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IN THIS ISSUE

BIOFERTILIZER AND BIOPESTICIDE FOR DEVELOPING WORLD: A BOON FOR SUSTAINABLE AGRICULTURE

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Director NBRI & President ISEB

In India, agriculture accounts for about 22 percent of gross domestic product. There are about 116 million farm holdings with an average size of 1.4 ha. The cultivated area is about 141 million ha and has remained constant for the past 30 years, although the cropping intensity has increased from 118 to 135 percent during this period. The introduction of high-yielding varieties in the 1960s boosted fertilizer use whose consumption has increased from less than a million tonne of total nutrients in the mid-1960s to almost 17 million tonnes today. The intensity of fertilizer consumption varies greatly between the regions, from 40.5 kg/ha of total nutrients in Rajasthan to 184 kg/ha in Punjab. Urea accounts for 82 percent of total nitrogen consumption and di-ammonium phosphate (DAP) for 63 percent of phosphate consumption. Strong correlation is found between fertilizer consumption and food grains production till 1997-98. After 1997-98, this relationship is distorted. Most States of the country are experiencing increase in fertilizer consumption with slower pace of crop productivity. Some states witness consumption of fertilizer picking up without any conspicuous gain on agricultural crop productivity. This shows that the use of agrochemicals has deteriorated the soil health and limited its capacity to produce more, even with higher consumption of fertilizers.

Use of Bio-fertilizers, organic fertilizers and balanced fertilizers can provide viable leverage to increase crop productivity. Bio-fertilizers have potential to enrich the soil with important nutrients and generate additional income to farmers from the same size of land. Studies on benefits and usefulness of bio-fertilizers on agriculture production reveal that on an average 10-20% increase in production can be realized by use of bio-fertilizers. In terms of nutrients, bio-fertilizers can provide 10-20 kg nitrogen and can solublize 10-12 kg of P_2O_5 per hectare per cropping season. They can replace chemical nitrogen and phosphorus by 25%. Use of bio-fertilizers also improves soil health by helping other beneficial micro-organisms to grow. Thus the use of bio-fertilizers is being promoted through Integrated Nutrient Management, enhancing awareness and field demonstrations. The use of biofertilizers has increased in recent years although its use is of relatively recent origin than organic manure and chemical fertilizers. Biofertilizers consist of N fixers (Rhizobium, Azotobacter for legume crop, blue green algae, Azolla for low land paddy, Acetobacter for sugarcane, Azoctobacter and Agospirellium for non legume crop), phosphate solubilizing bacteria (PSB) and fungi (mycorrhizae). As per the data available on use of bio-fertilizers in 2009-10, Tamil Nadu produced 3733 tonnes of bio-fertilizers followed by Karnataka, 3696 tonnes. The other major producers of bio-fertilizers are Kerala (1937 tonnes), Maharashtra (1861 tonnes) and Madhya Pradesh (1588 tonnes). In a developing country like India, biofertilizer and biopesticide industry is estimated at ~ 20 M in 2008-2009 increasing at a Compound Annual Growth Rate (CAGR) of ~3% and expected to grow at CAGR of 10-15% by 2012.

India's foodgrain requirement to feed the estimated population of 1400 million by

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- Members of ISEB are requested to immediately intimate any change in their contact address including postal, Email, Fax, Telephone to ISEB office.
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LETTERS

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You can leave a voice message and I will call you back, if you prefer a call instead of emails.

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We have recently been informed that colleagues from Belgium are bringing their Open Top Chamber (OTC) research programme to an end. Hence, they won't need their perfectly functioning (both mechanically as well as electronically) OTC facilities any longer and would be happy to give them away for free. However, they couldn't cover the costs for dismantling and shipping the chambers.
We just wondered whether anyone of you would be interested in these chambers and/or whether you could please circulate this offer among your colleagues and research networks to hopefully find future users for this excellent OTC facility.
Please get in touch with us if you have any ideas concerning this matter.

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I had the opportunity to meet you during my visit to NBRI last April in Lucknow. During the nice conversation that we had, you proposed to me to write a short article about the significance of nitric oxide.
In this sense, I have written a brief note trying to give an overview of the different milestones in the research of nitric oxide in animals and plants. I have avoided scientific terms while trying to explain the relevance of nitric oxide for potential general readers who are not familiar with this topic.
Please let me know if this article satisfies the main idea that you told me.

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I would like to inform you that I have shifted to Lucknow now. It is therefore requested that the forthcoming issues of ENVIRONEWS may kindly be sent to me at the following address :

Dr. S.K. Grover, 2/206, Viram Khand, Gomti Nagar,
Lucknow-226010.

Dr. S.K. Grover
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I am pleased to inform you that the 3rd Sulphyton meeting on Plant Sulfur Research will be held in the conference facilities of the Campus of Conegliano, University of Padova, Conegliano, Italy, from September 29th to October 1st, 2011.
The aim of the 3rd Sulphyton meeting is to gather researchers working in the area of plant sulfur research, including the sulfur metabolism, regulation, diversity, role in biotic and abiotic stress and importance of sulfur in agriculture.
(See for more information and registration: www.scuolaenologica.unipd.it/sulphyton)
The 3rd Sulphyton meeting will be preceded by the 1st BIONUT meeting, "State of the art in Plant Nutrition research", to be held at the same venue from 27th to 29th September 2011.
(For more information and registration see www.jic.ac.uk/events/bionut/)
Registration to both meetings is independent and has been opened at the corresponding webpages. Looking forward to seeing you in Conegliano

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2025 will be 300 million tonnes (based on rice, i.e. unhusked paddy rice). There will be a corresponding increase in requirement of other crops such as cotton, sugarcane, fruits and vegetables. The country will require about 45 million tonnes of nutrients (30 million tonnes for foodgrains and 15 million tonnes of nutrients for other crops) from various sources such as fertilizers, organic manures and biofertilizers. A further increase in crop production will have to come from an increase in yields besides maintaining the sustainability of agricultural lands as there is a limited scope for increasing cultivated area. The yields of a majority of crops are relatively low and there is great potential for increasing them through the increased use of inputs such as biofertilizers and manure which will remain key to the future development of ecofriendly and sustainable agriculture.

