Editorial

Prakriti Prerak Magazine

From the very first issue, Prakriti Prerak team has been delivering what's best for Environmental Science academic community. The audience of this magazine includes professor, scientists, research scholars and students, executives of highly prestigious organizations of World. In year 2018, Biotech Rainbow has made new editorial Board combining experience of prestigious Advisory Board Members who have been into Award winning Research and head prestigious Administrative positions.

Advisory Board

Advisors

Contents

Biological Control of Indian White Termites with Oriental Foliage

Nidhi Srivastava1* Anju Meshram2

1Department of Bioscience and Biotechnology, Banasthali University, Banasthali, 2Rajasthan1Department of Biotechnology, Kalinga University, Naya Raipur, Chhattisgarh

*Corresponding author: Dr. Nidhi Srivastava, Associate Professor, Department of Bioscience and Biotechnology, Banasthali University, Banasthali-304022, Rajasthan, India

Introduction

Termites, present in a broad range of terrestrial environment, are the most damaging pests and cause considerable problems in housing, agriculture and forestry. They are eusocial insects belonging to order Isoptera with extremely well structured colonies and division of labour among different castes. Termites are worldwide nuisance; particularly in tropical areas with relatively high humidity. They feed on cellulose-based material i.e. books, wood, furniture boxes, etc. In the sub-humid and semi-arid tropical regions, furniture, buildings, annual and perennial crops are substantially damaged by termites and they continue to be the most harmful pest because of their capability to damage wooden structures. Termites are numerous in number and usually form the diverse component of ecological system predominantly in the forest regions of the humid environment. Termites fit into the order Isoptera, identified by their distinguishing social behavior. A termite colony usually consists of reproductives (a king and a queen) as well as the soldiers and workers. These colonies are subterranean and present within wood above-ground. They are generally present in decomposing wood, timber, plant refuse, or in soil rich in organic or humus substance. The significant damage caused by these invasive termites in terms of both economy and ecology is expected to increase with change in climate, advancement in urbanization and financial globalization. These intruder termites classically spread with swarming timbers and characteristically attack the man-made environments and then spread to more indigenous environment or habitat. Apart from the damage caused by termites, increase in the use of prospective pesticides in urban areas and natural landscapes could lead to negative ecological impacts on food webs and invertebrate species composition.

(a) (b) (c)

Figure 1: Termites (a) Termite mounds at Banasthali University (b) termites on soil (c) wood infected with termites

Termites are well recognized for their economic consequences and the harm they cause to agricultural plants. They comprise huge substantial value to man in the bioconversion as well as degradation of lignocellulose waste materials. Fungus-growing termites are the most difficult termites in the agriculture belonging to Termitidae. They are the main threat of sub-humid and semi-arid regions, resulting in financial losses to the field crops, forests trees, buildings and rangelands.

Previously, termite management was completely dependent on chemical pesticides particularly the constant organochlorine. Their drawbacks include the highest left over effect and the expansion of insecticides resistance in target pests. In the same way, undesirable health effects on human and major concerns for environmental damage resulted in the substitution of chemical or synthetic insecticides with biological products, which is universally practical and acceptable approach. Thus, management of insect pest by wide use of chemical or synthetic pesticides as a basis for environmental pollution, is a global ecological challenge.

In current years, use of locally available plants has attained great significance mostly among the scientific community for their high bioefficacy against termites. Numerous plants possess repellent and antitermite activities such as Cassia leaf, Country borage, lemon grass, Eucalyptus, vetiver oil, clove bud, cedar wood and isoborneol.

The overuse and misuse of chemical pesticides has caused detrimental effects on environment with destruction of valuable organisms. The use of botanicals as microbial agents and biopesticides is thus a new credible approach for the control and management of various insect pests. These biopesticides being eco-friendly, target specific, biodegradable and economically feasible has emerged as better substitutes to synthetics pesticides.

Insecticide

Natural insecticides or botanicals should be derived from locally available plants with little or no processing. These plants should not act as hosts for the crop pests or develop into weeds. Active metabolites derived from plants can act as toxicants, insect growth regulators, synergists as well as repellents. Majority of insect pests are regulated with several plant derived oils. Plants contain several bioactive compounds like terpenoids, alkaloids, glycosides, phenols, tannins, flavonoids, etc. in their leaves, stem, bark, seed and oil. These natural bioactive compounds are reported to have potent anti-termite property.

