ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

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IN THIS ISSUE

Plant Shoe

In Vancouver, Native Shoes has introduced the Plant Shoe, a sneaker that is biodegradable, vegan, and can be composted. The launch is a step toward the company's goal of becoming 100% "life-cycle managed" by 2023. The shoe is comprised of jute thread soaked in olive oil and glue made from natural latex. The Plant Shoe is available in off-white and sells for $250.

CAN BIOFUELS SOLVE CLIMATE CHANGE

Biofuels can be any fuel produced from plant materials such as corn or soybean and even from non-edible grasses, wood and other plant waste materials. These biofuel plants suck carbon dioxide from air during their growth period. When the biofuels are burnt in automobiles, the carbon dioxide is released. This carbon dioxide is the same carbon that the plants had fixed while growing. This makes the biofuel zero carbon emitter.

Is it true?????

Here one should not forget that it takes energy to grow biofuel crops – fertilizer, tractor transportation and further converting it to liquid biofuel. Planting and growing these crops can also change how much carbon is stored in the soil. Emissions of nitrous oxide is another factor contributing to green house gas effect which is 300 times stronger than carbon dioxide. Beside this, growing biofuel crops would use the arable land leading to reduction of food crop production. Ultimately increasing the pressure on forest land for lost food production. The cost of deforestation is reduced C-budget.

So, if we want to accurately assess the impact of biofuels, we need to look at what's called a "life cycle analysis," which basically means the effort it takes to grow the crops, harvest them, convert them to fuel, transport them to distribution sites, and combust them. In other words - What is the best crop? Which is easiest to grow? Which is best for the environment? The trick is to find clean crops that don't need a lot of fertilizer, water, other inputs and easy to grow on marginal cropland.

Then there's the complicating factor of economics. The price of biofuels and the price of greenhouse gases matter. If society is willing to pay a small pollution charge like a carbon tax, it supports the producers of clean energy. But if society doesn't put a premium on clean energy, it's harder for clean industry companies to thrive.

(John Abraham, The Guardian Mar 14, 2018)

WELCOME NEW LIFE MEMBERS

Dr. Atul Kumar Upadhyay, National Post Doctoral Fellow, Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow, India (upadhyay.eb@rediffmail.com).

Dr. Navneet Kumar Mishra, Subject Matter Specialist/ Scientist, Krishi Vigyan Kendra West Kameng Dirang, Arunachal , India (navneetkumarmishra123@gmail.com).

Dr. Ajay Kumar Verma, Associate Professor Respiratory Medicine, Department of Respiratory Medicine, King George Medical University, Lucknow (drajay21@gmai.com)

NEWS FLASH

Dr. Amit Pal, Assistant Professor, Institute of Environment and Development Studies, Bundelkhand University, Jhansi and Life member of International Society of Environmental Botanists, has been conferred with Dr. A.P.J. Abdul Kalam Environmental Protection Award – 2019 by the Blue Planet Society, Prayagraj during the Global Conference on Our Biodiversity, Our Food & Our Health held at Botanical Survey of India (BSI) auditorium, Prayagraj, India on 21 – 22 May 2019. He is also elected the Member of Asian Council of Science Editors up to December 31, 2021.

BOOK REVIEW

Nanomaterials and Plant Potential

Edited by
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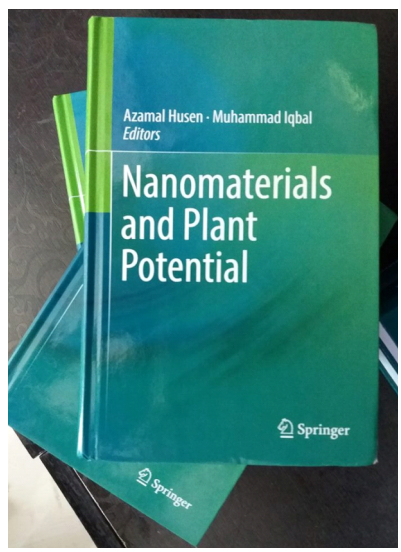

We know that several plants and plant parts are now used for green synthesis of the metal and metal-oxide nanoparticles (NPs), and that the various metabolites they contain, such as alkaloids, flavonoids, phenols, terpenoids, alcohols, sugars and proteins, act as reducing agents to produce NPs, and in some cases, also as capping agents and stabilizers for these tiny particles. Plants with either aroma or colour in their leaves, flowers or roots have drawn special attention because of possessing such chemicals that reduce the metal ions to metal NPs. The size and morphology of the metal and metal-oxide NPs depend on the biogenic-synthetic route, incubation time, temperature, concentration and pH of the solution used. Since the use of the metal and metal-oxide NPs with reference to plant system has begun only recently, little is known about their possible effects on plant growth, development and productivity. Accumulation and translocation of NPs in plants, and the consequent growth responses and stress modulations in the plant system are yet to be studied properly and understood fully. Plants responses to NPs may be positive or negative, and vary with species as well as with the type of the NP used. Cytotoxicity of NPs often depends on their concentration, size and shape. Their impact on vegetative growth and fruit/seed production is often positive at lower concentrations and negative at higher ones. Moreover, certain NPs enhance the antioxidant enzymatic activity and the free-radical-scavenging potential of plants, and alter the micro RNAs expression, which operative in regulating the different morpho-physiological traits and metabolic processes in plants, ultimately affecting the plant growth and yield. NPs also help in genetic reforms by effecting an efficient transfer of DNA or complete plastid genome into the respective plant genome due to their miniscule size and an improved capacity of site-specific penetration. Moreover, a controlled application of nanomaterials in the form of nanofertilizer offers a more synchronized nutrient fluidity for the uptake by the plants exposed, thus ensuring an increased nutrient availability and utilization. All these issues need to be addressed in details and the book under discussion makes a fine attempt to fulfill this requirement. It is hoped that the graduate and post-graduate students, research scholars and teachers in different areas of nanoscience and plant science will equally find this treatise interesting, informative and worth reading.

