ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

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IN THIS ISSUE

LESSONS FROM JAPAN

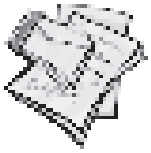
The recent tragedy in Japan as a result of a devastating earthquake with a magnitude of 9.0 and tsunami with waves rising as high as 30 ft has shaken the entire world. The crisis is further compounded by the impending nuclear meltdown at the Fukushima Daiichi nuclear power plant which makes a catastrophic combination with totally unpredictable consequences. While earthquake and tsunami may, or may not, be directly related to our fiddling with the planet's environment, the unfolding nuclear disaster is certainly the outcome of our increasing dependence on the nuclear power plants for galloping energy demands. In India, as well as in other parts of the world, serious questions are being raised about the safety of nuclear installations, and there is an urgent need for framing more stringent guidelines for the operation and maintenance of our nuclear power plants.

While thousands of people in Japan are being screened for possible exposure to radiations, extensive screening of plants and animals for detecting radiation level is also needed. Significant levels of radiations were detected in poultry, egg and milk in the animals in far off Southern Europe following Chernobyl disaster in Russia. Nuclear radiation can affect vegetation (including grasslands) in distant places and this can affect milching cows and other grazing animals. Through them, it will enter the food chain and cause serious hazards for human health. Oceans are also under immense threat and those living in coastal areas, or depending on sea food for their survival, are even more threatened.

Random screening of plants and animals along with human population for radiation level not only in Japan, but in other parts of the world, should be taken up on priority basis. Environmental pollutants in general, and nuclear radiations in particular, have scant regard for geo-political/geographical boundaries created by man and we can ignore this fact at our own peril.

K.J. Ahmad
Secretary ISEB

- **Members of ISEB are requested to immediately intimate any change in their contact address including postal, Email, Fax, Telephone to ISEB office.**
- All correspondence should be addressed to : **The Secretary, International Society of Environmental Botanists,** National Botanical Research Institute, Lucknow - 226 001 (India).
- **E-mail : isebnbrilko@sify.com** • **Website :** http://isebindia.com



LETTERS

We are pleased to announce that **1st SAARC Herbal Expo and Conference -2011** will be held from 28 to 30 April, 2011 at Bangladesh Agriculturist Institute complex, Kharmar Bari, Farmgate, Dhaka, Bangladesh.

This is the first ever initiative of its kind after formation of South Asian Association for Regional Cooperation (SAARC). Representatives from the member countries of SAARC, other Asian countries and international exhibitors will exhibit their herbal products and publications. The eminent scientists, herbal experts and speakers will also present their papers on herbs and herbal products. We request you to participate as exhibitors as well as in the conference.

Dr. Neem Hakim
Event Convener & Chairman,
Herbal International Centre for Integrated Herbal Research and Development (ICIHRD)
Bangladesh Neem Foundation (BNF)
Bangladesh Agriculturist Institute Complex, Kharmar Bari, Farmgate, Dhaka, **Bangladesh**
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I would like to thank you for your invitation and support to enable me to participate in ICPEP-4. Once again, the conference was highly successful. The presentations, both oral and poster, from researchers and graduate students were of the highest quality and I congratulate all presenters.

It was my greatest pleasure to meet so many colleagues again from ICPEP-3, as well as many new colleagues and to share our ideas. I look forward to participating again in ICPEP-5. Congratulations to the Organizing Committee headed by Dr. C.S. Nautiyal, Director NBRI and others who made ICPEP-4 such a great success.

Prof. Margaret Greenway
School of Environmental Engineering
Griffith University, Nathan Campus, Brisbane, QLD-4111, **Australia**
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The 8th Air Pollution Global Change Symposium entitled "Plant Functioning in a Changing Global and Polluted Environment" will be held in Hampshire Hotel Plaza, Groningen, The Netherlands from June 5-9, 2011. The Symposium will be hosted by Laboratory of Plant Physiology, Centre for Ecological and Evolutionary Studies, University of Groningen, The Netherlands. The aim of the APGC Symposium Series is to bring together scientists of various disciplines, who are actively involved in research on responses of plant metabolism and functioning to air, soil and water pollution and global change. The 8th APGC Symposium will be focused on the impact of a changing global and polluted environment on plant functioning in agro-, terrestrial- and aquatic ecosystems. See for more information: www.apgc.eu .

Previous symposia in the Series were held in Oxford, UK 1982; Munich, Germany, 1987; Blacksburg, USA, 1992; Egmond aan Zee, The Netherlands, 1997; Pulawy, Poland, 2001; Tsukuba, Japan, 2004 and Creswick, Australia, 2008.

Prof. Luit J. De Kok
University of Groningen, Laboratory of Plant Physiology,
Centre for Life Sciences, P.O. Box 11103, 9700 CC
Groningen, **The Netherlands**
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I hope you are keeping fit and doing well. I am happy to inform you that recently Govt. of India has constituted a Central Wetland Authority. I am one of the ten members of this Authority. In this connection I would request you to let me have your suggestions for promoting conservation and improvement of wetlands in the country.

Looking forward to hearing from you.