In numerous ways, phytochemicals toxicity to insects have been studied including growth retardation, suppression of calling behaviour, toxicity, fecundity and fertility reduction, inhibition of feeding property, and deterrence of oviposition. However, only the use of nicotine is widely described as insecticide in comparison to other alkaloids.

The utilization of plants or products of plant's origin for pest management is very familiar and numerous herbal products are employed to manage a broad range of insects e.g., Nicotine from Nicotiana tobacum, Azadirachtin from neem oil and rotenoids from leguminous plants roots, Lonchocarpus species. These plant products serve as feeding deterrents and insect growth regulators

Biological control

The burning issue of present scenario is the biological control of destructive pest termites via green management techniques focusing on minimum undesirable effect on environment. Various constituents and secondary metabolites from plants own toxic or repellent effect on termites. Pretreatment of wooden house building materials yielded good result in India. However the application in soil treatment against subterranean termite attacks needs further research. Plant extracts as new wood preservatives have healthier prospects against termite infestation, non-toxic, safe for environment and biodegradable, but they are less effective than chemicals.

Various termite control techniques used in India are under native conventional knowledge. Termites are used as indicator of different environmental aspects, viz. predictable rainfall, soil productiveness, etc. Since ages in Indian subcontinent, termite control by exploitation of locally available plants is a frequent practice. Since this practice has been emerged in old age time with no advancement in technology, it do not offer harmful effect on environment and absolutely safe for humans. Thus a scientific traditional knowledge of pest management and their implication is the requirement of present condition.

Phytochemicals

Phytochemicals (organic chemicals) on the basis of their function in plant metabolism are categorized as primary or secondary constituents, extracted from plants. Phytochemicals are plant protectants and studies have demonstrated their broad range of natural activities against insects. Phytochemicals serve as growth inhibitors, repellents, antifeedants, chemosterilants, attractants, or insecticides. Antioxidants serve a central role in defending biological systems against numerous diseases.