This book, comprising of 23 chapters in total, elucidates the latest developments in plant-mediated fabrication of the metal and metal-oxide NPs and their characterization by a variety of modern techniques. Application of NPs in various fields including drug delivery, therapeutic treatment, catalysis, photoluminescence, manufacture of paints and coatings, environmental sensing & renewable energy, plant production and protection, development of lubricants and fuel additives, antimicrobial and antioxidant formulations, inter alia, has been discussed in different chapters of the book. Special effort has been made to cover the impact of NPs application on plant growth and productivity, toxicity caused, if any, and plant responses to the stress imposed. The contents of the book are divided broadly in two sections, viz. (a) Plant-mediated synthesis and applications of nanomaterials and (b) Interaction of plants and nanomaterials. The first section includes 13 chapters, while the second one contains 10.

Interaction with pathogenic microbes and plant in the domestic sewage: Natural treatment systems

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District Jhansi is located in the Bundelkhand region of central India in the South Western part of Uttar Pradesh and lies between longitudes 78˚20' to 78˚30' E and latitude 25˚6' to 25˚29' N. Jhansi city is situated in a semi arid region of the country. It is located in the plateau of central India, an area dominated by rocky reliefs and minerals underneath the soil. It has an average altitude of 284 meters. Most part of the year the city people experience acute scarcity of water for agricultural, industrial and domestic uses. Water bodies are severely degraded as a result of discharge of raw sewage from communities into its watershed. The consequent consumption of water is making the city people more prone to diseases and health problems. Fresh water bodies are increasingly exposed to high load of nutrients from ever increasing urban population in the city thereby, causing serious impacts on its flora and fauna.

Presently, the population of Jhansi city is about 8,24,235. Water consumption in the city almost tripled in last 20 years. The swelling population of this city does not have services of any kind whatsoever, either for potable water or for sewage disposal. The city is occupied by very large residential complexes. Most of the residential area is located without proper planning of building and water supply. Sewage canals are under tremendous pressure due to ever rising population. The impacts are further aggravated during summer due to excess shortage of water. Treatment of wastewater is required because it causes foul smell, bad odours, and demands for dissolved oxygen in the water bodies, adds nutrients (nitrate and phosphate) and increases suspended solids or sediments in streams. The untreated water also contains pathogenic bacteria.

Moreover, frequent drought situation has severely affected agriculture. Today fresh water bodies are receiving million of liters of wastewater with high concentration plant nutrients and pathogens. Some studies in our laboratory has also revealed that the fresh water bodies in Jhansi city are highly eutrophic as result of input excessive plant nutrients from sewage and agriculture run off. These irresponsible situations exacerbate the quality of the water and limit or even prevent the use of the water for various purposes as they threaten the human health and aquatic life seriously. About 80% of the consumed water is released into local water bodies as wastewater. Wastewater treatment and reuse of treated water are potential solution to address the problem of poor quality and quantity of water in this region.

Pathogenic organisms present in wastewater flourish in the presence of rich nutrient of the domestic waste. In addition, domestic wastewater also contains certain group of bacteria and other microorganisms. The most commonly occurring pathogens in the wastewater include strains of *Salmonella, Shigella, Leptospira*, intra-pathogenic form *of Escherichia coli*, *Pasteurella, Vibrio, Mycobacterium*, human enteric viruses, cysts of *Entamoeba histolytica* and hookworm larvae. Bacterial pathogens are removed by different processes such as sedimentation, chemical reaction, natural die-off and action of different and biologically active substances released by the plant roots and predation by water animals (zooplanktons).

Although some have documented that macrophytes can improve BOD and bacterial removal from wastewaters through sedimentation, mechanical filtration, nutrient assimilation, oxygenation, and microbial attachment mechanisms, others did not detect any significant difference between planted and unplanted systems. Multifarious treatment technologies are available today to restore and maintain the chemical, physical and biological integrity of the nation's waters. The potential use of a variety of natural biological systems like ponds, land treatment and wetlands systems helps to purify water in a controlled manner. These systems show their efficiency due to their design, performance, operation and maintenance. These systems must be upgraded from time to time to ensure the removal efficiency of the contaminants

However, there is a lack of proper wastewater treatment in India. With respect to environment this situation should be changed as fast as possible. In most Indian cities, there are very few wastewater treatment process and lack of effective environmental pollution laws. Today conventional treatment facilities fail in satisfying all demands of ecologically aware societies. This is because they don't harmonize with

basic principles of water conservation, do not enable reclamation and reuse of water and nutrients, generate toxic sludge as by product and use chemicals harmful to environment and people.

