ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

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IN THIS ISSUE

ANOTHER FEATHER IN ISEB'S CAP

From: **Secretariat IUBS**

It is my pleasure to inform you that the application for Scientific Membership submitted by the International Society of Environmental Botanists (ISEB) was accepted by the 28th General Assembly of the International Union of Biological Sciences (IUBS), held on 18-22 January 2004, in Cairo, Egypt.

A formal letter to that effect will soon be sent to you by post.

Looking forward to a fruitful collaboration between ISEB and IUBS,

Talal Younès
Executive Director
International Union of Biological Sciences (IUBS)
51 bld de Montmorency, 75016 Paris, France

Date: February 12, 2004

- Informative news, views and popular articles/write-ups on current environmental researches/issues are invited for publication in ENVIRONEWS.
- Environews is published quarterly on the first of January/April/July/October; and is supplied free to all members of ISEB.
- Environews is also supplied in exchange for scientific literature published by reputed organisations.
- All correspondence should be addressed to : **The Secretary, International Society of Environmental Botanists,** National Botanical Research Institute, Rana Pratap Marg, Lucknow-226 001 (India).
- E-mail : **isebnbrilko@satyam.net.in**

LETTERS

Congratulations on getting the membership of IUBS. This will add further respectability to ISEB. My greetings to all colleagues associated with ISEB.

All those associated with ISEB in any capacity ought to think about ways and means for improving the poor financial condition of the Society (ISEB). How long will you be able to find sponsors for bringing out issues of the *Environews*? Will it be possible for you to maintain standards and regularity of publication of the newsletter in case you do not succeed in getting a suitable sponsorship for the purpose?

Addressing a similar situation in the Indian Botanical Society in the recent past, I propose that an appeal should be sent to all Life Members of the Society for making a one-time donation to the Society according to their convenience. The amount thus collected could be made a Fixed Deposit earmarked exclusively for publication of the Journal of Indian Botanical Society. The process, taking off with a humble beginning from my side, culminated in accumulation of a sufficiently huge sum of money within a few months. A similar drive needs to be started for ISEB, I trust.

I enclose herewith a cheque of Rs. 2500/= which may please be accepted as the first step in this direction. A small request sent from the office of the Secretary ISEB to each member individually must bear the fruit.

Prof. Muhammad Iqbal
Professor & Head, Department of Botany,
Hamdard University, New Delhi &
Executive Councillor, ISEB

**Excitingly encouraging gesture of Prof. Mohd. Iqbal. We thank him profusely for the same.*

Dr. P. Pushpangadan
(President ISEB & Director NBRI)

Thanks for the e-letter concerning contents of *Environews*. As you know we recently held the RAPIDC workshop in Bangkok, Thailand gathering scientists from across Asia to discuss the impacts of air pollution on crops and forests in that region. On returning to the UK I prepared a short piece describing this workshop and associated project for the University magazine. It occurred to me that something similar might be appropriate for publication in your newsletter. As such, I have attached to this mail a copy of the piece that was written. Please feel free to use this if deemed appropriate.

Dr Lisa Emberson
Biology Department, Stockholm Environment Institute at York University of York, York YO10 5YW, ***U.K.***

I was pleased to learn, from your paper published in ***Environmental Pollution*** that from time to time International Conferences are organized on "Plants & Environmental Pollution". I desire to come to the next one.

I shall appreciate any information you can give me about it.

Prof. Janusz Szurkowski
Institute of Experimental Physics, University of Gdansk
Wita Stwosza 57, 80-952 Gdansk, **Poland**.

Thanks for keeping us informed about the latest on local and global environmental issues through *Environews*. As you are perhaps aware, information dissemination is an important component of TERI's activities and we come out with number of books, conference proceedings, newsletters and journals on topics of scientific interest. It gives us great pleasure to introduce to you "*Coastal tourism, environment, and sustainable local development*", a deeply insightful publication from TERI. The book is a product of collaborative venture project by three Indian (TERI, National Institute of Oceanography, and Goa University) and four European Institutions (Universidade Nova de Lisboa, Laboratorio Nacional de Engenharia Civil, Instituto Cartographic de atalunya, and Universita Degli Studi di Trieste) and supported by the European Commission's Programme for International Cooperation with developing countries.

The publication explores interface between social and environmental issues relating to coastal tourism. It provides a comprehensive, accessible account of the analyses, results, and decision tools developed to measure, monitor, and manage coastal tourism developments along sustainable paths and opens up fresh perspectives for the development of sustainable strategies. As the chapters unfold you will find this book to be an excellent guide for coastal planners, professionals in the tourism industry, researchers, and those interested in developing a 'sustainability science'.

We would appreciate if you could kindly review the publication in forthcoming issue of your newsletter/journal.

Dr. Sandeep Sood
Information Analyst
Information Dissemination Services
TERI (now The Energy and Resources Institute), New Delhi.

I wish you to be in good health and working, as usually, intensively. I shall be most grateful if you could please inform me if the Proceedings of ICPEP-2, held at Lucknow in February 2002, are already available. We are interested that the Proceedings be a part of our library. Besides, I understand our contribution "***Aquatic Vegetation as Indicator of the Sustainability of Fresh Water Systems: Interactions with the Land Surface***" by O. A. Fernández and others, was accepted for publication in the Proceedings.

Prof. Osvaldo A. Fernandez
Consultant Professor
CERZOS-CONICET, 8000 - Bahia Blanca - **Argentina**

NEWS FLASH

Dr. P. Pushpangadan, whose term as the Director, National Botanical Research Institute, Lucknow was ending on 31 January, 2004, has been given an extension in service for a period of two years by the Government of India.

Dr. Pushpangadan will also continue to be the President of ISEB.

Dr. Ms. Neelima Jerath, Joint Director (Environment), Punjab State Council for Science & Technology, Chandigarh, and a Life Member of ISEB chaired a session on Environment and Health Education at "International Forum on Environment Education for Sustainable Development" held at Beijing (China) from September 8-11, 2003. She also presented a paper on "Education for Sustainable Development in Secondary Technical Vocational Schools: A comparison of 5 Asian Countries".