Prof. C. K. Varshney
Ex-Dean, School of Environmental Science
Jawaharlal Nehru University, **New Delhi**
E-mail: ckvarshney@gmail.com

I would like to inform you that I am a Life member of the International Society of Environmental Botanists (ISEB). I have recently been transferred from Himachal Unit to Garhwal Unit-I. I, therefore, request you to kindly note the change in my mailing address:

Dr. S.C. Joshi
Scientist
G.B. Pant Institute of Himalayan Environment & Development
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NEW LIFE MEMBERS

Dr. Pallavi Praveen is an Assistant Professor at Chas College, Chas (Bokaro), Dist. Bokaro, Jharkhand.

Dr. O.N. Tiwari is a Scientist in Microbial Resources Division at the Institute of Bioresources & Sustainable Development (ISBD), Takyelpat, Imphal, Manipur.

ontiwari1@rediffmail.com

Mr. Swadesh Kumar is a Research Scholar at the Babasaheb Bhimrao Ambedkar University, Lucknow.

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Dr. Raghvendra Pratap Narayan is an Assistant Professor at Dr. B.R. Ambedkar Govt. Degree College, Anaugi, Kannauj, U.P.

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NEWS FLASH

ISEB-I.T. College Symposium on Role of Plants in Environmental Protection

Under the ongoing celebrations of 125 years of Lucknow's prestigious Isabella Thoburn Post-Graduate College for Women (popularly known as I.T. College), a daylong symposium on "Role of Plants in Environmental Protection" was organized by the Department of Botany of the College in collaboration with International Society of Environmental Botanists (ISEB) on March 12, 2011.

The symposium was inaugurated by the Principal of the College, Dr. E.S. Charles in the presence of College students, faculty, and the experts of ISEB. In her welcome address, Dr Charles dwelt at length on the problem of environmental pollution and underscored the need for utilizing plants in mitigating pollution and providing healthy environment on the earth. Dr K.J. Ahamd Secretary of ISEB gave a brief introduction of ISEB in his speech. He explained the genesis of the founding of ISEB, its ongoing programmes and its work and achievements during the past sixteen years. This was followed by highly informative and illuminating scientific lectures by Dr. Kamla Kulshreshtha, Joint Secretary ISEB, (topic: Effect of auto-exhaust generated particulates on the leaf surface ultra-structures of some common roadside plants), Dr. S.C. Sharma, Vice President ISEB (topic: Impact of Climate change on the Floriculture Industries of India), Dr Shashi Dhawan, former Scientist of NRLC (topic: Bio deterioration of cultural property). These talks carrying a wealth of information were given by power point presentation and were very much appreciated by the students and faculty of the College. From the I.T. College faculty Dr. R.K. Jain, Lecturer in the Botany Department gave a very interesting valedictory lecture while the proceedings were conducted by Mrs. S.R. Verma, Dr. S.N. Joseph, Dr. Panzy Singh and Dr. Saini.

Ms. Kanti Srivastava, Convener Environmental Awareness Committee co-ordinated this programme on behalf of ISEB.

Selected pictures of the event are posted on ISEB website: http://isebindia.com

Workshop on plant-based management of river Ganga pollution

A workshop on plant-based management of Ganga Water Pollution was organized on 26th October 2010 at Chinmaya Degree College Hardwar by a team of scientists led by Dr. U.N. Rai, senior scientist of NBRI. The objective of the workshop was to involve, train and sensitize local people about the role of plants in improving the quality of Ganga river. The workshop, attended by nearly 100 professionals, local officials and educational institutions was inaugurated by Swami Nikhilanand Ji, Head of Chinmaya Mission, New Delhi. On this occasion, Prof S.P. Singh, Ex-Vice Chancellor, H.N.B. Garhwal University was the Chief Guest while Mrs. Rama Rauta, Convener Save Ganga Movement and Prof. Vinod Tare of IIT Kanpur were the guests of Honour. Dr P. Pushpangadan former Director of NBRI delivered the Keynote lecture.

Dr. R.D. Tripathi, Scientist 'F' and Group Leader, Ecotoxicology and Bioremediation Group, Organizing Secretary ICPEP-4 and Editor of ***Environews*** has been awarded the prestigious **'Vigyan Ratna Award'** of Government of Uttar Pradesh for his outstanding researches in the area of Environmental Science with special reference to bioremediation of heavy metal(loid) contaminated environment by plants.

Dr. Mridul Kumar Shukla, a Life member of ISEB and Technical Officer NBRI has been honoured with **'Young Scientist Award'** by the Government of Uttar Pradesh for his excellent research work in the field of environmental science.

Dr. O.P. Agrawal, President of International Council for Biodeterioration of Cultural Property (ICBCP) and Patron member of ISEB, has been awarded **"Padmashree"** by the President of India for his outstanding contributions in the field of Conservation of cultural property.

Dr. M.I.H. Farooqui, noted plant chemist and former deputy Director of NBRI has been honoured by the Ruler of Oman, Sultan Qaboos Bin Saeed, with an award of U.S $ 25,000 in appreciation of his acclaimed books, 'Plants of the Quran' and 'Medicinal plants in the traditions of Prophet Muhammad. Both the books contain scientific descriptions (botanical, chemical and medicinal) of plants mentioned in Quran and in the tradition of the Prophet. UNESCO is setting up a garden of plants mentioned in the Quran at Qatar.