NEWS FLASH

CSIR-National Botanical Research Institute (NBRI) Lucknow's Women Scientists organized a programme at Kalli village on the occasion of World Environment Day 2011, on 5th June. The Chief Guest of this programme was Mrs. Manju Nautiyal, Principal, City Montessori School, Jopling Road, Lucknow. Mrs. Nautiyal spoke on the importance of the Day and on ways to conserve and protect our earth. Nearly 250 people including village Pradhan and his team were present on this occasion.

As per the theme of 2011, Dr. Nandita Singh explained the importance of forests, plants/trees, their conservation and plantation. NBRI Scientists, Drs. M.R. Suseela, Kanak Sahai, Kamla Kulshreshtha, Poonam Singh, Manjoosha Srivastava, Vidhu Sane, Pratibha Mishra, Swadesh Malhotra, Sanjay Dwivedi, and several research scholars were present on the occasion. Chief Guest, along with village fellows, planted five "Panchwati" trees – Shami, Bel, Neem, Pipal and Gular at the Kalli Panchayat Office. Nearly 150 different tree species of NBRI Nursery were distributed among villagers for planting them in the backyard of their houses. Dr. Mridul Kumar Shukla conducted the Programme.

Dr. S.C. Sharma, Vice President ISEB, on a recent tour to South India, visited leading botanical gardens, horticultural institutes, field stations in Bangalore, Mysore, Salem, Yarcaud and Puducherry where he exchanged scientific information on the Impact of Climate Change on plant diversity with conservators, urban landscapists and environmentalists. During his tour, he visited world famous Lal Baugh Botanic Garden, Bangalore. While visiting Yercaud, a hill station, he observed a unique grove of *Bougainvillea arborea,* a tree species which had attained a girth of 10-15 meters.

Dr. Sharma was the Chief Guest of a function to mark the Earth Day organized by Brigade Metropolis, Bangalore on 22 April 2011. On this occasion, he also delivered a lecture wherein he emphasized the need for protecting the Planet Earth.

Dr. Upendra Nath Rai Scientist and Dr. Mridul Kumar Shukla, Technical Officer, NBRI and members of ISEB, attended Nirmal and Aviral Ganga Conference at Parmarth Niketan, Rishikesh, Haridwar during 23-24 April 2011 and delivered lectures on 'Plant based management of Ganga water pollution' and "Importance of tree plantation in restoring Ganga water quality" respectively. They also held discussions on their research work with Dr. R.K. Pachauri, Nobel Laureate and DG, TERI, New Delhi during brain storming session of the Conference.

Prof. R.S. Tripathi, Advisor ISEB was invited as the Chief Guest at the World Forestry Day celebration organized by the NEHU Regional Centre for Afforestation and Eco-development Board, Ministry of Environment and Forests, Govt. of India on 25th March, 2011 to raise awareness among the villagers about the importance of forest conservation. In his lecture delivered on this occasion, Prof. Tripathi stressed the role of forests in providing important bio-resources, their tremendous contribution to carbon sequestration and climate change mitigation, their role in maintaining soil fertility and in sustaining water streams and adjoining agro-ecosystems, and in imparting a serene look to the landscape. He emphasized that forests are the most important treasure house of biodiversity, and therefore, they need to be conserved at all cost if we have to conserve our valuable biodiversity.

Prof. R.S. Tripathi has been nominated by the Ministry of Environment and Forests, Government of India as the Chairman of the Research Advisory and Monitoring Committee of Centre of Ecological Sciences at Indian Institute of Science, Bangalore for a period of three years w.e.f. May, 2011.

Dr. Vivek Pandey, Scientist CSIR-NBRI & Life member, ISEB visited Finland and Czech Republic from 1 - 17 June 2011. This visit was in relation to ongoing Indo-Finnish project on 'Ozone stress and Indian crop species' funded by Academy of Finland. Dr. Pandey held discussions with Finnish collaborator Prof Elina Oksanen of the University of Eastern Finland. He visited university campuses at Joensuu and Kuopio. Later, Dr. Pandey attended 3 days conference on Ozone, Climate Change and Forests" held at Prague, Czech Republic from 14-16 June 2011. He presented a paper entitled "Ozone sensitivity of the most important Indian crop and tree species".

CSIR-NBRI organizes Farmers Training Programme on Adoption of Innovative Rural Technologies : National Botanical Research Institute, Lucknow, in collaboration with Department of Agriculture under RSP project of CSIR, New

Delhi organized one day Farmers training programme on "Application of microbial Biofertilizers for enhanced productivity and quality improvement of agriculture production " to farmers of village Kalli (west) situated on Rae Bareli Road, Lucknow. The programme was inaugurated by Dr Rita Bahuguna Joshi, who emphasized the role of rural women in increasing agricultural productivity. She also appreciated the significant contributions made by NBRI under the leadership of its Director Dr Chandra Shekhar Nautiyal (President ISEB) in development of low cost microbial biofertilizers that rejuvenated agriculture soils of not only Uttar Pradesh but many other states of India covering more than 250 lakh hectares. Dr. Nautiyal in his address introduced his vision about need-based catering of rural sector by transferring innovative rural technologies to farmers covering core area like microbial fertilizers, commercial floriculture, dried flower technology, medicinal plant cultivation, herbal technology and environment health etc. The programme was organized and conducted by Dr. Mridul Shukla, a Scientist of NBRI and Life member of ISEB.