Dr. R.D. Tripathi, Scientist E-II & Group Leader, Ecotoxicology and Bioremediation Group and Executive Councilor of ISEB worked as member WHO Expert Group on IARC monograph on the "Evaluation of Carcinogenic Risks to Humans, Vol. 87: Lead and Lead Compounds" at Lyon (France).

Dr. U. N. Rai, Scientist NBRI and Life Member of ISEB delivered an invited lecture on "Use of Phytoremediation Techniques in Management of Water Pollution" at Mahatma Gandhi Chitrakoot Gramoydaya Vishwavidyalaya, Chitrakoot (M.P.) on January 23, 2004.

Professor Muhammad Iqbal of Jamia Hamdard, New Delhi, has been elected as the Vice-President of Indian Botanical Society. He will also act as an Editor of the Journal of Indian Botanical Society. Prof. Iqbal is a Life Member and a Councillor of ISEB.

Dr. U. N. Rai, Scientist NBRI and Life Member of ISEB and his colleague Mr. O. P. Shukla (a member of ISEB), have been conferred "Aryabhatt Award" at 3rd All India Science Conference held at National Physical Laboratory, New Delhi during 19 – 21 February, 2004 for their presentation entitled 'Development of Integrated Bioremediation System using Biotechnological Means: Amelioration of Toxic Metals from Polluted Water and Their Management'.

WELCOME NEW LIFE MEMBERS

Shri U.C. Sharma, Director & CEO, ThyssenKrupp JBM (P) Ltd., Tamil Nadu has joined ISEB as a Life Member. Prior to joining the present assignment, he had served BHEL, HAL and Maruti Udyog. Mr. Sharma is a Mechanical Engineer and deeply interested in Environmental Protection.

Dr. Denzil J. Godin, Senior Lecturer, Lucknow Christian P.G. College, Lucknow joined as a Life Member of ISEB. Active in the field of Environmental Awareness and science communication, he is a recipient of the National Award, "ISWA Samman" of the Indian Science Writer's Association for 2003. He is also the Staff Advisor of the Environment Club of Lucknow Christian P.G. College, Lucknow.

INTER-COLLEGIATE ENVIRONMENT QUIZ

TThe Inter-collegiate Environment Quiz Competition', an annual feature of the 'Environment Club' of Lucknow Christian P.G. College was organized on 31 January 2004 in the College campus. More than 200 students and faculty members from a large number of associated colleges of Lucknow University attended the function. Dr. B.P. Masih, the Principal of the College emphasized the role of younger generation in environmental awareness and conservation and congratulated the Environment Club for its role spreading environmental awareness in Lucknow city. Dr. Denzil Godin, the Staff Advisor of the Club and a member of ISEB conducted this very lively and enlightening programme. The shield for the Best Team was won by Isabella Thoburn P.G. College, Lucknow.

Bhupendra Kaul *(Secretary, Environment Club)*

BOTANICAL MEET ON BIODIVERSITY IN CHANGING ENVIRONMENT

M. IQBAL

The Department of Botany in Jamia Hamdard hosted the 26th Annual Conference of Indian Botanical Society on(IBS) December 29-31, 2003. A national symposium on "Plant Biology and Biodiversity in Changing Environment" was also organized simultaneously. Several eminent scholars of Indian Botany delivered special invited talks on this occasion. More than 300 delegates from various parts of the country came to participate.

In the inaugural function, Mr. Siraj Hussain, Vice-Chancellor of Jamia Hamdard, emphasized upon the significance of higher education and upon the need of special attention and support to basic sciences. He referred to the Jamia Hamdard – Ranbaxy Research Tie-up in clinical pharmacy and hoped for its positive and remarkable outcome. The Chief Guest, Mr. D.S. Brar (CEO and MD of Ranbaxy Laboratories), described Jamia Hamdard as being the only institution that has a perfect interface of Unani medicine with the modern sciences and provides facilities for research on all different aspects of herbal medicine under one roof. He commended the efforts of Jamia Hamdard in emerging as a role model for institute-industry linkage.

The IBS Conference comprised eight technical sessions, two memorial lectures, four medal award lectures, in addition to the presidential address delivered by Prof. H.S. Shetty of Mysore University. The National Symposium comprised four sessions of invited talks by eminent scholars and two sessions of contributory papers. The Young Botanist Award of IBS, and the certificates and prizes for Best Poster Presentations were given in the valedictory session.

The following recommendations emerged from the events:

Periodic assessment of regional flora is essential for having an idea of the temporal changes in plant biodiversity and of the gradual loss and gain of species, if any.

Plant form and function need to be re-assessed under changing environmental conditions. This becomes more important with regard to medicinal plants wherein the process of secondary metabolite production may be influenced by changes in the local environmental set-up, and may in turn alter drug efficacy.

The current trend of pharmacognostic research which pays little or no attention to the authentic identification of plants to be studied and which includes several unstable and redundant parameters of study needs re-evaluation and right direction in order to avoid situations that bring in more confusion than the solution of problems.

The Government should provide special scholarships for research in basic disciplines of Botany so as to attract brilliant students who otherwise prefer professional courses that pave the way of early and quick earnings.

The funding agencies should see to it that the investigators of sponsored research projects be provided with suitable prerequisites out of the project allocations so as to enthuse in them a greater interest and sense of responsibility. The universities also should evolve mechanisms to encourage those who are actively engaged in research in addition to their normal teaching assignments.

***Prof. M. Iqbal** is Head, Department of Botany, Hamdard University & Convener, National Organizing Committee of the Symposium.*

THE CONSEQUENCES OF AIR POLLUTION FOR FOOD SECURITY

LISA D. EMBERSON

Air pollution can have disastrous consequences on agriculture close to pollutant sources. Research at the Stockholm Environment Institute at York (SEI-Y) is assessing the link between air pollution, agricultural production and subsequent food security. Dr Lisa Emberson of SEI-Y, who is co-editor of a recently published book entitled *Air Pollution Impacts on Crops and Forests*, says that studies conducted in the Hunan Province of China found that sulphur dioxide originating from coal-burning power stations resulted in 100% yield losses for sensitive crop species; similarly in India, crops grown in the vicinity of power plants recorded yield reductions of up to 50%.