Phytoremediation is the *in situ* use of plants and their associated microorganisms to degrade contain or render harmless contaminants in soil or groundwater that can be accessed by the roots of plants. Even though the use of plants in remediation of contaminants is not new, phytoremediation has evolved in the past decade as a technology for the treatment of contaminated soil and groundwater offering low costs and less landscape disruption. Constructed wetlands are decentralized, low-energy, low-cost systems to improve water quality. They rely on natural wetland function which includes plants and microorganisms which uptake and breakdown the wastewater nutrients either aerobically or an aerobically. These systems are responsible for providing multiple benefits like improvement in water quality, water security & reuse, CO_2 reduction, provides habitat for many plants and animals. It also acts as a source for recreation, education, aesthetic/amenity value**.** Plants (free-floating, emergent or submerge vegetation) are the part of constructed ecosystem to remediate contaminants from municipal, industrial wastewater, metals, acid mine drainage. Constructed wetlands are used to treat the municipal waste water also eliminate the pathogenic microorganism by macrophytes plant like *Typha latifolia, Phragmites karka and Phragmites australis.*

A number of problems can be solved by constructed wetland like denitrification, adsorption of ammonia, ions, heavy metals, phosphorus compounds, removal of pathogens, uptake of toxic substances as well as decomposition of biodegradable organic matter and toxic organic compounds.

Plant Based Packages for the Phytomonitoring and Phytoremediation of Lindane

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Lindane, the γ- isomer of hexachlorocyclohexane (γ-HCH) was one of the widely used organochlorine insecticide worldwide during the past five decades. Initially, technical HCH consisting of five major isomers such as α-HCH (60-70 %), β-HCH (5-12 %), γ-HCH (10-12 %), δ-HCH (6-10 %), and ε-HCH (3-4 %) was used for agricultural applications. However, later it was recognized that only γ-HCH has the insecticidal properties. As it was possible to isolate and purify the γ-HCH from the technical HCH, the utilisation of γ isomer peaked later under the trade name of Lindane for the large scale use as a pesticide, pediculicide and scabicide.

Manufacturing of lindane also generates large amount of waste isomers commonly called as HCH muck. Approximately 8 to 12 tonnes of HCH muck is generated during the production of a ton of lindane. This large amount of HCH muck is mostly dumped near the production facilities. These stockpiles of the waste are not secured and may cause detrimental impacts to the environment due to leaching and volatilisation, as lindane along with its other isomers is highly persistent in nature, possessing bioaccumulative, carcinogenic, endocrine disrupting properties and also the ability to undergo long range atmospheric transport. Thus it could also contaminate the distant sites and cause toxicity to the non-target organisms as well. The uncontrolled and injudicious use of lindane and the technical HCH for the past half-decade has polluted almost all the spheres of the environment globally. Today it has become one of the most common pesticide to be detected from diverse environmental samples . This was the reason that Lindane (industrial γ-HCH) and its two key waste isomers α-HCH, and β-HCH, were included in the Stockholm list of persistent organic pollutants (POPs) for global elimination. The parties to the Stockholm convention have taken legal action to stop the production and use of lindane altogether, however India has got exemption for its use to combat malaria. To this, we would not only have to identify and evaluate the contaminated sites but also have to develop cost effective non-environment invasive technologies for the remediation and ecological restoration of such sites.

Phytomonitoring of Lindane

The extensive application of lindane and mismanagement of its waste isomers has led to widespread pollution of the environment. Thus it is necessary to monitor and evaluate the waste deposit/dump sites for lindane contamination to develop control strategies for the management of such sites. Plants have been used to

indicate the contamination level of pollutants as they can be used as a passive sampler for monitoring of contaminated sites. Plants uptake and phytoaccumulate lindane in its various tissues acting as an effective sink. It reveals the level of level of pollutants uptaken by the plants. Thus, plant species can be interesting candidates for monitoring the occurrence of lindane and its contamination level at particular sites. Apart from the level of lindane in the vegetation, plants can be used as indicator of environmental pollution as they can adsorb the pesticide to their root tissues and then further uptake and transfer it to shoot. Plant leaves can also absorb lindane by trapping its atmospheric deposition as it is a volatile compound. Two years monitoring of HCH and its waste isomers in soil and vegetation of lindane manufacturing factory revealed that *Lantana camara, Erianthus munja, Calotropis procera, Withania somnifera, Solanum torvum and Achyranthes aspera* were the most abundant growing plants in the contaminated site. In the same study it was found that *Achyranthes aspera, Calotropis procera, Dalbergia sisso, Erianthus munja, Lantana camara, Solanum torvum,* and *Withania somnifera* were found growing naturally in lindane contaminated soils and accumulated HCH in the leaf samples. These candidate plant species could be easily used for phytomonitoring of lindane contamination as they have the capability to withstand the phytotoxicity of lindane. In other studies we have reported that the plants such as *Sesamum indicum, Vigna radiata, Spinacia oleracea, and Jatropha curcas* have potential to uptake and accumulate lindane from soil . Thus along with the naturally growing species in lindane contaminated soil *Sesamum indicum, Vigna radiata, Spinacia oleracea, and Jatropha curcas* could also be tested for phytomonitoring of lindane as they show lindane accumulation even at level of 5 mg/kg of lindane in soil. As the above mentioned plant species also have different life cycle period they could be applied for short or prolonged continuous monitoring of lindane contaminated sites. Short duration plants such as *Sesamum indicum, Vigna radiata, Spinacia oleracea*, *Solanum torvum* could rapidly give an idea about the current status of pollutant in soil, their uptake level by plants and whether the residue level is above or below the permissible limits in the edible tissues. Similarly long duration plants such as *Dalbergia sisso, Jatropha curcas*, *Withania somnifera* and *Erianthus munja* could be used for long term monitoring of the restoration of contaminated sites by continuously monitoring the residue level in soil and plants and physical chemical and biological attributes of the soil fertility. The perineal plant species could also be used for monitoring the seasonal variation of lindane concentration in rhizospheric soil and uptake by the plant species and its residual concentration in soil. Thus plant species are important to study the role of plants in distribution of lindane and its isomers in soil-plant system and develop a better understanding of distribution and cycling of lindane and its isomers in terrestrial ecosystems. The phytomonitoring of lindane and its isomers will help in assessing the risk of its transfer to the trophic chain. It will also help in development plant based sustainable remediation technologies for development of phytoremediation techniques that can be applied to lindane contaminated soils.