On this occasion several senior scientists of NBRI including Drs. A.K. Goel, R.S. Katiyar, R.S. Chaurasia, A.K.S. Rawat, Nandita Singh, Sanjay Dwivedi and L.B. Yadav spoke on their respective areas of expertise.

During the training programme, biofertilizer kit with relevant literature was provided free of cost to each farmer. About 1000 farmers participated in the programme.

Dr. S.C. Sharma Vice-President was invited to participate in the World Environment Day Celebrations at the Central Institute of Sub-tropical Horticulture (CISH), Rahmankhera, Lucknow on June 6, 2011. On this occasion a Tree Plantation Programme was organized. Also Dr. Sharma delivered a talk on "Pollution and Solution: Think globally but act locally"

NEW LIFE MEMBERS

Dr. Ms. Sushma is an Assistant Professor at the Department of Forestry, Wildlife & Environmental Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur-495 009, Chhattisgarh.

Dr. Kamlesh Kumar Tiwari is a Scientific Officer at Sophisticated Instrumentation Centre for Applied Research & Testing, Vallabh Vidya nagar-388120, Anand, Gujarat

Dr. Priyanka Agnihotri is working as a Woman Scientist (A) (DST) Biodiversity & Angiosperm Taxonomy in the National Botanical Research Institute, Lucknow, India

LITERATURE RECEIVED BY ISEB ON GRATIS

Acid News
Published by Air Pollution & Climate Secretariat, Goteborg, Sweden (Editor: Christer Agren)
www.acidrain.org

PLANET earth
Published by Gateway Media, Hyderabad, India (Executive Director: Ramprasad)
www.planetearth-india.com

Energy Next
Published by Focal Point Media Services Pvt. Ltd., Hyderabad (Editor-in-Chief: D. Majumdar; Publication Director: Ramprasad)
www.energynext.in

Association Meetings International (ami)
Published by Conference and Travel Publications Ltd. , West Sussex, U.K. (Managing Editor: Martin Lewis)
www.meetpie.com

DISTINGUISHED VISITORS TO ISEB OFFICE

1. Dr. Javier Francisco Corpas, High Council for Scientific Research (CSIC), Granada, Spain.
2. Dr. Juan Bautista Barroso University of Jaen, Campus University "Las Laguniallas", Jaen Spain.
3. Prof H.N. Verma, Pro-Vice Chancellor, Jaipur National University, Jaipur, India.
4. Mr. Md. Muazzam, Deputy Secretary, Ministry of Environment & Forests, Government of India New Delhi.
5. Dr. V.R. Balasubrahmanyam, Vice President – R & D farms, Jain Irrigation Systems Ltd. Jalgaon (Maharashtra), India.

SUSTAINABLE CARRYING CAPACITY WITHOUT INPUTS OF FOSSIL ENERGY AND MINIMAL ADVERSE ENVIRONMENTAL IMPACT

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Ecologists define carrying capacity as the maximum number of individuals that an area can support without detrimental effects on the environment – soil, water, air and the life forms. In natural as well as agro-ecosystems, humans and animals are dependent on the primary productivity in the area. The latter utilize the free resources of CO_2 and sunlight to convert into chemical bond energy in the form of carbohydrates, proteins and lipids that are utilized as food by humans and animals. Plants from the forests also provide firewood, the traditional source of energy for heating, and timber for housing. However, to utilize the two free resources, land area, water, plant nutrients and growth periods with moderate temperatures suitable for plant growth are essential. Before the start of agriculture some ten thousand years back, humans subsisted as hunter and gatherer of food. Their numbers were small and the primary productivity of the plants in nature was adequate to meet the modest demands of a small population.

Change, however, is part of the evolutionary processes. The first major change started some ten thousand years back when the humans discovered that the grains they have been collecting from natural growth of cereals like barley, wheat and rice can be grown in their own backyards. This was the beginning of agriculture. It led to a major change in life style from food gathering to growing food. Human settlements, domestication of animals and growth of civilization followed. Since then, humans have been striving to increase the productivity of the cultivated plants to harvest more and more. Earlier, they moved to virgin lands, kept their fields' fallow for few years, initiated crop rotations with leguminous crops to improve soil fertility and crop productivity. Later they started using animal dung, garbage, fish meal, bones, saltpeter (sodium and potassium nitrates) to increase the harvest.

The second breakthrough came with the development of chemical processes for the production of synthetic ammonia utilizing abundant nitrogen in the air. The application of synthetic fertilizers, along with mechanization of farm operations, and genetic enhancement of plants increased crop productivity several fold. The common denominator was the increased inputs of fossil fuels in farm operations and production of fertilizers. All this happened in just about 200 years, starting with the industrial revolution in the nineteenth century, first in the agricultural production systems of the developed regions and later in the developing countries.

Industrialization, increased food production, control of infectious diseases and other factors contributed to increased population growth rate. The World population that was 1.55 billion in 1900 reached 6.22 billion in the year 2000 and is expected to reach 7 billion in October 2011. The projections for 2050 are 9 billion. Addition of another billion, from 6 to 7 has taken only 12 years. That the world is able to currently feed 7 billion people is a great achievement which goes against the arguments of Malthus, who in 1798, said that population will grow geometrically while the production will increase in arithmetic proportion. Technology and energy inputs made this possible. However, currently annual population growth rates in many regions including India are higher that productivity growth rates.