However, it is the regional pollutant ozone that is perceived as the biggest threat to future agricultural productivity since levels reach high concentrations over remoter rural agricultural areas. Ozone is a secondary pollutant that is formed by the effect of sunlight on other pollutants, and filtration studies conducted in Pakistan illustrate the dramatic growth reductions caused by ambient ozone levels.

Such impacts on agricultural productivity can have serious implications where problems of food scarcity exist; studies in India have found that vulnerable sectors of society such as the poor and malnourished as well as those depending on sustainable agriculture for their livelihoods are more severely affected. The book has collated key studies in an attempt to assess the consequences of current and future global air pollutant concentrations on agricultural systems. The Asian region was identified as that facing the most serious risks to agricultural productivity

both now and in the future.

Site-specific studies have brought attention to the problems caused by air pollution however, the magnitude and spatial scale of the problem is hard to quantify across an area the size of Asia. Such assessments are urgently needed to develop appropriate emission abatement or adaptation policies. SEI-Y has established an Asian Air Pollution Network to bring together air pollution impact scientists to assess impacts in a standardized manner. A workshop in Bangkok organized by Dr Emberson recently bought together 30 delegates from 15 different countries to initiate a co-ordinated effort to assess air pollution impacts.

A list of distinguished participants from various countries at the Workshop and the titles of their respective presentations are given as under:

Dr. Lisa Emberson (U.K.): Introduction to the RAPIDC Programme; Prof. Yoshihisa Kohno (Japan): Current knowledge: Chronic effects of air pollutants on trees in Far East Asia; Prof. Hakan Pleijel (Sweden): Air quality and risk assessment in Europe and North America; Prof. Frank Murray (Australia): The need of standardised experimental protocols and observations; Dr. Mark Zunckel (South Africa): Approaches used in southern Africa: Assessing biological impacts; Prof. Andreas Klumpp (Germany): Applicaion og bio-monitoring techniques in developing countries; Prof. John Sheehy (IRRI, Phillipines): Monitoring exposures of agricultural crops to O3,NOx,SO2: implications for yield reductions; Prof. K. Kobayashi (Japan): Challenges in predicting the impacts of increasing surface ozone concentration on crop productivity in Asia; Prof. P.K. Jha (Nepal): Effects of pollution and climate change on crops and forests in Nepal; Dr. M. Iyngararasan (UNEP): Policy processes in Asia: The implementation of the Male Declaration in South Asia.

From India, there was a strong representation at the Workshop. The names of participants and titles of their papers are as follows:

Prof. Madhoolika Agrawal (BHU, Varanasi): (1) Current knowledge: Major approaches of air pollution research on plants in Asia, (2) Experimental work on agricultural crops (transect and field site studies); Dr. H.M. Behl (NBRI, Lucknow): (1) Air pollution impacts on biodiversity: Assessing the effects of landscaping remediation using bio-indicators, (2) Education, Networking and Information Dissemination; Prof. C.K. Varshney (J.N.U., New Delhi): The effects of air pollution on Indian crop plants and trees; Dr. S.B. Agrawal (BHU, Varanasi): Experimental evidence on effects of air pollution on agricultural crops; Dr. Ram Boojh (CEE, Lucknow): Air quality and policy in Asia.

Dr. Ms. Lisa D. Emberson *is Scientist at the Stockholm Environment Institute at York, Biology Dept., University of York, York, Y0I0 S5YW,* ***U. K.***

TROPOSPHERIC OZONE IN THE MEDITERRANEAN BASIN: EVIDENCE OF ITS EFFECTS

MARIA J. SANZ

ATMOSPHERIC POLLUTION : HISTORIC EVOLUTION

Atmospheric pollution is a relatively modern concept; the first book on this topic was written by John Evelyn in the 17th century (*Fumifugium*). Although it was known from several centuries as an undesirable product of civilization, it is only from the 19th century onwards, when real concern about it was raised. It became a real problem in certain European regions with the Industrial Revolution. The first problems derived from smelters, furnaces and primitive chemical industries: their effects were restricted to the urban areas surrounding the industries and had an episodic character. Thus, it is not strange that the first reports of injury to forests were from parks in large cities such as London. In fact, the first important public reactions were after several episodes from the 30's to the 50's, which even caused the deaths of a number of people. But it is not until after the 50's when air pollution was regarded as a problem of public interest in several industrial countries and when measures were taken (e.g.. *The Clean Air Act* in 1964 in England.

The first transnational report of air pollution affects dates from the 30's, when the injuries to vegetation detected in the Columbia river valley, in the Rocky Mountains, was identified as caused by the emissions of a smelter from Trail, Canada. In Europe, acidification of lakes and soil in the Northern Countries was attributed to acid rain at a regional scale in the 60's. Perception of air pollution has changed in the last two decades: urban air pollution was the major concern in the 70's, but currently air pollution encompasses several other problems which have appeared in the last 20 years. At present, urban pollution is a problem in many of the largest cities, and photochemical compounds are a problem at regional and even global scales. The most important pollutants are: tropospheric ozone and photooxidants in general (e.g. PAN, nitrogen oxides...), pollution in large cities (including several organic pollutants), "acid rain" long range transport of the pollutants, new toxic gases, and "global warming" due to the increase of greenhouse gases.

OZONE IN SOUTHERN EUROPE AND THE MEDITERRANEAN BASIN

The occidental Mediterranean Basin is surrounded by mountain ranges with altitudes over 1500 m. In coastal mountains the warm up of the eastern oriented slopes start with the sunrise. In summer, this situation favours the early development of the slope winds that «pull or reinforce" seabreezes. In this process,

slopes act as orographic chimneys connecting directly surface winds with fluxes in altitude, the latter being subject to compensatory subsidence along its return in altitude towards the sea.