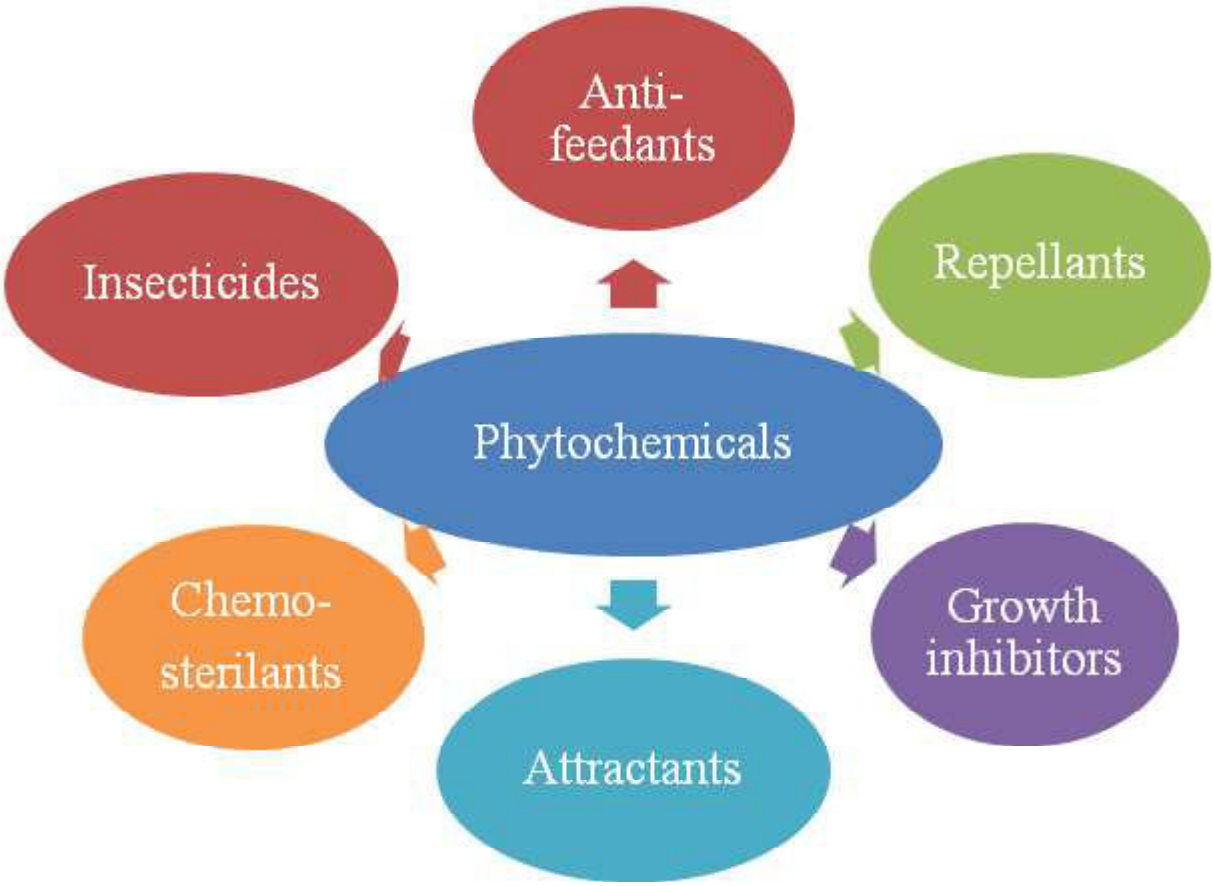


Figure 2: Biological properties of phytochemicals against insects

Secondary Metabolites

Secondary metabolites produced by plants are complex structures with a potential activity against insects. As an alternative for chemical/ synthetic pesticides, numerous plants have been identified so far with insecticidal property that can be utilized for pest management. Aim and management techniques dealing with termites protect constructions and prevent massive economic loss. Accurate recognition of the target termite species, appropriate mapping of their attack with proper treatment will lead environmentally safe, successful, cost effective management of termites. Educational and promotional activities for spread of knowledge will add to the prevention of buildings from termite's attack.

Alkaloids

Alkaloids are groups of basic compounds characterized by the presence of a heterocyclic nitrogen atom. They are naturally present in many plant species and are often toxic to animals and humans. Alkaloids include diverse molecules like strychnine, atropine, cotinine, nicotine, solanidine and pyrrolizidine alkaloids. Weak inhibitory activity against the MCF-7 cell line is exhibited by the piperidine alkaloid isolated from methanol extracts of Arisaema decipiens Schott (Araceae) rhizomes. The alkaloid obtained from Alstonia boonei showed potential insecticidal property against maize stem borer Sesamia calamistis. Alkaloids isolated from Stichoneuron caudatum possess significant insect toxicity, antifeedant and repellant activities. Root extracts of S. caudatum showed significant acetylcholinesterase (AChE) inhibitory activity associated with the insecticidal activity. The alkaloids of Cynanchum mongolicum is reported as potential insect growth inhibitors for Spodoptera litura larvae which effect many crops and causes substantial economic lossess.

Araceae

Araceae family comprises of monocotyledonous plants having flowers on spadix inflorescence. Usually the spadix is accompanied by a leaf like bract called spathe. Araceae is also called the arum family and its members as aroids. The family comprises of 114 genera and 3750 species generally present in tropical and temperate areas of the world. In India, about 25 genera and more than 140 species have been reported, mostly from the southern and

western parts of the country. Colocasia antiquorum and Pothos aureus are two well-known plants of this family.

Aroids are important medicinal plants as well, for instance, Agalonema treubii is a valuable source for glycosidase inhibitors that are antimetastatic, antidiabetic, immunomodulatory and antiviral in nature. Rhaphidophora decursiva is known to exhibit antimalarial activity. The rhizome powder of Homalomena aromatica is used for the treatment of skin disease in India and as an anti-inflammatory agent.

Epipremnum aureum

Epipremnum aureum (Linden and Andre) G.S Bunting commonly known as Rhaphidophora aurea, belonging to Araceae family is an evergreen herbaceous plant indigenous to Solomon Islands and Southeast Asia, and inhabits sheltered and shaded forests like a root climbing foliage. E. aureum is fashioned as an essential decorative flora utilized broadly as hanging baskets, totems or in dish gardens for interiorscaping owing to its ability to grow at low light intensity.