Prof. C.K. Varshney, Vice-President of ISEB has been nominated as a Members of the Central Wetlands Regulatory Authority, constituted by the Government of India.

Dr. S.C.Sharma, Vice President, ISEB, a renowned Bougainvillea Expert, participated in the Bougainvillea Festival at IARI, New Delhi during March 25-26,2011. Dr. Sharma is the founder member of the Bougainvillea Society of India (BSI) and actively associated with the R&D activities of BSI.

OBITUARY

Dr. P.N. Viswanathan, a renowned biochemist and toxicologist of the country, and former Deputy Director of Indian Institute of Toxicology Research (IITR), passed away after a sudden cardiac arrest at his Lucknow residence on 4th March 2011. Dr Viswanathan (72), was a pioneer in the field of toxicological research and played a significant role in the planning, development and management of IITR.

REMEMBERING THE LATE DR. PRAKASH CHANDRA

Dr. P. K. K. Nair
(former Deputy Director & Area Co-ordinator, Morphology & Palynology Division NBRI)
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It was with a feeling of shock and disbelief that I received the news of the sad and sudden demise of Dr. Prakash Chandra. Dr. Chandra was a charming personality with impeccable integrity, and academic acumen, as I knew him personally for nearly 3 decades. An event of significance has been his performance of a totally new assignment of developing a unit at NBRI on "Aquatic botany" which he built up, demonstrating the value of aquatic plants to science and Society. At that time he might not have realized that he was founding an area of Wetland research, which today is a high priority theme in Environment Research and Development all over the world.

An academic aspect of aquatic plants is in the evolution of plant kingdom as a whole and there is much new knowledge that needs to be generated from the area of reproductive biology, as for example the Podostemaceae. The aquatics are the only plant group that survived through geological time and continued to the present day, which alone explains the importance of the aquatic system in the survival of biological resources.

The economic value of aquatics is yet not fully understood and this offers opportunities for new research, although the presently available information on the value of blue green algae in nitrogen fixation, and of other plants in food and medicinal product development provide information on the beneficial value of the resource.

With the rising awareness on climate change and its impacts on human living, the wetland system and its resources are of key interest. The system is the reservoir of pollutants from run-off agro-residues, at the same time as forming the site for the emission of noxious gases like methane, a constituent of the trace gases associated with the climate change phenomenon.

The coastal districts of India are vulnerable to marine water flooding as a result of sea rise, and to the human sufferings in its aftermath. The index value of aquatics including bryophytes should not be underestimated as an index of the mechanisms for tiding over the climate change phenomenon. Thus, the dimensions of the research base laid by Dr. Prakash Chandra at a premier institution like the National Botanical Research Institute, at least two decades back could be a pioneering contribution of inestimable magnitude in the agenda of sustainable development in an era of climate change. I offer my prayers for the late Dr. Prakash Chandra, who, in effect will continue to be a living module for all the time to come.

OZONE SENSITIVITY OF INDIAN PLANT SPECIES

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Anthropogenic activities are altering the composition of the atmosphere, resulting in increased carbon dioxide (CO_2) and ozone (O_3), elevating temperature and increasing water deficits in many agricultural areas. These changes impose difficulties for plant and crop growth in many parts of the world. Sustainable and equitable global food security is dependent on the selection of crop plants with increased resistance to abiotic stresses, causing often oxidative stress to plants.

Oxidative stress occurs when plants are exposed to stress conditions that induce changes in oxygen (O_2) metabolism in plant tissues. During oxidative stress reactive oxygen species (ROS), such as hydrogen peroxide (H_2O_2), are formed within plant tissues. Accumulation of ROS during severe stress may result in irreversible damage, loss in physiological competence and eventually cell death. However, under moderate or mild stress, ROS formation may induce defence activation, promoting plant adaptation to stress conditions.

Oxidative stress in general is expected to increase during the climate change due to more frequent occurrence of extreme temperatures, soil drought or salinity, increasing UV-radiation, ozone concentrations, nutrient imbalance and high light stress. Combined action of these factors may significantly alter plant growth and development.

Tropospheric ozone

Tropospheric ozone is globally the most important gaseous oxidative stressor in many areas. Ozone is a natural constituent in the atmosphere being present in the stratosphere and throughout the troposphere. Stratospheric ozone is "good ozone", providing protection from UV radiation, while tropospheric ozone is a greenhouse gas and a harmful pollutant on the earth's surface, called also as "bad ozone". Ozone is formed in the atmosphere by sunlight driven chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs). These ozone precursors (compounds that participate in the chemical reaction that produces another compound) may be of natural origin or may be emitted as a consequence of human activities.

As with eutrophication and acidification, attempts have been made to estimate nature's "tolerance level" to ozone exposure. In the case of gaseous substances these tolerance limits are expressed as critical levels. The critical level for ozone is calculated as accumulated ozone exposure over a given threshold value. The threshold has been set at 40 parts per billion (ppb). For sensitive crops the critical level is set at 3000 ppb hours daytime during a three-month growing season (May–July) in Europe. This exposure is believed to result in crop losses of about 5 per cent.