The first oil crisis of 1970s initiated analyses of the energy input / output into all human activities including the food production, transport and utilization. It emerged that the spectacular increases in crop productivity have been achieved by large fossil energy inputs in the form of fertilizers, fuel and power. There have been no gains in net energy return, estimated as the ratio of energy input and output. The high quality energy of fossil fuels enhanced the harvest of solar energy. In simple words, crop plants converted fossil fuels into food.

As the input intensive, green revolution technology that contributed to self sufficiency in food production in high population growth areas like India, the adverse environmental effects such as, increase in nitrate content in water bodies, decline in water table and pesticide residues became apparent in many parts.

The environmental impact of the human activities is well expressed by the formula given by Ehrlich and Holdren[1].

$I = P \times A \times T$

Where:

I = Impact on the environment,

P = Population,

A = Affluence of the population,

T = Technology factor (the available technologies for food production and other human activities).

The environmental impact involves complex interactions between P - the population numbers and consumption of natural resources including food (quantity and quality) dependent on the affluence of the population. Technologies used for food production as well as all other human activities and their energy use efficiency make an important component of T.

It is apparent that tradeoffs are involved, and large populations with high consumption of natural resources cannot be sustainable. It is important to recall that agriculture was possible only after destruction of the natural vegetation that must have caused loss of considerable biodiversity. Till recently, forests were cleared to provide land for settling displaced persons. Thus the Carrying Capacity (CC) depends on the natural resources and levels of environmental degradation acceptable to the society. Reducing the

consumption of resources by changing the life styles and food habits are the other options for increasing the CC which may not always be socially acceptable.

Ecologists have widely different views on the world's CC; some say that 2 billion is the right population for the world. Others argue that we already have over 6 billion, and earth can support 40 billion, provided the consumption and life style are altered. It has been suggested that a much larger world population can be supported by reducing the consumption of meat, fats and sugars. Carrying capacity without the inputs of fossil energy would be less than two billion.

It is now widely accepted that the known resources of fossil fuels may be exhausted in the next fifty years. Hence, in future, plants will be a large source of renewable energy, different starting materials for chemical industry, presently obtained from fossil fuels, besides food, feed and fiber. All these must come from shrinking land and depleting water resources on a sustainable basis. Indeed, it is a tall order and a great challenge for plant scientists. It is obvious that all cannot get everything; for sustainable development either the number of people, or the life styles and consumption levels will have to change for minimizing the environmental impact. Sustainable agriculture is possible only for a sustainable population. Scientific advances and new energy efficient technologies will certainly play key role in ameliorating the environment and sustaining human populations. It is, therefore, important to estimate human CC of different agro-climatic regions under various possible scenarios for the future.

Ehrilch, P. R. and Holdern, P. R. 1971, Science 171:1212-1217

www.holon.se/folke/kurs/logexp/carry

Summing up, carrying capacity of the world increased when humans started growing plants that provide food, instead of gathering grains from natural stands. Industrialization, development of synthetic fertilizers and other agrochemicals further enhanced productivity through large inputs of fossil energy. This made it possible to support even larger population. Then came the realization that the known fossil energy sources are limited and will be exhausted in the next fifty years. Further, the adverse environmental impact of intensive farming became apparent in many areas. In future, plants will be the source of liquid fuels and other starting materials for chemical industry besides much more diversified food, feed and fodder. All this, must come from shrinking cultivable land and water resources on a sustainable basis without damaging the resource base. .

BIOLOGICAL RECULTIVATION OF "INDUSTRIAL DESERTS" OR "LUNAR SCAPES"

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"Industrial deserts" or "Lunar scapes" are large territories over-loaded with technogenic waste. Soil washing and cleaning in such situation is cost prohibitive. Therefore, one of the emerging approaches is "biological recultivation". It has been satisfactorily implemented in USA and Russia by seeding of perennial grasses, tree and bushy species.

The environmental problems associated with mining and industrialization are the cause for concern in India. Recently, the environment minister of India announced that the MOEF has planned to add five million hectares of forest cover and improve its quality in another five million hectares in the next ten years. All this is possible when we have robust lab-cum-field research program in biological recultivation.

Despite the wide ranging constraints at hazardous waste dump sites and substrates, there have been some important success stories in the direct restoration yielding significant biodiversity benefits. The principal restoration options, on a site-specific basis, are the ameliorative approach (improving the physical and chemical nature of the site) and the adaptive approach which seeks to achieve the ecological restoration goal of establishing ecosystem structure and function and thus biodiversity. Ecological restoration without ameliorative and adaptive approaches usually depend on:

a) careful selection of suitable substrates for plant growth
b) species with good adaptability and suitability for ground stabilization
c) the value of the species as wildlife habitat (and as forage for domestic animals),
d) aesthetic value.

Indigenous species available as propagules do not always satisfy the above criteria, in which case native, but not locally indigenous, species can be sown as a supplement, usually in a way that provides a rapid solution to short-term problems such as erosion, but one which enables colonization by local volunteer species and thus facilitates succession to eventually restore the native ecosystem and biodiversity

The use of metal tolerant plants, in particular of the temperate grasses *Agrostis capillaris* and *Festuca rubra*, is a proven reclamation technology of 20 years for a variety of mine tailings and metal contaminated soils

More recently, a technology has been promoted whereby the tolerance to metals of some plants is used in a different way. Some species are described as "hyper accumulators" in recognition of their ability to accumulate elements that are usually present in trace concentrations in plants. For highly toxic metal mine wastes, it has been suggested that such species could be manipulated to clean-up or 'bioremediate' soils and at the same time stabilize and reclaim land for other purposes. Long term trials are also underway in the U.S.A. and Chile.