E. aureum (Pothos aurea) is capable of removing indoor pollutants like xylene, benzene and formaldehyde. The phytochemical constituents in the E. aureum aerial roots intertwined over two different trees may vary. This may be accredited to the varying biological composition of the host tree. Aerial roots of P. aurea can be regarded as a promising source for antimicrobial drugs.

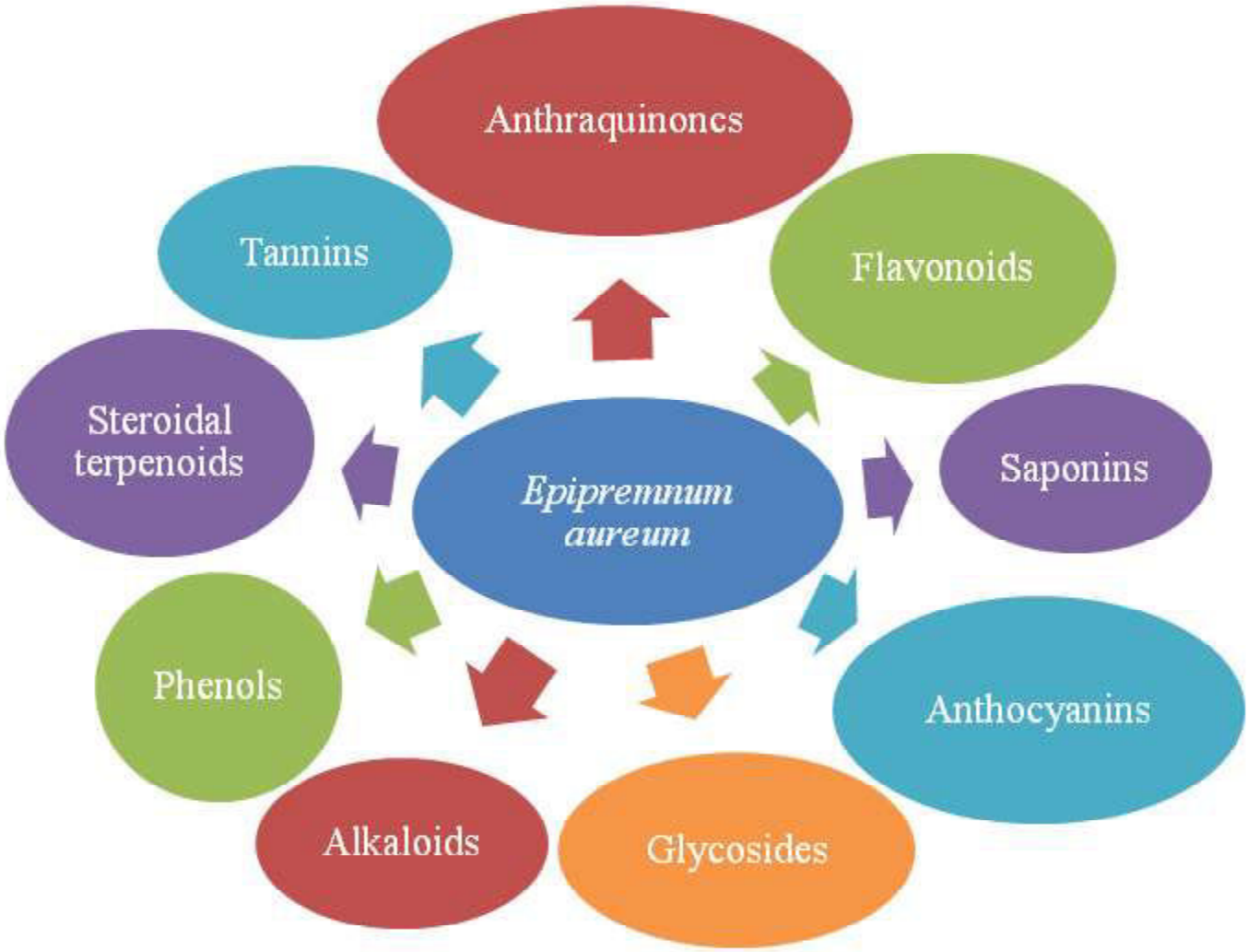


Figure 3: Phytochemicals present in Epipremnum aureum

The antitermite, antibacterial and antioxidant activities of E. aureum ethanolic extract have been reported. The antibacterial efficacy of E. aureum aqueous extract against Escherichia coli and Streptococcus aureus is also proved.