In large areas of the industrialised and developing world, ground-level or tropospheric ozone is one of the most pervasive of the global air pollutants, having adverse effects on human health, food production, the capacity of forests to store carbon, and the environment even at current ambient concentrations of 35-40 ppb. Ozone concentrations have doubled within the last century and continue to rise globally at an annual rate of 0.5-2.5%. During this century, economic growth and increasing global population will drive the processes that lead to increasing emissions of ozone precursors such as NOx compounds especially in new hot spots arising in rapidly developing Asia, Central Africa and South America. Increasing demand for energy, transport, food and non-food crops and other resources will generally enhance the precursor emissions from human activity. In Asia, increases in power generation and traffic volumes are the main reasons for larger NOx emissions. The effects of climate change on future ozone concentrations in 2050 will be regionally variable; ozone will tend to increase in already polluted environments (due to dense population and high emissions) and decrease in clean environments (due to improved technologies in industry and traffic leading to reduced emissions). In addition to anthropogenic sources, ozone precursor emissions are increasing from natural sources such as lightning, soils, wetlands and vegetation, particularly due to warming climate and during heatwave events. The average lifetime of ozone is approximately three weeks, and therefore it can be transported long distances, e.g. from North America to Asia and from Asia to Europe and *vice versa*. This, in combination with the potential for ozone to be produced from its precursors for a long time after they have been emitted, makes ozone a global problem, where active international cooperation is needed.

Impacts of ozone on plants

In crop plants, major concerns of ozone are related to impaired primary production, smaller leaf area and decreased photosynthesis, resulting in late grain filling and losses in production and yield. To cope with elevated ozone concentration, plants activate several chemical defence processes (e.g. production of volatile organic compounds and phenolic compounds), which results in enhanced levels of antioxidative capacity. Investments to defence processes reduces allocation of resources to growth and production of reproductive organs. Plants try to avoid harmful

ozone by reducing the entry of ozone to leaves, by smaller leaf area or by structural modifications (e.g. thicker leaves).

Much research has been done to understand the phytotoxic action of tropospheric ozone, which is ultimately leading to impaired carbon fixation and accelerated aging of leaves. However, ozone experiments have been mainly conduced with those European and North American crop species and forest trees, which are important for human nutrition and welfare, and for mitigating the climate change as carbon sinks. So far, **ozone sensitivity of Indian crop species is poorly known**, although the yield losses and socio-economic impacts of ozone have serious implications in India. In addition to ozone problem, oxidative stress in general is expected to increase during the climate change due to more frequent occurrence of extreme temperatures, soil drought or salinity, increasing UV-radiation, nutrient imbalance, and high light stress. Therefore, it is very important to use all available means to diminish oxidative stress of vegetation.

Limited information from India

According to Air Pollution Crop Effect Network (APCEN) assessment (http://www.sei.se/apcen/), in south Asia, particularly India and Pakistan, evidences of high concentrations of ozone have been reported. However, present ozone monitoring stations in the Indian region, concentrating on metropolitan areas, are not sufficient to document the extent of ozone problem in India. Some recent studies have indicated that **surface ozone levels are much above critical levels at most places in the Indian region**. They also showed that there is a substantial temporal and spatial variation in ozone concentrations across the region due to meteorological conditions and anthropogenic emissions of precursor gases. Highest ozone concentrations have been measured in March, at the same time with the main growing season. Simulated percentage loss in gross primary productivity (GDP) due to ozone in India is expected to be roughly 20-30% by 2100. But, species-level information is very limited. It is known that there are clear differences in ozone tolerance among the Indian wheat and rice cultivars. However, only few cultivars have been tested so far. Ozone stress has caused reduction in biomass and yield of wheat, rice, mung, spinach, and Indian (yellow) mustard. Increasing ozone has also been reported to result in delayed flowering, impaired flower production, increased flower abortion and impaired seed quality and seed germination in several crop species. Therefore, we urgently need more detailed information about the differences in ozone sensitivity of Indian plant species and different varieties of species.

New collaboration between Finland and India

A new collaboration has been established between University of Eastern Finland (UEF) and National Botanical Research Institute (CSIR-NBRI), Lucknow. It is funded by the Academy of Finland and The Finnish Government.

The main purpose of this project is to screen the general ozone sensitivity and tolerance of the most important Indian crop and tree species and varieties so that we can eventually help the farmers to select the most suitable varieties. In parallel, we collect ozone concentration data from the main agricultural and forested regions of India.

Both crop and tree species will be selected for ozone sensitivity screening. Rice, wheat and pea are the most important crop plants grown in the region (Uttar Pradesh), and different varieties used by local farmers in this

Photo 1: Free-air ozone fumigation site in University of Eastern Finland, Kuopio campus.

Photo 2: Typical ozone injuries in birch *(Betula pendula)* leaves

area will be tested. From tree species, teak that is valuable for timber. will be selected All these plants constitute a major part of livelihood of small and marginal farmers.