The above processes decrease during the afternoon and stop at nightfall. On the next day, the lowest strata are transported inwards with the new sea breeze and the described circulations replenish the ozone rich layers in altitude. As a result of this process, a clear vertical stratification of the air mass occurs over the sea, along the coasts, the most recently formed strata being accumulated over the oldest ones, which are close to the sea surface. The strata act as reservoirs since the pollutants emitted in previous days or their products may be the "background" for subsequent days. Moreover, strata can move along the coasts contributing to inter-regional and long range transport of atmospheric pollutants.

These processes have been documented experimentally in several projects of the European Commission, three of which under the leadership of Spanish teams. MECAPIP and RECAPMA projects were initially co-ordinated from CIEMAT and later from Fundación Centro de Estudios Ambientales del Mediterráneo (CEAM), together with SECAP project. The CEAM, was founded by Spanish and Valencian governments, with the support of the European Commission, to specifically deal with these subjects in the Mediterránean Basin. The results achieved indicate that the strata system is extended along the coast, reaching up to 2 a 3 km of altitude over the sea. Over the land it has a variable width (up to 100 km), and it extends to more than 300 km over the sea. The continuity of these processes over the whole Mediterranean Basin has also been documented. Experiments with tracers conducted in the eastern Spain have documented that the time needed for the first return is two days, for the given meteorological and site conditions of the experiment. Recent numerical simulations with mesoscale models and re-analysis of data of the RECAPMA project show that air pollutant masses in the occidental Mediterranean Basin in summer may require over 5 days to renovate 50%, and 7-10 days for a 80% renovation. Under strong summer sun radiation, coastal re-circulations acts as "large natural photochemical reactors" in which NOx emissions and other precursors (VOCs) are transformed into acidic compounds, aerosols and photooxidants, including ozone, which frequently reach relatively high concentrations.

The threshold for ozone injury to vegetation (65 ug/m^3, 24 h), is exceeded systematically during more than six months of the year, the threshold for heath protection (110 ug/m^3, 8 h) is exceeded intermittently during more than four months in the highest of the monitoring stations considered, and the threshold for information to population (180 ug/m^3, 1 h) is also sometime exceeded, from April to August/September. These situations are the rule more than the exception along all the coasts of the occidental Mediterranean Basin, illustrating the episodes with chronic levels of O_3, caused by the re-circulation of the air masses. On the other hand, peak episodes with high ozone concentrations during a few days may also occur; they are typical from Central Europe, and are originated under stable anticyclonic conditions.

It is remarkable that the described processes were not documented before 1986-91, in spite of the protocols and of the large international programs (e.g. EMEP and other models of atmospheric pollution) and is used as a base for the European Directives. Probably, the large grid (150 x 150 km) used for the calculations in those models did not allow to reproduce the above mentioned processes. To model such re-circulation processes in the Iberian Peninsula, Salvador *et al.* (1999) used a smaller grid of 10 x 10 km complemented with a local nested grid of 2 x 2 km for the Valencian Community (eastern Spain); this allowed to reproduce 95% of the variability of the atmospheric fluxes. Part of the above mentioned results and their possible consequences have been taken into account for the definition of priorities within the 6th Framework Research Programme of the European Union (European Commission, 2001).

RECOGNIZING OZONE EFFECTS TO VEGETATION IN A SIMPLE WAY

Photo-oxidants, and especially ozone, have been widely regarded as harmful to vegetation since the 80's, although in the 60's its effects were already detected in California. However, it is during the last decade when ozone become an issue of concern in Europe. Ozone pollution, unlike fluoride or sulphur dioxide, does not leave elemental residue that can be detected by means of analytical techniques in vegetative tissues. Thus, ozone injury in leaves, are the only evidence easily detected in the field. So far, experimental studies have focused mainly on explaining the mechanisms that produce damage, rather than to identify and characterise symptoms observed in the field at a regional scale. Recent researches have increased our knowledge on the subjacent mechanisms that explain the effects of ozone on crops, and to a lesser extent, on trees and other wild plants. A long term effect of this pollutant on forests may affect some of their functions, e.g. their role in water and energy balances, protection against soil erosion, cover of vegetation, and aesthetics of the landscape. One possible effect on plant communities might be the change in species composition and loss of biodiversity, an important potential threat when regions with many endemic plants are considered. Furthermore, before these problems are approached, more basic and detailed studies on the sensitivity of the species under different environmental conditions, including e.g. nutritional aspects, have to be undertaken.

Still, there are discrepancies between models and observed concentrations specially in the southern Europe. However, some recent modelling works are able to detect the so called "Mediterranean anomaly". Thus, on the basis of modelling and experimental evidence, we strongly suggest that ozone occurs at concentrations causing visible foliar injury to sensitive plants in several parts of Europe.

Visible symptoms are the result of oxidative stress, which also causes a cascade of physiological changes on the plant. Thus, although they are only a part of all the effects of ozone to plants (e.g. physiological changes, or growth and yield reduction, they may also occur before specific symptoms are developed). Their observation in the field is being a useful, cheap tool to detect areas in which ozone

concentrations produce phytotoxic adverse effects since the 60s. After mid 90s, surveys have recorded ozone-like symptoms on numerous native tree, shrub, and forbs species in southern Switzerland, Greece, Italy, France and Spain. However, still little information is available on the effects of ozone on the multitude of native plant species throughout Europe. And not only in native species visible injury is being recognised in Europe, also crops also show such injuries quite frequently, specially in the Mediterranean, in countries like Spain in crops like potato, beans, artichoke, watermelon, etc.

INTERNATIONAL CO-OPEARATION PROGRAM FOR FOREST UNDER UN/ECE CLRTP OZONE INITIATIVE.

The lack of ozone data was a serious limitation for the EU Intensive Monitoring (Level II) database. Besides the obvious connections with the potential effects on forests, ozone data are also relevant in relation to other themes which were subjected to important political agreement, like the tropospheric chemistry changes and the regional ozone formation (e.g. the CLRTAP multi-pollutant, multi-effect directive; the UN Biodiversity Convention; the EU Habitat Directive; the EU acidification strategy, the UN/ECE CLRTAP, the EU Air Quality directive. The WG on Air Quality within the Expert Panel started a monitoring activity by using the tools *passive sampling* and *visible injury assessment* on Main Tree Species and Ground Vegetation on Intensive Monitoring Plots within ICP-Forests. Since much of the ozone data at European level comes from monitoring devices located in urban/sub-urban areas, a comprehensive dataset about forest sites can be considered an important input for a better understanding of ozone levels in remote areas across the European continent, including the Mediterranean region. Details about the methodological details of the program as well as information on injury identification can be found on the Coordination Center Webpage (http://www.gva.es/ceam/ICP-forests).

