipal Singh
Jodhpur Scientific Publishers (India) 2006
ISBN: 81-7233-415-X
Price: Rs. 1250.00

Risk Assessment for Environmental Health
Edited by Mark G. Robson and William A. Toscano.
San Francisco: Jossey-Bass, 2007
ISBN: 978-0-7879-8319-2,
Price: US $85

Hot House
Global Climate Change and the Human Condition
By Robert Strom
Springer & Praxis Publishing U.K. 2007
ISBN: 978-0-387-34179-8
Price: € 24.95

Global Climate Change
Insights, Impacts and Concerns
By Har Darshan Kumar
Vitasta Publishing Pvt. Ltd., New Delhi, India 2008
ISBN: 81-89766-10-4
Price: Rs 1995

Energy and Natural Resources
Sustainability and Management
By H D Kumar
Vitasta Publishing Pvt. Ltd., New Delhi, India 2008
ISBN: 81-89766-79-1
Price: Rs. 1295

Carbon Nanomaterials in Clean Energy Hydrogen Systems
Proceedings of the NATO Advanced Research Workshop on Using Carbon Nanomaterials in Clean-Energy Hydrogen Systems 2008
Editors: Baranowski, B.; Zaginaichenko, S.Y.; Schur, D.; Skorokhod, V.; Veziroglu, A.
ISBN: 978-1-4020-8896-4
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Environmental Health Risk IV
Edited by C.A. BREBBIA, Wessex Institute of Technology, UK
Series: WIT Transactions on Biomedicine and Health, Vol 11
ISBN: 978-184564-083-5

Environmental Problems in Coastal Regions VII
Edited by C.A. Brebbia, Wessex Institute of Technology, UK
Witpress, U.K. 2008
ISBN: 978-1-84564-108-5
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