Revegetation is the basis for most contaminated land reclamation programs. The revegetated contaminated area must meet two basic

objectives; (i) forage and habitat for livestock and wildlife suitable for the approved post mining land use must be provided, and (ii) erosion from the mined lands must be controlled to the same extent that erosion is controlled on undisturbed native lands. Vegetation grown on the mined area is the forage for animals, a basic part of the habitat for animals, and the principal means of controlling erosion from mined lands.

There is not a single "best" method in all circumstances for any of the reclamation operations. The procedures and techniques described in this article have proved successful in at least one and possibly more situations.

1. Revegetating contaminated site

The objective of a revegetation program is to establish desirable vegetation. The procedures described for establishing vegetation include the aspects such as, seed-bed preparation, farming practices, seed handling, planting, mulching, shrub establishment and reforestation. Revegetation involves the following points/exercises.

a) Preparing a revegetation package
b) Cultivation practices
c) Drill seeding practices
d) Hydro seeding practices
e) Mulching practices
f) Seed handling
g) Planting methods for permanent reclamation
h) Broadcast seeding
i) Transplanting live plants and planting plant parts.
j) Seeding shrub seed

2. Seed technology

Seed quality is vitally important. The quality of the seed many a time determines the success or failure of a revegetation effort. This includes the following points/aspects.

a) Seed procurement
b) Preparing a seed bed and seedlings
c) Procuring seeds/propagules of seasonal grasses
d) Sowing the seeds of good shrubs, under trees and trees

3. Surface Stabilization

It is an important facet of restoration ecology. If the reclaimed land surface is stable, then soil erosion from that land is controlled to the extent possible. Vegetative and non-vegetative methods for stabilizing the land surface or controlling erosion are practiced in different sites.

4. Husbandry (management)

After the vegetation is established, the husbandry (management) of the vegetation becomes critical for its survival and longevity. The revegetation will degenerate to less than desirable cover and production and to a less desired species composition without some type of management to sustain it. Native plant species evolved under same type of foraging pressure should be included in the revegetation programs. Therefore, some type of management that at least simulates "use" is vital for the maintenance of the revegetated stand. The husbandry practices should include mowing for weed control, regulated grazing, and burning.

5. Monitoring

It is important to know how the vegetation is progressing toward the desired stage. The monitoring should focus on status of weed infestation, invasion by alien plants, protection afforded to native species, record keeping and document management.

Sodding

It is a bioengineering technique that uses vegetation mats for soil stabilization and erosion control. Plant salvage and transplant techniques with perennial grasses have been used with success. Perennial grasses with sturdy adventitious root mat anchoring them in place are preferred. The following is a list of recommendations for using vegetation mats as bioengineering materials:

- To anchor perennial solid/soil binding grass mats to a slope, mats can be cut to form any shape desired. A shallow, narrow trench built along the contour of a slope and planted with a vegetation mat may become an effective terrace.
- The mat should remain attached to stable vegetation and thus be held in place from the top. The mat can be pegged to prevent ripping and sliding. This technique would be used to stabilize the contaminated soil.
- Vegetation mats can be used as building bricks. Slice the mats into rectangular pieces and use them to construct a very steep, living wall. The bricks can be pegged to each other and to the underlying substrate. This technique may be useful around culverts or sunken walkways and controls erosion.

Following three basic techniques are being used in different parts of the world:

a) Land filling: Putting the top fertile soil on the surface of the hazardous waste. An ash dump site is overlaid in strips (strip sodding) each 3 to 6 m wide. Such strips are sown with perennial grasses or planted with shrubs and trees in a parsimonious technique

b) Ferlilizer application: Mineral fertilizers (NPK) are necessary in certain instances. Application of phosphate fertilizer at a dose of 30 kg per hectare and nitrogen fertilizer @ 30 kg per hectare is a normal sodding practice in different parts of world.

c) Irrigation: Watering of the surface disposal areas with domestic effluents. This is done through the growing season. High productivity perennial grasses, trees and bushy shrubs are planted in strips or in clumps or patches which is important for erosion control.

Examples of Plants that have successfully revegetated the land of mine spoils in different parts of India are mentioned below.

Bauxite mined area of Madhya Pradesh: *Grevillea pteridifolia. Eucalyptus camaldulensis, Shorea robusta.*

Coal mine spoils of Madhya Pradesh : *Eucalyptus hybrid, Eucalyptus camaldulensis, Acacia auriculiformis, Acacia nilotica, Dalbergia sissoo, Pongamia pinnata*

Lime stone mine spoils of outer Himalayas: *Salix tetrasperma, Leucaena leucocephala, Bauhinia retusa, Acacia catechu, Ipomea carnea, Eulaliopsis binata, Chrysopogon fulvus, Arundo donax, Agave americana, Pennisetum purpureum, Erythrina subersosa*

Rock-phosphate mine spoils of Musoorie: *Pennisetum purpureum, Saccharum spontaneum, Vitex negundo, Rumex hastatus. Mimosa himalayana, Buddlea asiatica, Dalbergia sissoo, Acacia catechu, Leucaena leucocephala and Salix tetrasperma, etc.*

Lignite mine spoils of Tamil Nadu: *Eucalyptus species, Leucaena leucocephala, Acacia and Agave*