First results on the passive samplers indicate that higher concentrations occur in southern Europe, 58 % of the Spanish Sites and 63 % of the Italian sites show a 6-month-time weighted-average concentration in the range of 45-60 ppb. In respect of ozone visible injury, nine countries reported results from 72 plots in the first ozone injury assessment in 2001 (DeVries et al. 2003). The adult trees that showed injury when the level II plots were prospected were: *Fagus sylvatica*, *Carpinus betulus, Pinus nigra* and *Pinus pinaster*, *Pinus halepensis* and *Pinus strobus*. Overall 24 % of the plots where main tree species were prospected showed injury. Within the specially light exposed plots stabilised to better detect ozone injury apart from the Level II plots but nearby, 27 species of trees, 19 of shrubs and 15 of herbs showed injury. From those, 17 species of shrubs and herbs were not known as sensitive in literature surveys (see the list of sensitive European species, www.gva.es/ceam/ICP-forests). Although the results have to be considered carefully,preliminary studies show the potential of visible injury as a tool to detect potential areas under ozone stress in Europe. In fact, it appears that there is a considerable agreement between the observed concentrations and the appearance of visible injury, specially in southern Europe.

Dr. Maria José Sanz *is a Scientist at the Fundación Centro de Estudios Ambientales del Mediterráneo**,** Parque Tecnológico, c/ Charles R. Darwin, 14. Paterna, 46980 Valenci.* ***Spain.***

BIOPULPING AND BIOBLEACHING: AN ENERGY AND ENVIORONMENT SAVING TECHNOLOGY FOR INDIAN PULP AND PAPER INDUSTRY

O.P. SHUKLA[1], U.N. RAI[1] AND S.V. SUBRAMANYAM[2]

Pulp and paper industry in India is the sixth largest energy consumer in the industrial sector and it's energy costs account for about 24.5% of the total manufacturing cost. Paper can be made from wood, agricultural residues or from waste paper, having a share of 43%, 28% and 29%, respectively. The use of wood based technology is gradually on the decline because of capital and raw material availability constraints. The share of waste paper (secondary fiber) based technology, which is less energy intensive, is expected to increase in future. The production of pulp and paper involves three major processing steps – pulping, bleaching, and paper production. The type of pulping, and amount of bleaching used, depends on the nature of feedstock and the desired quality of the end product. The production of the chemical pulps has been dramatically altered over the past decade in response to new environmental regulations and consumer activism. Although current pulp manufacturing technologies address required environmental performance regulations, new challenges and opportunities are developing. The need for improved manufacturing efficiencies, enhanced wood utilization practices and continuing environmental concerns has become one of the central research themes of the late 1990's. Recently, significant interest has developed in the production of bleached kraft pulp originating from high lignin content pulps. The primary factor contributing to this research is the well known loss of pulping selectivity when attempting to remove the last vestiges of lignin in pulps by kraft delignification. Several recent publications have examined the improved yield benefits of utilizing a single or double oxygen stage to delignify high lignin content pulps.

Unfortunately, chemical consumption and environmental considerations severely limit the types of delignification technologies that can be employed with high kappa pulps. To date, the two most promising delignification

technologies for high lignin content pulps consist of using oxygen delignification or modifying the pulping process. The use of fungus prior to pulping offers an attractive opportunity for mechanical wood pulp facilities. This technology could save an estimated 30% of the energy consumed in refining the mechanical pulp. The technology also improves paper strength, reduces pith content, and could reduce the emissions of volatile organic compounds.

CONCEPT OF BIOPULPING

Biopulping is the treatment of wood chips and other lignocellulosic materials with natural wood decay fungi prior to thermomechanical pulping. The technical and economic feasibility of biopulping was established through two industry sponsored consortia and 22 pulp and paper and related companies of U.S.A.

The fungal treatment process fits well into a mill's woodyard operations. Wood is debarked, chipped and screened according to normal mill operations. Then chips are briefly steamed to reduce natural chip microorganisms, cooled with forced air, and inoculated with the biopulping fungus. The inoculated chips are piled and ventilated with filtered and humidified air for 1 to 4 weeks prior to processing.

While engineering analysis indicates that the biopulping process is technologically feasible, economic analysis indicates that the biopulping process is also economically beneficial. The use of biopulping as a pretreatment for the kraft process is still an open research issue. Finally, the use of this technology for other substrate – non woody plants such as kenaf, straw, and corn stalks will have to be investigated.

Advantages of Biopulping

Reduced electrical energy consumption (at least 30%) during mechanical pulping; potential 30% increase in mill through put for mechanical pulping; Improved paper strength properties; Reduced pitch content and Reduced environmental impact.

CONCEPT OF BIOBLEACHING

The biobleaching of kraft with laccase/mediator continues to receive strong interest, in part due to the discovery of new mediators for laccase. Therefore, new environmentally benign elemental chlorine free (ECF) and totally chlorine free (TCF) bleaching technologies are necessary for minimizing the hemicellulose content in dissolving pulp, adjusting the brightness at a high level and improving simultaneously, the quality of the effluents in terms of toxicity and adsorbable organic halogen (AOX). Biological methods of pulp prebleaching using xylanases provide the possibility of selectively removing upto 20% of xylan from pulp and saving up to 25% of chlorine containing bleaching chemicals. Alternatively, pulp can be bleached with white-rot fungi and their lignolytic enzymes, enabling chemical savings to be achieved and a chlorine free bleaching process to be established.

Advantages of Biobleaching

Reduced consumption of bleaching chemical; reduced adsorbable organic halogen; improved pulp and paper quality; improved brightness; reduced effluent toxicity and pollution load.