Ecological profiling of a contaminated system is the necessary requirement for adapting any in situ restoration activities. We recently developed a cost effective, simple, adequate and consistent inventorying, monitoring ecological profiling method for the screening and characterization of a soil site contaminated with lindane and its isomers. Plant diversity, microbial biomass, total organic carbon, soil dehydrogenase activity, pesticide concentration in soil and plant samples as well as the occurrence of ecologically sensitive species such as earthworms, honey bees and butterflies were taken as parameter for a complete ecological profiling of pesticide contaminated site near lindane producing industry in Lucknow North India. A total of 7 plant species were reported from the contaminated site; whereas control site has 25 plant species. The presence of α, β, γ, and δ-HCH isomers in the soil samples of contaminated sites were varied from 5.18–12.45, 30.15–68.77, 6.93–16.55 and 0.75–7.54 mg kg−1, respectively, whereas the concentrations of total HCH isomers in plant samples varied from 2.78 to 12.47 mg kg−1. Also germination percentage of test plants in contaminated soil system was lower in comparison to control. No honeybees, earthworms and butterflies were spotted in or near the contaminated site. A FTIR analysis further showed the presence of contaminant functional groups. Also the microbial biomass, total organic carbon and soil dehydrogenase activity were lower in the contaminated soil. All these parameters clearly indicate that soil is heavily polluted with lindane and its isomers and requires consistent inventorying and monitoring. This ecological method is simple, adequate and consistent for knowing the extent and level of contamination of HCH isomers in soil, understanding the adaptive capacity of the contaminated soil system and for the in situ restoration of contaminated soil sites by adopting suitable methodical frame works. However, it is need of the hour that more methods should be explored for effective monitoring and management of lindane contaminated sites.

Phytoremediation of Lindane

Plant based remediation technologies offer a more sustainable approach for the clean-up of the contaminated soils in comparison to their physicochemical counter parts. Apart from remediation plant based technologies also offers biomass, biofuel for bioeconomy, aesthetic value, timber and fibre for the stake holders. Plants can substantially support the remediation of lindane contaminated land as they can withstand its toxicity and also can dissipate it from the soil. Plants can help in the process of remediation by variety of mechanisms like immobilization, removal, phytovolatalization via evapotransportation through leaves, phytouptake and enzymatic degradation and microbial assisted rhizoremediation. Plants roots run down to several miles per acre, increasing the root surface area thus increasing the rhizospheric domain and more effective binding of soil resulting in reduced soil erosion. Due to increased root area the associated soil comes under the rhizosecretion thus increasing the carbon sources and others sources in soil enhancing microbial activity. The increased microbial activity helps in enhanced rhizoremediation of the organic pollutants like lindane.

Legumes were found to be more tolerable to the contamination of HCH in soil. Leguminous plant are known for their symbiotic relationship with Nitrogen fixing bacteria, it might help in easier supply of the nitrogen leading to increased chlorophyll synthesis in legumes, as nitrogen is a key component of the chlorophyll molecule and not easily available to plants. Though the leguminous crops seem to have tolerance towards lindane, however use of agricultural crops cannot be suggested for remediation as lindane has bioaccumulative property and its consumption may lead to the contamination of the food chain. It could produce deleterious effect if consumed as food or fodder. Alternatively use of flowers, biofuel and other non-edible crops of economic importance should be promoted for the remediation of lindane contaminated soils. Using non edible crops of economic importance can provide socio-economic benefits by diversifying the regional manufacturing into newer products that may offer employment to local labour helping to build a bioremediation based value-added industry.

Effect of elevated CO_2 on Two Varieties of Guar (*Cyamopsis tetragonoloba*) Plants

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According to the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2014), global warming has occurred in the recent past and will continue during the 21st century. Associated with the accumulation of greenhouse gases, climate change is expected to decisively affect agricultural production. Global atmospheric CO_2 concentration is likely to surpass 550 ppm later in this century (IPCC, 2014), up from current concentrations of just above 400 ppm resulting in a greater rate of global climate change. Many climate change scenarios suggest global warming and altered precipitation patterns are anticipated to cause severe drought events in some regions. Global climate model predicts increased frequency and intensity of such drought episodes in a water-limited dry environment which will pose a significant challenge on crop production in future.

The world population is estimated to reach 8.3 billion by the year 2030, therefore, the demand for food grains is expected to increase by 50% globally. To feed such a population globally considerable stress will be imposed on increasing crop productivity due to combination of factors, like limited agricultural land, resource constraint of water and nutrients and rapid global environmental change. To ensure food security globally in the past and present times various assumptions were made and numerous experiments were designed to see the possible effects of increased carbon dioxide on the plant growth, photosynthetic rate and nitrate uptake and nitrogen metabolism.