For ozone exposures and validation of results different and complementary methodological approaches: will be utilized. Laboratory experiments with elevated ozone concentrations will be mainly conducted in Finland. Field studies will be conducted in Lucknow, NBRI, which has two campus sites with cultivation fields, differing in background ozone concentrations. To evaluate the effect of current ambient ozone concentrations, the exposure plants will be grown in these two field plots, where ozone concentrations will be monitored regularly. One of the ultimate aims is to set up a free-air ozone fumigation (FACE) system in NBRI, Lucknow, where the most realistic ozone responses of Indian species could be studied (Photo 1). The exposure plants will be studied for example for growth, visible injuries (Photo 2) photosynthesis efficiency, grain quality, anatomical properties, antioxidants and changes in chemical composition.

Expected outcomes of this ozone project

This multidiciplinary project will produce (1) basic information about the ozone sensitivity/tolerance of the most important Indian crop and tree species and differences between varieties about (2) the tolerance mechanisms that are necessary for plant breeding actions to increase ecological tolerance of Indian plants. In addition, the data will be collected from prevailing ozone concentrations across India, and (4) make synthesis of plant sensitivity and ozone data information to form a reliable ozone risk assessment paper from India, that is useful for forestry and agriculture managers and planners, and ultimately farmers. Finally, the studies will contribute to greehouse gas mitigation through forestry and land-use actions. In addition to high scientific value, the results of this project would have large economic and socio-economic impact through agricultural improvements in food production in this highly populated developing country needing to improve its food security.

ECODEVELOPMENT IN THE CONTEXT OF ENVIRONMENTAL CONCERNS

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The painful *tsunami* episode of 26 December 2004 was the beginning of an awakening of people to protect the coasts all over the South East Asia, including India. The havoc brought about large scale destruction of lives and properties as a result of which a Disaster Management Authority has been set up by Government of India, to deal with both natural and accidental disasters and other unforeseen human sufferings, which we hope, will attend to future national calamities. However, looking at the disaster prone areas there is much to learn from the ecological settings, which are inbuilt mechanisms for protection and safety of the coastal ecosystems. The mangrove vegetation found along the estuarine regions of the coastal belt is characterised by salinity friendly life serving to arrest the force of sea waves to a great extent at the same time as its proliferous root system providing a protective zone for diverse aquatic life forms including prawns and fishes. These natural ecosystems when destroyed do affect the coastal stability, and it is contended that the total demolition of the mangrove vegetation to develop the Paradweep Port in Orissa left the port open to sea hazards. In fact, the rich mangrove vegetation of the western coast of India has been decimated due the pressure of habitation and incompatible developmental activities, coupled with uncontrolled use of the resource by the coastal inhabitants as firewood leaving the coast open to such natural hazards as *tsunami* and coastal erosion.

A study of the *tsunami* affected coastal strips of Arattupuzha and Alappad on the west coast of Kerala provided information on what survived and what did not survive the event. For example, the coconut palm is a survivor because of its spreading adventitious roots and tolerance to salinity while mango and jack fruit trees have dried out, apart from crops like plantain and minor vegetable crops of the homesteads. However, the overall destruction of life and properties has been very painful in terms of biodiversity loss and livelihood disturbances. The coastal area in this region was once rich in mangroves and mangrove associates like *Calophyllum inophyllum* (a potential species to yield biodiesel), which have been lost due to anthropogenic activities, and that needs to be restored and sustainably utilised. Over a period of time of 6 years since 2004 a natural revival has been building up, which can be fortified with green/shelter belt development not only for coastal protection and conservation but also for providing the local inhabitants with better livelihood support through sustainable management of plant resources and improvement of their living environment and occupation, with thrust on fishing.

The above sketch enhances the need for a thematic approach to eco-development conforming to the ecosystem settings, its resources/components and people's aspirations. The living habitats are continuously changing in line with the agenda of national development. With the expanding urbanization process, there is a manifold increase in public

and private amenities, leading to the increase in vehicular traffic, proliferation of habitations of all kinds and changing lifestyle, all contributing to increasing pollution and environmental degradation. India with its multiplicity of agro-climatic zones needs to be given a focal attention with regard to the local environmental resources and the pattern of occupation of people with a single minded approach for improving the local livelihood security.

It is, therefore, imperative that eco-development ought to be ecosystem specific with the aim of evolving solutions to overcome the local problems of livelihood on the one hand and to develop clean environment on the other hand. Tree planting and greenery development should be preceded by development of a data bank on indigenous and acclimatized species of locality, edaphic and climatic conditions, atmospheric pollution, lifestyle pattern and other aspects of human benefits followed by appropriate selection and planting of trees and other plants, which possess the desired attribute for pollution abatement, ecosystem protection, clean air development, aesthetics and socio-economic benefits.

Along with the existing technologies in the development agenda, the green belt/shelter belt development should be an integral component of industrial estates with thrust on pollution abatement, landscape improvement and income generation. The climate change, being perceived as the most challenging problem of hazards that may strike humanity, deserves an integrated approach in eco-development alone. The people should be educated to identify local environmental problems and to formulate appropriate solutions; in all of which an ecosystem approach is what is decisive. This information is of value to the scientists and policy makers to plan and implement appropriate programmes to the benefit of the nation. In fact, eco-development should evolve into a dedicated people's movement, in the agenda of development.