Aerial roots of Pothos aurea can be regarded as a promising source for antimicrobial drugs. Aqueous extract of E. aureum can be used for the discovery of biologically active natural products for the development of new pharmaceuticals as it possesses high antimicrobial activity comparable to standard drugs.

Rhaphidophora aurea is reported to have potent wound healing, antimicrobial, antioxidant activity and contains phytoconstituents like flavonoids, alkaloids, steroids, tannins, terpinoids, saponins, anthocyanin, phenols, anthraquinin and glycosides.

The plant E. aureum is reported as rich source of alkaloids and many alkaloids were reported from the leaves of the plant using GC-MS. In vitro antitermite activity of alkaloids isolated from leaf, root and stem of E. aureum against Odontotermes obesus have also been reported.

Epipremnum pinnatum

Epipremnum pinnatum (Linn.) Engl. (syn. Rhaphidophora pinnatifida Linn.) is another closely related Araceae member. It has potent anti-inflammatory and analgesic property.

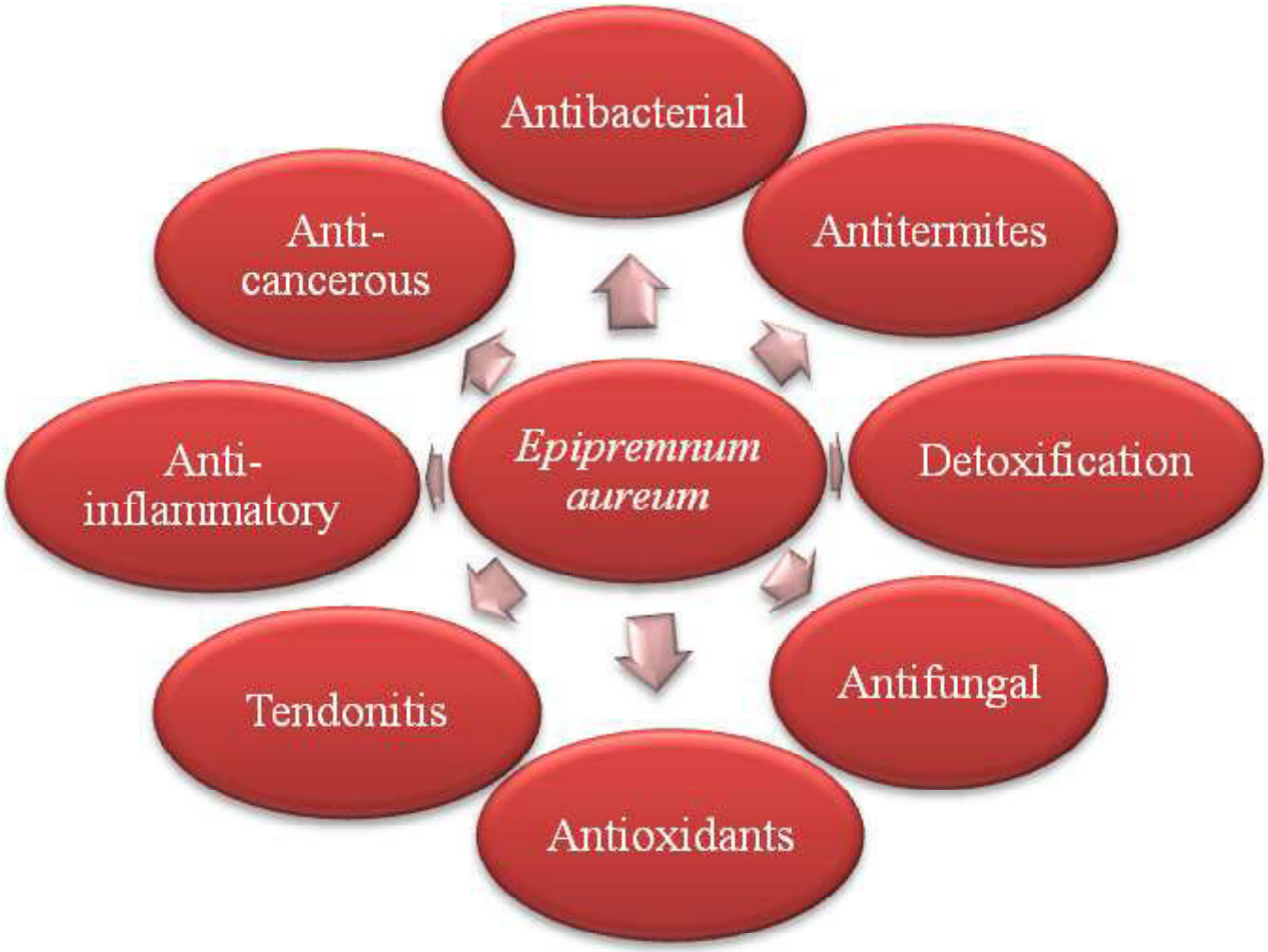


Figure 4: Ethnomedicinal and pharmacological properties of Epipremnum aureum

Epipremnum pinnatum (L.) Engl. is a large root-climber (Araceae) commonly known as Dragon Tail plant or centipede togavine, broadly identified in Singapore and Malaysia. It is traditionally known for the treatment of skin disease and in anticancer preparation. E. pinnatum pose potent anti-inflammatory and analgesic property. It has been exploited as traditional remedies due to its therapeutic properties and ability in enhancing the immune system. It has potent analgesic and anti-inflammatory activity. Its beneficial effects may be from their role in satabilization of lysosomes and free radical scavenging activity.

Epipremnum aureum (Linden and Andre) G.S. Bunting and Epipremnum pinnatum (L.) Engl. belonging to the family Araceae were studied for the isolation and characterization of alkaloids for their antitermite activity against subterranean termites O. obesus. The present research study could be summarized and concluded as follows:

Currents Findings