Elevated CO_2 (e[CO_2]) by itself stimulates growth and yield of C3 crops through increased photosynthetic rate, which together with decreasing stomatal conductance (gs) leads to greater leaf-level water use efficiency (WUE). As e[CO2] improves plant WUE, the relative increase in grain yields under e[CO2] may be greater with decreasing water availability. Therefore, e[CO2] may provide a particular yield advantage in water-limited environments by reducing water use. Among C3 crops, grain legumes play a critical role in cropping systems because of their

potential to improve soil fertility and cheap source of protein. Grain legume production in rainfed environments is mostly affected by the terminal drought.

Increased biomass and yield under e[CO2] are often associated with decreases in tissue [N] and grain protein concentration, leading to concerns about the nutritional quality of food crops. Several mechanisms may explain the decrease of [N] under e[CO2]. Carbon (C) and nitrogen (N) are the key structural elements for plant growth and constitute 45 and 5% of plant dry matter, respectively. Studies have reported drastic changes in nitrogen concentration in plants grown under elevated condition which indicate physiological and morphological changes occurring in plant. For example, limited nitrogen availability alters C:N ratio and it leads to nitrogen limitation as leaves acquire faster carbohydrates than nitrogen, that leads to decrease in nitrogen content in leaves. Studies have reported that under enhanced carbon dioxide concentration overall content of plant nitrogen decreases. This decline in the nitrogen in the plant is the indication that the restricted rate of nitrate translocation, its assimilation and photosynthesis occurs and differs greatly. The dilution hypothesis suggests that soil N supply or N uptake fail to keep up with the increased N demand of e[CO2]-stimulated biomass growth. It is found that effect of elevated carbon dioxide concentrations on photosynthetic activity and growth depends on total nitrogen available in plants which indirectly depends on soil nitrogen content. In legumes, the decrease in seed protein concentration under e[CO2], however, is less than in cereals or even absent, because e[CO2]-induced stimulation of N_2 fixation may reduce the dependence of legumes on soil N re-sources. When N_2 fixation and N uptake are constrained, seed N in legumes becomes dependent on the remobilization of previously assimilated N from vegetative tissues. However, remobilization of N to the grains has been shown to be modified by environmental factors, such as e[CO2].

India is the world largest producer of pulses. Highest being in Madhya Pradesh (23%) followed by Uttar Pradesh (18%) and Maharashtra (14%). Yet we have to meet increasing population demand. Pulses (grain legume) are part of daily intake for humans and animals, as they are rich in protein and fibers. Guar (*Cyamopsis tetragonoloba* L.) is a drought-tolerant legume characterised by a spring-summer life cycle, which has many uses such as human nutrition, animal fodder and industrial purposes. India produces approximately 80% of the world's guar, followed by Pakistan (15%); the remaining 5% is produced in USA, Australia and South Africa. From guar seeds, two semi-transformed products are obtained: guar splits with a yield of 27-35%, obtained from endosperm, and guar meal, obtained from teguments and embryos which represent 65-73% of the processed seed. This latter is largely made up of proteins (more than 42%) and is used as a nutritional supplement in livestock feed, especially poultry. Guar splits are ground to produce guar gum, a high added value product, made up mainly of galactomannans, which are 75-85% of the endosperm. Worldwide, guar gum is used in the food industry as a thickener and stabiliser, as well as in many other industries, including the chemical, pharmaceutical, cosmetics, construction, textile, explosives, and paper industries. In recent years the price of guar seed has increased considerably, because of the exponential growth of demand for its use in hydraulic fracturing. Thus due to such unique features it is interesting to considered it as a model plant for studying the consequences of carbon dioxide elevation effect on plant growth, photosynthetic rate, nitrate uptake and nitrogen metabolism and predict its outcome on production (yield), seed weight, seed quality and biomass production.

Free Air Carbon dioxide Enrichment System (FACE) experiments have been conducted in several geographical locations around the world to estimate, under the most realistic agricultural conditions possible, the impact of the carbon dioxide levels projected for the middle of this century on crops species. The experiment was conducted in the FACE setup located in CSIR-National Botanical Research Institute, Lucknow, India. Seeds of *Cyamopsis tetragonoloba* two varieties RGC 1002 and RGC 1066 were taken from the belt of Rajasthan district of Jodhpur, Jaiselmer and Barmer semiarid areas. The two varieties RGC 1002 and RGC 1066 were grown under elevated carbon dioxide (490 ppm) and ambient carbon dioxide (300 ppm) concentration for 160 days and different growth parameters were determined. Plant yield and nutritional quality of seed is of utmost importance for leguminous crop plant. The present experimental study demonstrated that under CO_2 elevation the overall biomass of the plant increased significantly, which suggest that fodder production increases 25–35% annually per unit area when compared with ambient grown plant varieties. Nitrogen reduction under elevation seems to affect the nutritional quality of leaf thus affecting seed quality and production. RGC 1002 variety was found to be more tolerant to elevated carbon dioxide concentration than RGC 1066 plant variety. Moreover, the C : N ratio increases showing a reduction in nitrogen content and increase in carbon content on mass basis in leaves which causes reduction in protein content leading to detoriation in the nutritional quality of seed.

WORLD ENVIRONMENT DAY CELEBRATION AT CSIR-NBRI

CSIR-NBRI, Lucknow and International Society of Environmental Botanists (ISEB) jointly celebrated World Environment Day 2019. Dr. Ashiho A. Mao, Director, Botanical Survey of India, Ministry of Environment, Forest and Climate Change, Government of India was the Chief Guest of the Function.