Mica, copper, tungeston, marble, dolmite, limestone, and mine spoils of Rajasthan: *Acacia tortilis. Prosopis juliflora, Acacia Senegal, Salvadora oleodes, Tamarix articulata. Zizyphus nummularia, Grewia tenax, Cenchrus setigerus. Cymbopogon, Cynodon dactylon. Sporobollis marginatus and Dichanthium annulatum*

Iron ore wastes of Orissa: *Leucaena leucocephala*

Haematite, magnetite, manganese spoil from Karnataka: *AIbizia lebeck*

INTERESTING BIOCHEMICAL AND MEDICINAL PROPERTIES OF SOME COMMON INDIAN SPICES

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Common plant species constitute a wide range of organic chemical compounds such as essential oils, alcohols, aldehydes, flavonoids, phenolic compounds, terpenoids, alkaloids and various aromatic compounds such as anethole, estragole, camphene, pinene, myrcene, cymene. These compounds collectively generate a pungent aroma to ward of insects and many have anti-microbial properties and are a part of defence mechanism of the plants. Several medicinally important chemicals are also present in the spice plants attributing to different medicinal properties to spices in traditional medicines. It is also important to note that food habit is cultural in origin and people exposed to specific dietary habits at the younger age depending upon their social and cultural perspective get used to specific diets. Some of us are capable of adapting to newer foods with widely divergent taste and aroma while others cannot. So the same flavour may feel like unpleasant to some and stimulating to others. Some plant products are also allergenic to some individuals resulting in uncomfortable responses.

Fenugreek/methi (*Trigonella foenum-graecum* L.) is an annual legume crop and is extensively used as a spice and, to a certain extent, as a forage crop and as nutraceutical in parts of Asia (particularly India), north Africa, Mediterranean Europe, Australia and North America. The plant has been reported to possess a number of important medicinal properties. Research has indicated that the presence of steroidal sapogenins, 4-hydroxyisoleucine (free amino acid) and mucilaginous fibres (galactomannans) present in the seed and leaves contribute to the anti-diabetic and hypocholesterolaemic properties attributed to this plant. It is also known as a powerful galactogogue (an agent increasing milk production in both humans and animals). While several species are reported worldwide, *T. foenum-graecum* is the most well known and widely cultivated species.

Fenugreek has a characteristic strong aroma in the seed as well as in the foliage parts (both fresh and dry). This is mostly due to presence of specific aromatic compounds such as n-alkanes and sesquiterpenes and several oxygenated organic aromatic compounds like hexanol, γ-nonalactone and others. In addition, the presence of several steroidal sapogenins such as diosgenin, tigogenin, neotigogenin, gitogenins, yamogenins, and other complex chemicals such as spirostanol saponins (graecunins), sapogenin peptide esters (fenugreekine), alkaloids (trigonelline), flavonoids, carotenoids, and coumarins in the seed and foliage parts synergistically contribute to the characteristic aroma, well know for the "curry flavour" of fenugreek. It is the constituent of most commercially sold East India curry formulations.

Hot and spicy food items such as chilli pepper (*Capsicum spp.*) usually contain specific stimulant chemicals (such as capsacin) that stimulates the nervous system and sensory receptors distributed in the oral cavity and inner part of the nostril. Such specific stimulant chemicals also stimulate the circulation rate in the body and also raise the average body temperature. Once the receptor receive these chemicals (*i.e.* they bind to the receptors surface), it simultaneously stimulates mucous secreting cells to secrete mucous profusely. It is a kind of an internal defense mechanism of the body that tries to eliminate irritant and stimulant chemicals and tries to bring back the normal homeostasis or equilibrium. It also reflects to the personal immune system activation and differs from person to person. For some, it has violent allergenic reactions while for others, it is mild dribbling. It is also important to note that the body could be trained to react according to subsequent exposures to such irritant and stimulant chemicals. For example, people living and sharing a culture where consumption of hot and spicy food is common and is a regular part of their diet, experience less or infrequent dribbling compared to those who are occasional or amateur consumers. The receptors in the nostrils get trained or recognize the stimulant chemicals over long exposure and do not alert the mucous secreting cells frequently to cause dribbling. Frequent consumption of chilli and other hot spices help in clearing of the sinuses in human beings.

Coffee May Reduce Risk of Lethal Prostate Cancer in Men

Prostate cancer is the most frequently diagnosed form of cancer and the second leading cause of cancer deaths among U.S. men affecting one in six men during their life time. According to a recent study carried out by scientists of Harvard School of Public Health (HSPH) in USA, men who regularly drink coffee appear to have a lower risk of developing a lethal form of prostate cancer.

Coffee contains many beneficial compounds that act as antioxidant, reduce inflammation and regulate insulin, all of which may influence prostate cancer. Coffee also lowers the risk of Parkinson's disease, type 2 diabetes, gallstone disease, and liver cancer or cirrhosis .As a result of their study the researchers observed that men who consumed six or more cups of coffee daily had nearly a 20%lower risk of developing any form of prostate cancer.

In the case of aggressive prostate cancer it was found that coffee drinking resulted in 60% lower risk of developing lethal prostate cancer.

The scientists are now trying to validate their results in additional populations that have a range of coffee exposure and a large number of lethal prostate cancer cases.

From: Journal of the National Cancer Institute U.S.A (Online edition)

Organic farming - India's future

India's farmers are starting to profit from a budding interest in organic farming. Not only are the incomes of organic farmers soaring-by 30% to 200% but their yields are rising as the pesticide-poisoned land is repaired through natural farming methods.