LIQUID BIOFERTILIZERS: ADVANTAGES OVER CARRIER BASED BIOFERTILIZERS FOR SUSTAINABLE CROP PRODUCTION

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As the disadvantages of the use of chemicals in agriculture have been noticed in recent years, a search for alternatives for chemical fertilizers and pesticides has started throughout the world. The use of chemical fertilizers as well as pesticides is much more in developing countries as compared to developed countries. Organic farming is the only alternative to get rid of chemical fertilizers and synthetic pesticides. There is increasing awareness about organic agriculture practices in the world. Organic agriculture is the growing food without pesticides and fertilizers. Organic production is a system of farming that restores, maintains and enhances ecological balance.

What are the alternatives for chemical farming?

Biofertilizers have been identified as alternative to chemical fertilizers to increase soil fertility and crop production in sustainable farming. There are abundant microorganisms thriving in soil, especially in the rhizosphere of plants. It is well known that a considerable number of bacterial and fungal species possess a functional relationship and constitute a holistic system with plants. They are able to exert beneficial effects on plant growth. Application of beneficial microbes in agricultural practices started about 50 years ago and there is now an increasing evidence that these beneficial microbial populations can also enhance plant resistance to adverse environmental stresses, e.g. water and nutrient deficiency and heavy metal contamination.

What are biofertilizers?

Bio-fertilizers are natural fertilizers which are microbial inoculants of bacteria, algae, fungi alone, or in combination, and they augment the availability of nutrients to the plants. The use of bio-fertilizers, in preference to chemical fertilizers, offers economic and ecological benefits by way of soil health and fertility to farmers. These are products containing living cells of different types of microorganisms, which have the ability to convert nutritionally important elements from unavailable to available form through biological processes. They are involved in symbiotic and associative microbial activities with higher plants. These are natural mini-fertilizer factories that are economical and safer source of plant nutrition for increasing the agricultural production and improving soil fertility. The microorganisms colonize roots of rice, wheat, maize, sugarcane and form root nodules in leguminous plants. Different biofertilizers have shown nitrogen fixing, phosphorus solubilizing and phytohormone producing abilities that are used for increasing the agricultural productivity, e.g. (*Bradyrhizobium* for legumes grain, fodders), plant growth promoting rhizobacteria (PGPR) for cereals (wheat, rice, grasses etc.), *Azolla* for rice ecosystem, and actinomycetes (*Frankia* spp.) for forest trees. These microorganisms convert atmospheric nitrogen to plant usable form and can provide up to 200 kg N/ha/crop. Next to nitrogen, phosphorus is essential for crop production. Although our soils have sufficient phosphorus but this

phosphorus is not available for plants and most (>90%) of our soils are phosphorus deficient. Usually the pH of our soils is more than 7.5 and at this pH, very low amount (3-10 mg/ kg) of phosphorus is in available form. In such soils, when phosphatic fertilizers are added only a part of it is utilized by the plants and remaining part is precipitated due to the presence of calcium and with time it is converted into highly insoluble forms of calcium. In recent years, biofertilizers have emerged as an important component of the integrated nutrient supply system and hold a great promise to improve crop yields through environmentally better nutrient supplies. However, the application of microbial fertilizers in practice, somehow, has not achieved consistent results.

A group of bacteria referred to as plant growth-promoting rhizobacteria (PGPR), which participate in many key ecosystem processes such as those involved in the biological control of plant pathogens, nutrient cycling and seedling establishment, and, therefore, deserve particular attention for agricultural or forestry purposes. PGPR may colonize the rhizosphere, the surface of the root, or even superficial intercellular spaces of plants. It has been revealed that the effect of nitrogen fixation induced by nitrogen fixers is not only significant for legumes, but also non-legumes. Moreover, some strains have multiple functions for plant growth. Phosphate (P) – and potassium (K)-solubilizing bacteria may enhance mineral uptake by plants through solubilizing insoluble P and releasing K from silicate in soil. Soil microorganisms are important components in the natural soil sub ecosystem because not only they contribute to nutrient availability in the soil, but also bind soil particles into stable aggregates, which improve soil structure and reduce erosion potential.

Advantages of biofertilizers over chemical fertilizers

The utilization of microbial products has several advantages over conventional chemicals for agricultural purposes. Microbial products are considered safer than many of the chemicals now in use, neither toxic substances nor microbes themselves will be accumulated in the food chain, self-replication of microbes circumvents the need for repeated application, target organisms seldom develop resistance as is the case when chemical agents are used to eliminate the pests harmful to plant growth and properly developed biocontrol agents are not considered harmful to ecological processes or the environment.

Azotobacter

Azotobacter is a free-living, gram negative, aerobic, nitrogen-fixing bacterium and is therefore being used as biofertilizer to replace chemical fertilizers. It grows from 28 – 30 ^{0}C and a pH range 7.0 to 7.5. It uses sugars, alcohols and salts of organic acid for growth. Generally it fixes non-symbiotically about 10 mg of atmospheric nitrogen/gm of carbohydrates (usually glucose) consumed. It is non-spore forming but can form cyst in adverse conditions and in older cultures grown with sugar as the carbon source. Cyst has a characteristic structure a central body surrounded by a cyst coat, consisting of an exocystorium and an exine. Cysts accumulate poly B-hydroxyl butyric acid (PHB). With the onset of favourable conditions they give rise to vegetative cells. On nitrogen free agar medium with sugar as carbon source colonies appear within 48 hr at 30 ^{0}C. The colonies are smooth, opaque, low convex and viscid.