Presence of phytochemical compounds in the methanol extract of aerial root and leaf explants of E. aureum and E. pinnatum opens new door for the use of these plant in various biological activities including, pharmacological and environmental field. The usage of this ornamental plant should be promoted as an alternative for synthetic chemicals as it is very common well known plant , can grow and maintained easily and also affordable. In earlier studies, many evidences confirmed the identified phytochemicals of this particular species to be bioactive. The high antioxidant potential, free radical scavenging activity and antioxidative enzymes of E. aureum and E. pinnatum should be utilized for the development of new drugs for antioxidant therapy.

Isolation of alkaloids from E. aureum and E. pinnatum leaf explants were done with acid-base procedure and alkaloids were separated by incorporating miscible and immiscible solvent system. Purification of alkaloids was done through silica gel column chromatography with non-polar to polar solvents. The alkaloids were separated on the basis of polarity. Purified alkaloid fractions of E. aureum and E. pinnatum were tested for their in vitro antitermite activity by No-choice and Direct-choice assay on paper and soil. Further identification of alkaloids structure was done using GC-MS on the basis of mass fragmentation pattern. It was observed that the antirepellant activity of alkaloids of E. aureum and E. pinnatum alkaloids was more than the termiticidal activity.

Morphological analysis of images of dead termites through SEM revealed distortion and deformation of whole body cuticle alkaloids treated E. aureum and E. pinnatum in comparison to control termites having normal cuticle distribution on the body surface. The number of mechanical/ chemical sensory system i.e. hairs present on the anterior portion of the termites have been decreased in E. aureum and E. pinnatum alkaloids treated O. obesus in comparison with control worker termites.

After purification of alkaloids with solvent extraction, Epipremnum species promised for a good termiticidal activity. However, to confirm the exact nature of the toxicant, further molecular studies are needed. Nevertheless, the present study clearly indicates that the alkaloids reported from E. aureum and E. pinnatum act as potential agents for controlling the soft bodied termites.