A poster exhibition by the ENVIS Centre of the CSIR-NBRI was, displayed to create awareness about the Plants and Pollution. The information on different pollution mitigating plants was, also given. During the programme prizes were also distributed to the winner of the Environment Day Quiz contest held in the institute earlier on June 04, 2019.

Earlier Dr. RD Tripathi, Secretary, ISEB highlighted the genesis of the programme. He informed that NBRI has been working on environmental protection and climate change forover the last two decades. Institute has reported many plants that mitigate water and air pollution and are currently being used to purify rivers and air.

While welcoming the Chief Guest, Prof. SK Barik, Director, CSIR-NBRI discussed the importance of environment day and highlighted this year's theme 'Air Pollution'. He said that air pollution has reached on hazardous level globally and we have to jointly tackle this problem. The Chief Guest of the function, Dr. Ashiho A. Mao, in his lecture informed about the Rhododendron tree found in North Eastern Himalayan regions from 600 meter to 6000 meter altitude. He said that this plant is considered as an indicator of height in the Himalayan forest area. In the north-eastern Himalaya region, many species of different colours of Rhododendron are found. This plant has been preserved by the Sikkim state by establishing a sanctuary. It is also used as a beverage in Sikkim. He also shared the visual scenes of Rhododendron plants growing naturally in the Himalayan areas.

While discussing environment and climate change, Dr. Mao said that the number of trees per head in India is the lowest in the world. As the global temperature of the environment is continuous increasing, we must ensure to plant at least 5 trees per head in the coming monsoon season. This initiative will help to provide safe and clean environment for future generations. He also informed the efforts of Botanical Survey of India for plantation. He mentioned the BSI will plant approx. 35000 plants in north-eastern regions in the coming monsoon season.

Twice as many plants have gone extinct than birds, mammals, and amphibians combined

When scientists talk about recent extinctions, birds and mammals get most of the attention. But the first global analysis of its kind finds that twice as many plants have disappeared than birds, mammals, and amphibians combined.

Researchers reviewed published research, international databases, and museum specimens such as grasses from Madagascar (pictured), tallying up 571 plants species that have gone extinct in the past 250 years. One reason the total exceeds that of well-studied animals is that there are simply more kinds of plants. Looking at percentages, the situation is worse for mammals and birds; an estimated 5% of those species have gone extinct, compared with 0.2% of plants.

The losses include the Chile sandalwood tree in the South Pacific, exploited for its fragrant timber. It was last seen on Robinson Crusoe Island in 1908. (The extinction rates among plants have been highest for trees and shrubs on islands—which often have species that occur nowhere else—and in regions with rich diversity, especially the tropics and in Mediterranean climates.)

Just a few years later, the world lost the banded trinity (*Thismia americana*), a leafless plant that grew entirely underground except for its flowers. Most species of this kind of plant grow in rainforests, but *T. americana* was first described in 1912 in a sandy wetland in Chicago, Illinois, and was wiped out by development.

The total of 571 extinct plant species is four times higher than the official listing kept by the International Union for the Conservation of Nature in Gland, Switzerland, the team reports today in *Nature Ecology & Evolution*. Even so, it is probably still an underestimate, as less is known about the status of plants in Africa and South America than on other continents. Many of these species may vanish, too; a major review of the status of global biodiversity recently estimated than more than a million species (including 14% of plant and animal diversity) are threatened with extinction.

Erik Stokstad
(Source- Environment, Plants & Animals Jun. 10, 2019)

Africa's strangest trees are stranger than thought—and they're dying mysteriously

Africa's baobab tree looks like something from a Dr. Seuss book. When young, the species (*Adansonia digitata*) is single-stemmed, branchless, and sports fruit that resembles giant sausages. Now, researchers report things get even weirder as the tree grows older. Over its lifetime, its roots send up several more stems in a ring, which eventually fuse to form a cavity "inside" big enough for bars, churches, or prisons for people, and refuges for animals seeking relief from the hot sun. The work also addresses the mystery of why so many of these strange trees are dying.

To conduct the study, researchers combed books, articles, and the internet and asked local Africans in order to locate the biggest baobabs. The team leader is a nuclear chemist who loved giant trees and had developed a way to date ancient trunks without harming them. The scientists considered baobabs a good challenge because others had said wood was difficult to determine the age of. The team dated more than 60 of the trees, revealing that—unlike most other trees—the baobab grows new trunks, instead of branches, which eventually create their giant, hollow interiors.

Some of these trees are more than 2000 years old, the team reports in *Nature Plants*. But in 2011 the oldest known specimen—a shrine for rainmakers named Panke that sprouted about 2450 years ago—died and toppled over. And now seven more of the 13 oldest trees, and five of the six biggest trees, have also died, the researchers report.

They suspect climate change—and underground water that's harder for the roots to reach—may have something to do with the trees' demise, but also point out that over each one's life span, it has undergone wetter, drier, colder, and warmer conditions that stress the tree and sometimes kill other plants. Whatever the cause, these mysterious deaths will have a big impact on the southern African landscape, as in addition to shade, the tree's bark, roots, seeds, and fruit are key food sources for many animals.