IMPORTANCE OF THE TECHNOLOGY

The paper industry has been investigating biological replacements for some of the chemicals used in the paper making process in the hope of reducing capital and operating costs and minimizing its environmental impact. One use of biological treatments, which has been of recent interest, is for reducing refining energy consumption in mechanical pulping processes. It has been shown that certain fungal treatments can achieve this end without damage to the resulting fiber and possibly with better quality fiber in the end. There has also been some success in pretreating wood chips for chemical pulping processes. In this type of application more uniform delignification, improved yield, or decreased chemical usage are the goals. Research into chip treatment with cellulose and hemicellulose enzymes is just beginning. Pretreatment of hard wood chips with *Pseudomonas chrysosporium* shows an improvement in kraft pulp yield after 20 days, but is more pronounced after a period of 30 days. The resulting pulp compared at the same kappa number has a higher tensile strength and a corresponding lower tear strength. The pulps also refine faster, thus saving refining energy to achieve the same pulp properties.

CONCLUSIONS

White rot fungi produce extracellular oxidative enzymes, which initiate oxidation of lignin. Due to their lignin degrading capacity, whole cultures of various white rot fungi cause extensive brightness gains and delignification of kraft pulp. MnP is considered to be the most important enzyme involved in kraft biobleaching. Pretreatment of sulphite pulp with *Aureobasidium pullulans* xylanases could improve alkali volubility and brightness, important parameters of dissolving pulp for producing viscose rayon. The major effect caused by xylanases is a selective reduction of the hemicellulose content of dissolving pulp. On the other hand, biobleaching with the white rot fungus *Ceriporiopsis subvermispora* could enhance significantly the brightness affecting the cellulose content of the dissolving pulp.

The use of environment friendly processes is becoming more popular in the pulp and paper industry and therefore biotechnological processes are coming to the forefront of research. An application of biotechnology in Indian pulp and paper industry is the xylanase pre-bleaching of pulp. Extensive R & D work on enzymatic prebleaching of pulp from raw materials is widely prevalent in India. Due to pressure on reducing organochlorine compounds in the effluent, more and more paper mills are getting interested in this process and have also started taking mill trials. The commercialization of freeness control and biomechanical pulping will serve to continue the optimization of these processes and reduce the costs associated with the enzymes and fungi. Enzyme technology offers great potential for reducing capital and energy costs, improving properties of degraded fiber furnishes, and reducing the environmental impact of paper making processes.

[1]Dr. U.N. Rai *is a scientist at the National Botanical Research Institute, Lucknow, India*
[1]Mr.O.P. Shukla *is a Senior Research Fellow at the National Botanical Research Institute, Lucknow, India*
[2]Dr. S.V. Subramaniam *is a scientist at the Central Pulp and Paper Research Institute, Saharanpur, U.P., India*

PHYTOREMEDIATION OF HAZARDOUS LEAD FROM ENVIRONMENT

SUDHAKAR SRIVASTAVA, SEEMA MISHRA AND R.D.TRIPATHI

Lead (Pb) pollution of the environment is a major problem today. It causes health hazards to livestock and human beings, children being most sensitive. Recently it has been established as a potential carcinogen. Lead enters in the environment through air, water and soil and finally enters the food chain through contaminated water, edibles and other foodstuffs. Besides, human beings can be directly exposed through occupational and environmental exposures.

Most of the heavy metal contaminated sites are lead affected. Lead affects many physiological parameters in plants and causes sharp decrease in crop productivity. Currently lead contaminated sites are being remediated by a variety of rather costly engineering technologies. Phytoremediation, popularly known as green clean, is an emerging technology for the clean up of contaminated sites by the use of plants, and is ecofriendly and low cost technology compared to traditional engineering remediation methods.

There are many ways in which plants may be utilized for remediation and these constitute different subcategories of phytoremediation viz. phytoextraction, rhizofiltration, phytostablization and phytovolatilization. Of these phytoextraction is best suited for remediation of lead contaminated sites and is much studied area. It is defined as accumulation of metal in above ground plant parts and those plants which accumulate more than 0.1% of lead as dry weight of shoot are known as "hyperaccumulators".

PHYTOEXTRACTION OF LEAD:

Lead persists in soil for very long time. Its remediaion is problematic due to its low availability to plants as it forms complexes and gets precipitated and also due to its low traslocation from root to shoot.

A few plants are known to hyperaccumulate lead such as *Thlaspi rotundifolium, T. alpestre, Alyssum wulfenianum, Polycarpaea synandra, Armeria martima,* few bryophytes and lichens etc. Various aquatic plants like *Hydrilla, Vallisneria, Marsilea, Cyperus, Polygonum* etc., algae like *Phaeodactylum, Stichococcus, Stigeoclonium* etc. have also been found to be potential accumulators of lead. However, many of these plants named above are not good for phytoremediation due to their very low biomass and slow growth rates, thus will take very long time for effective remediation of a site. It is speculated that even the best accumulators will take 13-14 years to clean up a site.

To achieve lead remediation in reasonable time there is need of plants which has short lifetime, could accumulate greater than 1% of lead of shoot dry weight and produce more than 20 tonnes of shoot biomass ha^{-1} $year^{-1}$. To achieve this goal availability of lead in soil needs to be increased. Chelate mobilization has been studied in much detail in this context.

Chelates bind lead removing it from complexes and thus increase its availability to plants. They also enhance its translocation from root to shoot and cause more accumulatiom. Many chelates e.g. ethylenediaminetetraaceticacid (EDTA),N-hydroxyethylenediamine-triaceticacid (HEDTA), ethyleneglycol-bis (β-aminoethylether) (EGTA) etc. has been tested. Of all these EDTA has been proved to best chelate. It considerably increases availability of lead, enhances its mobility from root to shoot to even more than 100 times and increases lead accumulation in shoot to more than 400 fold. Research is going on to find suitable amount and number of doses of chelate and timing of its application. It has been found that multiple doses in small quantities are better than single time application of high dose. Application after planting gives good results as compared to application before plantation. Soil condition like fertilizer applied, soil temperature, salinity etc. also affect effectiveness of remediation.