There is a 10% to 20% premium to be earned by selling organic products abroad and in India's increasingly affluent cities. Organic farming slashes cultivation and input costs by up to 70% due to the use of cheaper, natural produce like manure instead of chemicals and fertilizers. An overuse of chemicals has made land acidic and hard, which means it needs even more water. Chemicals have killed the biggest civilization in agriculture – earthworms, which produce the best soil for growth.

Banana crop is wrecked by temperature fluctuations and climate change at many places. Organic bananas can withstand these fluctuations.

Many farmers are reluctant to make the leap because they fear a drop in yields in the initial period; good results tend to show after three years. While critics argue that organic farming is not the answer to India's rising food demands, those in favour say it is the only sustainable way out for the impoverished farmers.

Source: Nishka Patel in 'Guardian Environment Network'

Fog helps water economy in trees

Of all the abiotic factors that plants need for growth and development, water is one of the most important. Most plants get water they need from the soil via their roots, but others – such as coast redwood (*Sequoia sempervirens*) – also rely on a more direct aerial source. Although the trees are primarily watered by winter rains, the fog is a major boost to the water economy of those arborescent giants, especially in dry summer months. Whilst some of the fog merely envelopes the leaves and prevents transpiration, some of the water vapor enters the plant via their stomata. Not only is the normal transpiration exit route used as an entry point for water, but that water is subsequently drawn down through the branches to the roots. Apparently redwoods are the first trees found to move water in both directions, though others have since been identified.

Source: Scott Catron, Wikimedia Communications

(Nigel Chaffey in Annals of Botany)

Clean stoves would cut pollution

For nearly half of the World's population in developing world cooking food at home in the kitchen poses a most serious health risk due to the smoke from dirty stoves. Some 3 billion people live in homes where food is cooked on stoves or over fires burning fuels like wood, dung, charcoal or agricultural waste. These fuels produce toxic fumes, and in poorly ventilated homes, the mix of chemicals can reach 200 times the level that is considered safe to breath. It can cause lung cancer, pneumonia, cataracts, low birth weight, even death. According to the World Health Organization, smoke from dirty stoves and fires kills almost 2 million people each year, most of them Women and children. It kills twice as many people as malaria.

The impact goes beyond people's health. Burning these fuels produces carbon dioxide, methane, and black carbon, which contribute to climate change.

All of this presents a major challenge but it can be solved. If we can get cleaner, more efficient cook stoves in wider use throughout the developing world, we can save lives, cut back on carbon emission and create new economic opportunities for millions of women.

The technology for clean cook stoves already exists. Several companies are already producing them, and countries like India, China Mexico have begun to introduce them in their national programmes. But the uptake has been slow, because well coordinated efforts have not been made

to popularize them and make them affordable in the developing world.

By Hillary Clinton and Julia Roberts

Source: USA Today

UN Wire < un_wire@smartbrief.com >

Lawn of moss to conserve water

A traditional grass lawn comes burdened with cost, chemicals and ongoing time commitment and is difficult to maintain. Some scientists have found advantage in replacing grass with moss. It might seem strange to be replacing green grass with moss, but it is an excellent way to have a green lawn without a lot of hassles. There are several benefits for replacing grass with moss. Some of the benefits include reduced water consumption, reduced pesticide and herbicide use and – of course – the beautiful look and feel of moss.

Replacing grass with moss is a great way to help conserve water. Since moss does not grow tall like grass does, there is no need to mow the lawn. This considerably reduces maintenance cost. In order to have good healthy looking green lawn, regular application of herbicides, pesticides and fertilizers is required. Besides increasing maintenance cost, these chemicals lead to environmental pollution. Moss is, therefore, a perfect solution for the above problems. There are many different types of moss, with many shades of green, a wide range of textures, and many levels of thickness. To sum up, the moss lawn is as beautiful and comfortable as a grass lawn.

Source: Care2 News

Wonder Shrub

Sea-buckthorn (*Hippophae rhamnoides*) is a hardy plant that grows in sub-zero temperatures and where there is is low water availability. Every part of the plant has use. Its leaves can be used to make herbal tea; its fruits can be used to make juice, biscuits, jam, jelly and sauce. Eight industries market this juice under different brand names. Its root nodules have nitrogen-fixing properties and thus enrich the soil. The roots stabilize the soil in the trans-Himalayan region and help ward off landslips. Defense Research & Development Organization (DRDO), India has developed an anti-ultraviolet ray cream from the oil extracted from its seeds. The plant has anti-ageing, antioxidant and flavonoid properties. It has wound healing properties.

India's Minister for Environment & Forests, Mr. Jairam Ramesh was so captivated by this wonder shrub that he proposed a Rs. 25 crore pilot project to Planning Commission to cultivate it in the trans-Himalayan Region.

Source: T.S. Subramanian in Frontline.

Traditional Chinese Medicine – A boon or bane ?

According to some of the deeply ingrained beliefs in Traditional Chinese Medicine (TCM), consuming the body parts of some of the world's most exotic animals makes you healthier and stronger. Elephant skin cures acne, turtle meat makes you live longer, lizards lower your blood pressure, bear paw soup makes you stronger, etc. These and other TCM beliefs have led to the senseless slaughter and torture of some of the most remarkable wild animals we have on this planet. Sharks are left dying in the bottom of the ocean with their fins cut off, wild tigers are poached to extinction, and live black bears are "milked" with a huge needle in tiny cages for their bile to provide a cure for liver disease. Thousands of rhinos have been killed for their horns, an estimated 20 million seahorses are consumed every year, and the peculiar-looking saiga antelope population has crashed from more than a million to fewer than 50,000 in just a couple of decades. And this is just the tip of the dark TCM iceberg. Many other species are suffering and dying in unprecedented numbers because of the unproven health benefits their deaths offer for TCM. The list of the victims of the growing TCM trade is long and heartbreaking.