Elizabeth Pennisi
(Source –Plants & Animals, Jun. 11, 2018)

Houseplant with added rabbit DNA could reduce air pollution, study shows

A devil's ivy plant. Scientists say their study showed that a houseplant could reduce toxins in domestic air. A humble houseplant with a dash of rabbit DNA could help lower our exposure to indoor air pollution, research suggests. Scientists have revealed that by inserting a rabbit gene into devil's ivy (*Epipremnum aureum)* the plant is able to clean the surrounding air by breaking down chemicals such as benzene and chloroform, which in certain concentrations can harm health. The researchers say these chemicals end up in household air as a result of everyday activities, with chloroform released from chlorinated water during showering, and benzene from sources including outside air and smoking.

"The levels aren't very high, but they are high enough to be of concern," said Prof Stuart Strand, a co-author of the study from the University of Washington, adding that some studies in developed countries had suggested some of these volatile chemicals could approach industrial limits within homes – a particular concern for children.

While previous studies have revealed certain plants can remove some of these problematic chemicals, the rate at which they can do so differs from study to study. In an attempt to reduce human exposure to such substances, scientists say they have inserted a synthetic form of the rabbit version of a gene known as P450 2e1 into devil's ivy. This gene is found in many mammals, including humans, and produces an enzyme that breaks down a

range of chemicals in the body. While it has been inserted into plants before, including poplar trees, researchers say their study shows the trick also works for house plants.

Writing in the journal Environmental, Science and Technology, researchers from the University of Washington say they inserted two other genes at the same time to allow them to check that the genetic modification had worked. They put the genetically modified plants into vials containing either chloroform or benzene, and measured their levels over time. The results were compared against the same setup with unmodified plants, and no plants. The results reveal only a small drop in the concentration of benzene when unmodified plants or no plants were present, with no effect on the concentration of chloroform for either setup. However when the genetically modified devil's ivy was present, the team found benzene concentration fell by about 75% in eight days. Further analysis revealed the genetically modified plant took up benzene at 4.7 times the rate of the unmodified plant. In the case of chloroform, the team report it was "barely detectable" after six days in the presence of the genetically modified plant.

The team say they are now conducting experiments to explore whether the ivy can also reduce levels of other problematic chemicals, or whether other genes could be inserted to help break down a larger range of substances in the air including formaldehyde, which can be released by upholstery and during cooking. The team proposes that the plants could be enclosed in a "bio-filter", with air forced through the device by a fan. "If you just have one of these plants sitting over in the corner, it is not going to have enough contact with the home air to do any good," said Strand, adding the device would look a bit like a miniature greenhouse, about the size of a sash window, and would need about 5-10kg of plants to clean the home's air. It could also have a particle filter incorporated. "There aren't any devices presently on the market for dealing with these [volatile chemicals] so what we are proposing here is a technology that can fill that gap."

Prof Laurence Jones from the Centre for Ecology and Hydrology, whose work has shown that plants in the UK remove 1.4m tonnes of air pollution, said more work was needed to see if the approach would prove useful outside the laboratory, noting the time it took for the devil's ivy to break down the chemicals and the fact there is much more air to clean in a room as well as regular emissions of pollutants. However, Dr Liz Rylott, a plant biotechnologist from the University of York welcomed the study. "This is a great breakthrough technology – on paper the health benefits are clear … these plants are lowering your exposure to toxins and that can only be a good thing," she said. "It is difficult to say how this will affect your life [on] a long-term basis, but who doesn't want to lower their exposure to toxins?" But she added the plant was unlikely to be available in the EU any time soon. "Legislation in Europe is becoming increasingly restrictive on releasing this technology."

Nicola Davis

(Source – The Guardian, Dec. 19, 2018)

New climate 'stripes' reveal how much hotter your hometown has gotten in the past century

A social media campaign called 'Show Your Stripes' is flooding the climate science community with beautiful blue and red striped barcode-like images, each of which represents more than a century of temperature data for virtually all countries and all 50 U.S. states.

Inspired to create visually elegant and shareable climate data, climate scientist Ed Hawkins at the University of Reading in the United Kingdom created the "warming stripes," which use bands of colour to indicate warming or cooling temperatures from 1901 to 2018. Hawkins has unveiled show your stripes. info, allowing anyone to download and post their region's stripy climate data.

The site has logged more than 1 million downloads, from more than 180 countries. Offline, the stripes have decorated ties, cufflinks, a Tesla in Minnesota, and a German music festival's stage. Through a campaign led by non-profit Climate Central, more than 100 TV meteorologists in the United States and abroad have featured the stripes, which have been re-tweeted thousands of times.

The campaign hasn't been without its detractors, however. Some have worried that warming stripes of individual countries or states, taken out of context, could advance the idea that global temperatures aren't rising. Others say the charts should include axes or a legend. But J. Marshall Shepherd, former president of the American Meteorological Society in Boston, has commended Hawkins for his "innovative" approach and "outstanding science communication" effort.

Eli Kintisch

(Source - Climate, Scientific Community, Jun. 26, 2019)

Humans held responsible for twists and turns of climate change since 1900

While industry and agriculture belched greenhouse gases at an increasing pace through the 20th century, global temperature followed a jagged course, surging for 3 decades starting in 1915, leveling off from the 1950s to the late 1970s, and then resuming its climb. For decades, scientists have chalked up these early swings to the planet's internal variability—in particular, a climatic pacemaker called the Atlantic Multidecadal Oscillation (AMO), which is characterized by long-term shifts in ocean temperatures. But researchers are increasingly questioning whether the AMO played the dominant role once thought. The oceanic pacemaker seems to be fluttering.