Researchers have studied accumulation of lead by high biomass plants like *Brassica juncea, B. rapa, Helianthus annuus, Vicia faba, Pisum sativum, Phaseolus vulgaris* etc. on application of lead. *Brassica juncea* could accumulate more than 1.5% of lead of its shoot dry weight on EDTA application. It has been designated as best lead phytoremediator plant as it is non-edible plant and poses no health hazards for public. It is also a very high biomass plant and has short life cycle. However there are concerns about side effects associated with chelate application. Pb-EDTA easily percolates through soil profile and causes ground water pollution. Studies are thus going on to find a better biodegradable organic chelate.

DETOXIFICATION AS BIOREMEDIATION STRATEGY:

Once inside the plant metal needs to be detoxified. Detoxification of lead occurs by its binding to some chemical groups e.g. to cell wall, to polyphosphates bodies in some cyanobacteria and in most cases by binding to specific peptides called phytochelatins.

Phytochelatins (PCs) are low molecular weight peptides having the general structure $(\gamma\text{-Glu-Cys})_n$-Gly where n=2-11. These are enzymatically synthesized by the enzyme Phytochelatin synthase (PC synthase) and their synthesis is induced by the entry of metal. Induction of PCs by Pb has been reported in algae, lichens, aquatics and cells cultures. Phytochelatin responses to lead have been extremely sensitive and these detoxifying peptides are synthesized even at 1 nM Pb^{2+} levels in a marine alga, *Thalassiosira weissflogii*. PCs bind Pb via thiolate coordination. PC_2 and PC_3 can bind one Pb molecule per peptide molecule whereas PC_4 forms two distinct species with stoichiometries for binding one or two Pb ions per peptide molecule respectively.

In case of cadmium (Cd), S^{2-} incorporation stabilizes the PC-Cd

complexes. The PC-metal complexes are finally transported to vacuole via ATP-binding cassette (ABC) type transporter where metal causes no harm. Though mechanism has not yet been elucidated for Pb, however, as PC-Pb complexes are formed, it is likely that these are sequestrated in vacuole in a similar way.

A future prospective of the problem is to genetically engineer high biomass non-edible plants for better hyperaccumulation of lead. There is one report of transfer of PC synthase gene (TaPCS1) of wheat to *Nicotiana glauca* (Shrub tobacco), where it doubled the accumulation of Pb.

BIOSORPTION OF LEAD:

Biosorption is another emerging potentially economic technology for metal removal and recovery. It consists of several mechanisms including ion exchange, chelation, adsorption, and ion entrapment in structural polysaccharide network. This also uses dead or inactive microbial biomass for sorption of metal by chemically active surface groups. Due to high surface area, microbial biomass eg. algae like *Oscillatoria, Anabaena, Eudorina etc.* fungi e.g. *Aspergillus* and bacteria like *Pseudomonas* can adsorb high amount of lead on their surfaces and can achieve quick remediation.

CONCLUSION:

Thus phytoremediation is best-suited technology in present context to clean up Pb contaminated sites and it is cost effective as well. Since there are no known high biomass plants which could hyperaccumulate lead, research is going on to genetically engineer the plants, which produce more biomass in short time and then incorporating genes for hyperaccumulation and detoxification of lead into them to achieve the goal. Genetic engineering efforts thus may strengthen phytoremediation as a much better applied technology in recent future and remediation will be achieved in quicker time at low cost.

Dr. R.D.Tripathi *is a senior Scientist and Group Leader in Ecotoxicology and Bioremediation Group at National Botanical Research Institute, Lucknow, India; E-mail: tripathi_rd@rediffmail.com*

Mr. Sudhakar Srivastava *and* ***Ms. Seema Mishra*** *are Junior Research Fellows in Ecotoxicology and Bioremediation Group at National Botanical Research Institute, Lucknow, India*

NEWS AND VIEWS

DEADLY DIESEL EXHAUSTS

Premature deaths due to the exhausts from diesel vehicles appear to account for 1-2 per cent of all deaths in Germany. A general use of particle traps could reduce the background concentrations of $PM_{2.5}$, by 3 ìg/m^3, which would add to 1 to 3 months to everyone's life expectancy in Germany.

Future Diesel/Acid News

NEW POWER PLANTS OR NEW LIGHTING?

Building a new 1000 MW thermal power plant would cost at least 1 billion Euros – or sufficient to buy at least 500 million 11-Watt CFL lamps as replacement for 60-Watt incandescent one. In other words there will be sufficient saving of energy that there would be no need to build the thermal power plant. CFL lamps cost only 2 Euros a piece.

Acid Rain

Goteborg, Sweden

OLDEST LIVING PLANT

43,600 years old 'King's holly' (*Lomatia tasmanica*) is the oldest living plant individual. It was discovered in 1937 by a miner and scientific collector named Denny King while mining tin by hand in the remote southwest of Tasmania (Australia). The sole remaining individual straggles out in a line of 500 clone bushes, nearly 1.2 km long. It produces itself by dropping branch pieces that take root. The shiny-leaf plant bears pink flowers but neither fruit nor seeds.

(USA Today)

TYRE BURNING CAUSES CANCER

Tyres are a consumer product not designed for burning. The burning of tyres emits toxic chemicals as well as heavy metals such as mercury, lead, chromium, beryllium, cadmium and arsenic. Burning tyres also releases dioxin, which is recognized as the most potent human made carcinogen known. Tyre burning emissions have been found to cause respiratory diseases and cancer.

Clean Energy Nepal

DIESEL FUMES WORSEN ALLERGY

Air borne components of diesel engine exhaust significantly worsen allergy symptoms in people with a certain genetic make up, researchers report. It is estimated that up to 50 per cent of the U.S. population could be in jeopardy of experiencing health problems related to air pollution.

Diesel exhaust particles are thought to act by causing the production of molecules called reactive oxygen species in the lungs' airways. In response, the immune system pumps out substances that cause allergy symptoms – compounds called antioxidants can detoxify these particles and tamper the body's allergic inflammatory response.