To stop the senseless killing, we have to accept that the part of TCM that uses endangered and rare animals for medical purposes doesn't belong in the modern world – a world with an ever-growing human population and a decreasing number of wild animals and species in our forests and oceans. TCM's well-meaning methods using exotic animals were maybe useful and acceptable in the traditional world where the human population was much smaller and scientific medicine had fewer options to offer. But now the entire scenario has changed and modern medicine has cure for everything from common flu to severe depression, there really isn't any need to kill tigers and torture bears for medical purposes that have few or no proven health effects.

TCM is now more widespread than ever and its methods are gaining popularity all over the world. This being the case, we have to make sure that the unsustainable parts of the medicine don't spread along with the sustainable and useful ones. There are without doubt many good things about TCM (acupuncture, traditional massage, use of herbs, etc.), and its traditions are old and intriguing, but the part of it that leads to destruction and senseless killing of defenseless wild animals must go. These practices simply don't belong to the 21st Century.

Source: J. Max Cromwell in Ezine Articles

Global warming good for carbon storage capacity of trees

Planting more trees and preserving forests will be helpful in facing the challenge of global warming. Plants capture carbon dioxide during photosynthesis, thereby removing the most abundant greenhouse gas from the atmosphere and storing some of it in their woody tissues. But global warming may affect the capacity of trees to store carbon by altering forest nitrogen cycling according to a recent study

carried out by U.S. scientists at the Marine Biological Laboratory.

The study confirmed that a warmer climate causes more rapid decomposition of the organic matter in soil, leading to an increase in carbon dioxide being released to the atmosphere. But the study also showed that warmer temperatures stimulate the gain of carbon stored in trees as woody tissue, partially offsetting the soil carbon loss to the atmosphere. The carbon gains in trees, is due to more nitrogen being made available to the trees with warmer soil.

Tree growth in many of the forests is limited by the lack of nitrogen. The researchers found that warming causes nitrogen compounds locked up in soil organic matter to be released as inorganic forms of nitrogen such as ammonium, a common form of nitrogen, they grow faster and store more carbon.

Biological processes that link soil warming, increased soil organic matter decay - increased nitrogen availability to trees, and increased tree growth will likely operate together in many temperate and boreal forests -- forests found in North America, Europe, Eurasia and much of the developed world. Tree growth in tropical forests is often limited by factors other than nitrogen, so lessons from this new study are not widely relevant in the tropics.

Source: Science Daily

GM foods - raging debate

The topic of genetically modified (GM) foods has been raging globally now for the past two decades. The main concern is quite simple – we do not know enough about the potential environmental and health implications involved with splicing the genes of one organism with the genes of another organism. And once we let GMOs out into the environment, there is no taking them back. They are there for good.

In the middle of this raging debate, we have two major markets which have moved in two completely different directions with respect to GM foods. On one side, the US has led the development of GMOs and has embraced GM foods. On the other side, the European Union (EU) has rejected GM foods.

GM foods became an issue in Europe when food exports from the US containing GM soya first began trickling into the EU without labeling of any kind. When this came to light, European consumers voiced their clear displeasure causing EU legislators to take a careful look at GM foods. The end result was new legislation enacted in 2004 which required all genetically engineered foods to be labeled as such.

This policy change brought on by consumer pressure was significant because once GM foods had to be labeled, consumers actively avoided them. The end result was that many retailers simply stopped carrying GM foods. In fact, approximately 49 major food and drink retailers in the EU now have non-GMO policies. In other words, these food and drink retailers have made a corporate decision to not carry any GM foods in their stores. As such, GM foods are effectively locked out of the highly lucrative European market. And this does not look to be changing any time soon.

The US policy on GM foods is in stark contrast to the EU. In the US all varieties of food crops are GM. As an example, 93% of all soybeans, 86% off all corn, 93% off all cotton, and 93% of all canola are GM. Furthermore, the US does not require any labeling of GM foods. As such, consumers have no way of knowing whether the foods they eat are GM or not.

Why such a stark contrast between the EU and the US on this issue? The reason is that Americans tend to trust scientific authority. There is an underlying belief that if the experts say its ok, there is a tendency to trust that authority.

Given the direct high level connections of many of the decision making highly placed U.S. individuals with the major producers of GM seeds, herbicides and pesticides in the world, the GM lobby has the final say in the matter.

Source: Ezine Articles

Watermelons explode

Farmers growing watermelons in eastern China are facing a unique problem as the fruits are exploding one after the other on reaching maturity and huge quantities of their produce are thus lost. Preliminary investigations revealed that the problem was primarily due to the overuse of growth boosters – chemicals that help the fruit grow faster.

However, it is not just the chemical-laced fruits that are exploding, even chemical-free fruits are exploding. A few experts blame the climate vagaries and abnormal size of the melons as the reason. According to a report by China Central Television, farmers were overspraying their crops with the growth booster, in their hurry to get the fruit to market ahead of the peak season and make a good profit.

Source: PLANET earth

(Gateway Media – Hyderabad, India)

Six-fold deforestation of Brazilian rainforest

Satellite images show that deforestation of the Amazon rainforest has increased about six fold from 103 sq km in March – April 2010 to 593 sq km in the same period of 2011. Rising demand for soybean is prompting farmers to clear more of their land.

Source: BBC News

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