It is now possible to explain the record's twists and turns almost entirely without the AMO, says Karsten Haustein, a climate scientist at the University of Oxford in the United Kingdom and lead author of a new study published this month in the *Journal of Climate*. After correcting for the distinct effects of pollution hazes over land and ocean and for flaws in the temperature record, Haustein and his colleagues calculated that the interplay of greenhouse gases and atmospheric pollution almost singlehandedly shaped 20th century climate. "It's very unlikely there's this ocean leprechaun that produces cyclicity that we don't know about," Haustein says—which means it is also unlikely that

a future cool swing in the AMO will blunt the ongoing human-driven warming.

Others aren't convinced the "leprechaun" is entirely vanquished. "They are probably right in that [the AMO] is not as big a player globally as has sometimes been thought," says Kevin Trenberth, a climate scientist at the National Center for Atmospheric Research in Boulder, Colorado. "But my guess is that they underestimate its role a bit."

The AMO arose from observations that sea surface temperatures in the North Atlantic seem to swing from unusually warm to cold and back over some 20 to 60 years; the ancient climate appears to have had similar swings. Researchers theorized that periodic shifts in the conveyor belt of Atlantic Ocean currents drive this variability. But why the conveyor would regularly speed and slow on its own was a mystery, and the evidence for grand regular oscillations has slowly been eroding, says Gabriele Hegerl, a statistical climatologist at the University of Edinburgh. "Those are harder to defend."

The new skepticism kicked off with work led by Ben Booth, a climate scientist at the Met Office Hadley Centre in Exeter, U.K.. In 2012, he reported in *Nature* that pollution hazes, or aerosols, began thickening the clouds over the Atlantic in the 1950s, which could have cooled the ocean with little help from an internal oscillation. In the past year, several independent models have yielded similar results. Meanwhile, most global climate models have been unable to reproduce AMO-like oscillations unless researchers include the influence of pollutants, such as soot and sulfates produced by burning fossil fuels, says Amy Clement, a climate scientist at the University of Miami in Florida.

Now, it seems plausible that such human influences, with help from aerosols spewed by volcanic eruptions, drove virtually all 20th century climate change. Haustein and his co-authors tweaked a relatively simple climate model to account for the fact that most pollution originates over land, which heats and cools faster than the ocean—and there's much more land in the Northern Hemisphere. And they dialed back the cooling effect of volcanic eruptions—a reasonable move, says Booth, who is not affiliated with the study. "We've known models respond too strongly to volcanoes."

The also adjusted the global temperature record to account for a change in how ocean temperatures are measured; during World War II, the British practice of measuring water samples in buckets gave way to systematically warmer U.S. readings of water passing through ships' intake valves. Past efforts to compensate for that change fell short, Haustein and his team found, so they used data from weather stations on coastlines and islands to correct the record.

As input for the model, the team used greenhouse gas and aerosol records developed for the next U.N. climate report, along with records of historical volcanic eruptions, solar cycles, and El Niño warmings of the Pacific. Comparing the simulated climate with the adjusted temperature record, they found that multidecadal variability could explain only 7% of the record. Instead, soot from industry drove early 20th century warming as it drifted into the Arctic, darkening snow and absorbing sunlight. After World War II, light-reflecting sulfate haze from power plants increased, holding off potential warming from rising greenhouse gases. Then, pollution control arrived during the 1970s, allowing warming to speed ahead.

It's a compelling portrait, but it could have been substantially different if the team had used other, equally justifiable assumptions about the climate impact of aerosols, Booth says. Trenberth thinks the team's adjustments had the effect of fitting the model to an uncertain record. "There is considerable wiggle room in just what the actual record is," he says.

Haustein disputes that the team tailored the model to explain the 20th century warming. "All we did was use available data in the most physically consistent way," he says. The researchers ran the model from 1500 to 2015, and he says it matches paleoclimate records well, including Europe's Little Ice Age.

If a grand ocean oscillation isn't shaping climate, a future ocean cooling is unlikely to buy society time to address global warming. But the demise of the AMO also might make it easier to predict what is in store. "All we're going to get in the future," Haustein says, "is what we do."

Paul Voosen

(Source - ScienceMag. May 23, 2019)

100m bacteria a day keep the doctor away, apple research suggests

The impact of an apple a day in keeping the doctor away may be partly down to the beneficial bacteria it carries and their subsequent colonisation of your gut, according to scientists. A study has found that a typical apple carries more than 100m bacteria. Some of these microbes are important in maintaining a healthy gut environment, or microbiome, says Prof Gabriele Berg from Graz University of Technology, Austria, one of the authors of the research.

"The bacteria, fungi and viruses in our food transiently colonise our gut," she said. "Cooking kills most of these, so raw fruit and veg are particularly important sources of gut microbes." Variety in the microbiome is thought to be key to a healthy gut and the researchers said there appeared to be more microbial diversity in organic apples.

"Freshly harvested, organically managed apples harbour a significantly more diverse, more even and distinct bacterial community, compared to conventional ones," explained Berg. "This variety and balance would be expected to limit overgrowth of any one species, and previous studies have reported a negative correlation between human pathogen abundance and microbiome diversity of fresh produce."

Birgit Wassermann, also at Graz University of Technology and the lead author of the study, suggested that, "The microbiome and antioxidant profiles of fresh produce may one day become standard nutritional information, displayed alongside macronutrients, vitamins and minerals to guide consumers".

Gregory Robinson

(Source: The Guardian Jul. 24, 2019)
The research was published in the journal Frontiers in Microbiology

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