***Azotobacter* biofertilizers**

Azotobacter biofertilizers contain very high number of live *Azotobacter* bacteria. It can be used in any non-legume crop of short, medium and long duration. Besides fixing nitrogen these bacteria secrete certain growth promoting hormones such as indole acetic acid, gibberellic acid and cytokinins, which promote vegetative growth and root development. *Azotobacter* cultures used as inoculants have been reported to produce gibberellic acid, indole 3-acetic acid and cytokinin, which may promote seedling development and plant growth. The potential use of *Azotobacter* spp. was reviewed by Brown (1982), who concluded that inoculation with *A. chroococcum* occasionally promoted yields, probably by mechanisms other than biological N fixation.

Carrier-based biofertilizers

Carrier-based biofertilizers are prepared with the help of activated charcoal, which act as a carrier for microbial inoculants. Biofertilizer consumption is not very satisfactory due to certain disadvantages associated with carrier-based biofertilizers like low shelf life (3-4 months), storage condition (stored in cool temperature) as it is temperature sensitive, bulky to transport, therefore, high transport cost, less scope for export, more chances of contamination, problem of proper packing, poor cell protection, poor moisture retention capacity and restriction on use of charcoal as a measure of conservation.

Liquid Biofertilizers: solution to carrier based biofertilzers

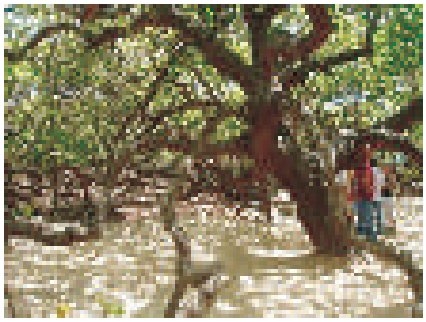
The strength of biofertilizers is determined by two basic parameters 1. Number of cells 2. Efficiency of the microorganisms to fix nitrogen or solubilize phosphates. Liquid biofertilizers are liquid formulation containing the dormant form of desired microorganisms and their nutrients along with the substances that encourage formation of resting spores or cysts for longer shelf life and tolerance to adverse conditions. The dormant form on reaching the soil, germinate to produce fresh batch of active cells. These cells grow and multiply by utilizing the carbon source in the soil or from root exudates.

The advantages of liquid biofertilizers over conventional carrier based biofertilizers are: longer shelf life (12- 24 months), no effect of high temperature and no contamination, no loss of properties due to storage at high temp. up to 45^{0} C, high populations can be maintained more then 10^{9} cells/ ml up to 12 to 24 months, easy to use by the farmers, high export potential, dosages are 10 times less then carrier-based, quality control protocols are easy and quick. Lot of work has been done on carrier-based biofertilizers in the context of organic food production. In view of the advantages of liquid biofertilizers over carrier based formulations, research has now been started on the production and testing of liquid biofertilizers.

World's Largest Cashew Tree

The largest cashew tree in the world is found at the district of Pirangi do Norte, city of Parnamirim, Rio Grande do Norte, Brazil. The tree covers an area of about 7500 m2, with a perimeter of about 500m. It was planted in 1888, by Luiz Inácio de Oliveira, a fisherman; Oliveira died years later, aged 93, resting under the shadows of the tree.

The tree grew so much because of the combination of two genetic anomalies. First, instead of growing upwards, the branches of the tree grow sideways; because of its weight, the branches eventually bend downwards, and touch the ground. Then, the second anomaly takes place: instead of just keep growing



resting on the floor, the branches create roots and start to grow up again, as if they were new stems; this causes the impression that there are several trees, when there is actually only one.

The money generated by entry fee to the park is invested towards improving the structure of the parks. Bi-lingual guides (English and Spanish) are available. Inside the park, there is an observation point, about 6 meters high, from where one can view the tree from above.

From: Natal Brazil Blog

1.25 m Plant Names in New Database

Capping the UN's International Year of Biodiversity, Botanists in Britain and the US unveiled a library of plant names aimed at helping conservationists, drug designers and agriculture researchers. The database, accessible at www.theplantlist.org, identifies 1.25 million names for plants, ranging from essential food crops to garden roses and exotic jungle ferns, and provides links to published research.

Source: **www.theplantlist.org**

Cell Phones and Cancer

Cell phones have only been in widespread use for a couple of decades, which is far too short a time for us to know conclusively whether or not using them could cause cancer. Research thus far appears to indicate that most of us have little if anything to worry about.

According to National Cancer Institute U.S.A., the low-frequency electromagnetic radiation that cell phones give off when we hold them up to our heads is "non-ionizing", meaning it cannot cause significant human tissue heating or body temperature increases that could lead to direct damage to cellular DNA. By contrast, X-rays consist of high-frequency ionizing electromagnetic radiation that can lead to the kind of cellular damage resulting in cancer. Nonetheless, some cell phone users and researchers still worry about our cell phone usage.