Researchers suspect that the better the body can use antioxidants to defend itself, the better it can protect itself from airborne pollutants. Researchers sampled the DNA of volunteers who are allergic to ragweed to find which forms of gene they had. The participants were then given doses of ragweed through the nose, followed by

either placebo or quantities of diesel exhaust particles equivalent to breathing the air in Los Angeles for 40 hours. The mix of ragweed and diesel exhaust triggered greater allergic responses than ragweed alone.

Source: *Environment News Service/*
Clean Energy News

BITING THE DUST

Researches carried out by Stanford University reveals that simply walking around your home can increase your exposure to particulate pollution. Researchers measured the amount of dust kicked up by household activities such as walking, dancing, making a bed and vacuum cleaning by setting up particle detectors in a house and asking its occupants to perform a range of activities.

Two people striding across a rug kicked up dust particles at a rate of almost milligrams a minute, which is about half the amount of particulate matter belched out by smoking a cigarette.

(ANI)

AUGUST 2003 HEAT WAVE IN EUROPE

August 2003 was the warmest on record in the northern hemisphere. The heat wave is estimated to have caused at least 35,000 deaths in Europe. In France, where the temperature rose to 40ºC and remained there for two weeks, 14,802 people are said to have died. Deaths in Germany numbered 7000, in Portugal 1300 and in the Netherlands 1400.

In London, where temperatures rose to about 100ºF (37ºC) for the first time ever, the death toll was put at 900. In Belgium temperature higher than any recorded in the Royal Meteorological Society's register dating back to 1833 brought 150 deaths.

Though heat waves are rarely given adequate attention, they claim more lives each year than floods, tornadoes and hurricanes combined. Heat waves are a silent killer, mostly affecting the elderly, the very young, or the chronically ill.

Acid News

DIESEL SOOT CAUSES GLOBAL WARMING

Soot mostly from diesel engines is blocking snow and ice from reflecting sunlight, which is contributing to worldwide melting of ice and as much as a quarter of all observed global warming, according to top NASA scientists.

Soot comprises carbon particles that are, along with salts and dust, byproducts of burning fossil fuels and vegetation. In developed countries, the biggest source is diesel fuel. Elsewhere, burning wood, animal dung, vegetable oil and other biofuels are a major source of soot. It has been found that soot is twice as potent as carbon dioxide in changing global surface air temperatures in the Arctic and the Northern Hemisphere.

Levels of airborne soot as high as about 100 parts per billion were found in the Alps, enough to reduce the snow's ability to reflect – light rather than absorb it from about 98 down to between 80 and 90 per cent. In the spring and summer, the snow melts and some soot accumulates as curd on the surface, the remaining snow is even darker. The same could occur in Himalayan range of South Asia, where prevailing winds might deposit fossil fuel and biofuel soot carried in a brown haze from India.

Until recently, scientists thought that only carbon dioxide and other greenhouse gases have global reach and effect. They are now finding the same thing with the microscopic suspended particles of pollutants, known as aerosols, that settle on ground, later. Soot particles, which absorb toxic organic material are minute enough to penetrate skin when breathed in. Soot is the aerosol most responsible for the haze in rapidly developing countries such as India and China.

John Heilprin

Source: Associated Press/Clean Energy News, ***Nepal***

BIRD FLU

Avian flu is a form of influenza that often kills domesticated poultry such as chickens and turkeys. Some strains of bird flu can make humans sick, too. The most dangerous is H5N1. This strain first jumped the species barrier from birds to humans in Hong Kong in 1997. The fear is that H5N1 could combine with a human-flu strain to create a deadly virus that is so contagious that it could cause a human pandemic. Pigs are considered the perfect mixing vessels for gene swapping because they can be infected by avian and human viruses alike.

The symptoms of the bird flu range from fever, sore throat, cough, and muscle aches to eye infections, pneumonia and acute respiratory distress. The people most at risk are those who work with life infected poultry. If one stays away from chicken farms and live-bird markets in areas where avian flu is rife, the odds of infection are minimal. Avian flu is not a food-borne virus, so eating poultry is safe. There is no evidence yet that bird flu is being spread from human to human.

TIME *Magazine (U.S.A.).*

OCEAN BACTERIUM CONTROLS GREENHOUSE GAS

Since the beginning of the industrial revolution atmospheric concentrations of carbon dioxide have increased by 30 per cent and this rise is due to increased combustion of fossil fuels and other human activity. A study led by Imperial College, London has revealed that most abundant ocean-bound photosynthetic bacterium, *Prochlorococcus cyanobacterium* helps to control levels of carbon dioxide. It traps atmospheric CO_2 and stores it in the sea.

Over 50 per cent of global photosynthetic activity takes place in the oceans. A 10 per cent decrease in CO_2 uptake by the oceans would leave about the same amount of CO_2 in the atmosphere as in produced by fossil fuel burning each year. Therefore, understanding what factors influence this bacterium's ability to regulate CO_2 is crucial for humans' continued survival.

Iron plays a crucial role in the ability of this marine organism to use energy from light to convert CO_2 into organic molecules by the process of photosynthesis. Iron is also critical to the health of organisms and low levels in the ocean significantly decreases the ability of *Prochlorococcus* to grow and reproduce. Iron is the fourth most abundant element in earth's crust. Yet its levels in the aquatic ecosystem, particularly in open oceans are low. In experiments where regions of the ocean have been artificially 'seeded' with extra iron, there is a dramatic increase in biomass production due to an increased amount of *Prochlorococcus* and other photosynthetic organisms.

The researches carried out by Professor Jim Barber of Imperial College London, open the possibility of artificially increasing ocean levels and iron to combat global warming.

Spectrum *(U.K.)*

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Contact: <symbiosis@accelerate.com>
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Contact: Luit J. De Kok
l.j.de.kok@biol.run.nl OR
apgc2004.en.a.u-tokyo.ac.jp

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Executive Editor :
Dr. H.M. Behl

Editors :
Dr. Mrs. Kamla Kulshreshtha
Dr. Amit Pal
National Botanical Research Institute
Lucknow, India.
Tel. 2205831-35 Extn. 223, Fax : 2205836
E-mail : isebnbrilko@satyam.net.in

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