The reason the issue keeps coming up is that some initial studies in Europe, where cell phone usage caught on a decade before the U.S. showed links between some forms of tumors and heavy cell phone usage. As a result, researchers teamed up to do a more definitive study, called the "Interphone" study, across 13 countries between 2000 and 2004. The results, published in May 2010 in the *International Journal of Epidemiology*, indicated no increased risk of developing two of the most common types of brain tumors, glioma and meningioma, from typical everyday cell phone usage. Study participants who reported spending the most time on their phones showed a slightly increased risk of developing gliomas, but researchers considered this finding inconclusive.

Researchers recently launched a longer term study, dubbed COSMOS (short for Cohort Study on Mobile Communications), in Europe. Some 250,000 cell phone users between the ages of 18 and 69 and located in Britain, Finland, the Netherlands, Sweden and Denmark will participate by allowing researchers to track their cell phone usage and health over three decades. The study will factor in the use of hands-free devices and how people carry their phones and will also be on the lookout for links to neurological diseases such as Parkinson's and Alzheimer's.

There are some precautions one can take to minimize whatever risk may exist. The Federal Communications Commission (FCC) suggests reserving the use of cell phones for shorter conversations, or for times when a conventional phone isn't available. Also, using a hands-free device places more distance between the phone and the head, significantly reducing the amount of radiation exposure.

Our Planet Weekly

Perforated 'Tawa' (hot plate) saves energy

A hot iron plate commonly known as 'Tawa' is used to make chappaties in nearly every house of indo-Pak subcontinent. A chappatie, which is an essential part of the meal, is about eight inch diameter disc-shaped bread. A recent research has shown that a perforated hot plate baked a chappatie in 45% less time as compared to conventional plain hot

plate and thereby saving time as well as energy. This perforated hot plate also acts as toaster by dispensing expensive electric toaster which is more prone to damage.

It is premised that when a chappatie shaped dough is placed on conventional hot plate the moisture of dough in contact with the hot plate converts to steam and steam pockets emerge between dough and plate. The steam puts dents into the dough surface making it uneven. Thus, heat transfer to dough is reduced by presence of steam and also the contact area between dough and hot plate is reduced because of uneven surface of dough. The trapped steam vents through perforations in the perforated hot plate getting rid off the culprit of reduced heat transfer.

From the point of view of overall energy saving, it is estimated that 0.025 m^3 of gas per person per day will be saved and this would result in substantial saving in domestic consumption of gas reserves by a section of urban population. An added advantage will be that a housewife will have to spend less time in the kitchen where she is exposed to substantial indoor pollution.

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Source: Alternative Energy Sources, Hydrocarbons/Energy Transfer Energy Research Institute, University of Miami, **U.S.A.**)

Cyperus plant could provide a substitute for olive oil

Cyperus esculentus seeds could provide a cheaper alternative to olive oil used for cooking in Middle Eastern countries, according to research conducted at El Minia University, Egypt. The study found that *Cyperus* plants – already grown in Egypt for the edible seeds, and mentioned in scientific literature as a source of biofuels – taste and smell similar to olive oil, which could make them an ideal substitute. More than two-thirds of Cyperus oil is oleic acid, which makes it less likely to break down and more durable. This is similar to olive oil's content.

Cyperus seeds contain up to 23 per cent of oil. *Cyperus* can be planted in deserts, as it does not need clay soil or fertilisers. It also tolerates the salinity of the land and the lack of water, *Cyperus* produces between 1.8 and 3 tonnes of seeds per hectare. Another advantage of *Cyperus* is that it can be easily extracted from the plant using the same method as for olive oil. Olive oil extraction industries work only during the olive harvesting season, because olives are not a harvest that can be stored, so these industries could extract *Cyperus* in other seasons.

The study deserves more research in a biochemical laboratory.

Hazem Badr

Source: SciDevNet

Animals can predict the weather

Frogs are said to croak longer and louder than usual when a storm is brewing. When birds are flying high the weather is generally clear, but if they are flying closer to the ground it signals the arrival of storm as the air pressure of a storm system caused them pain at higher altitudes. Cows, on sensing bad weather become restless, antsy and swatting flies with their tails. Sudden disappearance of bees and butterflies from the flower beds is sure indication of approaching heavy weather. When sheep gather in a huddle and shield each other, a storm is expected. Ladybugs are one of the cutest insects around; they give us a hint as to the day's thermostat. When they swarm, a warm day is expected, but if they are looking for shelter, then cold weather is on its way. In preparation for bad weather, red and black ants have been known to build up their mounds for extra protection and even to cover the mounds. So the high mounds are a sign of approaching bad weather.

Source: **Care2 Newsnetwork**

An effective water treatment biocide

Chlorine dioxide (Clo_2) a yellowish green gas, is a more effective biocide than traditional chemicals such as chlorine or bromine in industrial water treatment. It has a number of advantages over other oxidizing biocides. At room temperature, it is a water soluble gas that dissolves in water but does not resist with it, while chlorine and bromine resist with water giving solution containing a range of ionic species. As a dissolved non-ionic gas, solutions of Clo_2 are particularly effective in controlling the formation of bio-films chlorine dioxide selectively oxidize organic material without chlorination. It cannot be compressed or liquefied and is always produced on site. It is often used as a disinfectant in food washing application. Because of these advantages chlorine dioxide has become an extremely importance element of the water treatment industry.

Source: **Rick Lees**
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