The presence of various bio-active compounds detected after GC-MS analysis using the alkaloid fractions of E. aureum and E. pinnatum justifies the use of whole plant for various elements by traditional practitioner. However, isolation of individual phytochemical constituents and subjecting it to the biological activity will be definitely giving fruitful results and will open a new area of investigation of individual components and their insecticidal activity. Therefore, it is recommended as a plant of environmental importance.

Conclusion

Chemical insecticides have resulted in environmental deterioration and harmful effects on human and consequently resulted in the utilization of biological components. Termite's management based on excess application of pesticides has resulted in severe economic losses and environmental problems like soil and water contamination due to their low biodegradability and high toxicity. Globally, termiticides include a number of active ingredients like chlorfenapyr, cypermethrin, bifenthrin, fipronil, imidacloprid and permethrin. However, social organization and enigmatic lifestyle of termites makes their control difficult. Thus, it is absolutely important to look forward for new methods of termite control to facilitate safe environment and human beings.

Effects of Hazardous Lead (Polychlorinated benzenes) in the Environment

Jyoti Mathur & Priti Chauhan

Department of Bioscience and Biotechnology, Banasthali University, Rajasthan, India

1. Introduction

Global industrialization and urbanization in the past decades have resulted in the generation of huge quantities of toxic wastes. These wastes include a variety of organic and inorganic compounds which pose serious threats to the environment. Organic contaminants include various compounds such as heavy metals, petroleum hydrocarbons, polychlorinated benzenes (PCBs) and other pollutants like radionuclides (Oncel *et al*, 2000). There are 35 metals that concern because of occupational or residential exposure; 23 of these are the heavy elements or "heavy metals". The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations.

Lead (Pb) is one of the most widespread heavy metal contaminant in the environment. It is highly toxic to living organisms and one of the main sources of environmental pollution (Mahaffay, 1990). Lead forms a variety of compounds and exists in the environment in various forms. Organic lead compounds, which cross the skin and respiratory tract easily, affect the central nervous system predominantly.

2. Distribution & occurrence of Lead

Lead is ubiquitous and widely distributed as metallic lead, inorganic compounds & organometallic compounds. Metallic lead usually found in ore with zinc, silver and copper (most abundantly) and is extracted together with these metals. The main lead mineral is galena (PbS), which contains 86.6 % lead by weight. Other common varieties are cerussite ($PbCO_3$) and anglesite ($PbSO_4$).

Lead has been known since ancient times and is relatively abundant in the earth's crust (13 g/ton, ranking 36th), where it is found in galena (PbS). Lead having 82 atomic number in the periodic table and its atomic weight 207.19. The lead crystal has a cubic structure with centered faces. Lead. This metal is highly resistant to corrosion because of this property; it is used to contain corrosive liquids (for example, sulfuric acid) because lead is very malleable and resistant to corrosion. It is extensively used in building construction- for example in the external coverings of roofing joints.

3. Sources of lead

Lead can be found in many products and locations. Some you might never have thought of, including some imported candies, toys and traditional medicines. Lead was used in household paint until 1978 and was also found in leaded gasoline, some types of batteries, water pipes, and pottery glazes. Lead paint and pipes are still found in many older homes and lead is sometimes also found in water, food, household dust and soil. There are various sources of lead in the environment-

3.1 Paint Industry

Now a day's various paint industries are using lead in the manufacturing of paints. Lead was used in paint to add color, improve the ability of the paint to hide the surface it covers and to make it last longer. However, when such paint is peeling, flaking, chipping or otherwise deteriorating it can create lead contaminated dust and paint chips that pose a potential health risk, especially to children. Lead based paint is also a potential hazard if it is disturbed during remodeling or repainting activities that create lead contaminated dust.

3.2 Dust and soil

Lead dust is the most common way that people are exposed to lead. Inside the home, most lead dust comes from chipping and flaking paint or when paint is scraped, sanded or disturbed during home remodeling. Young children usually get exposed to lead when they put something with lead dust on it into their mouths. Lead dust may not be visible to the

naked eye. Homes near busy streets may contain higher levels of lead in the soil because lead used to be used in gasoline. Today, lead still comes from metal smelting, battery manufacturing and other factories that use lead. This lead gets into the air and then mixes with the soil. Lead-based paint mixing with soil is a problem during home remodeling if workers are not careful.

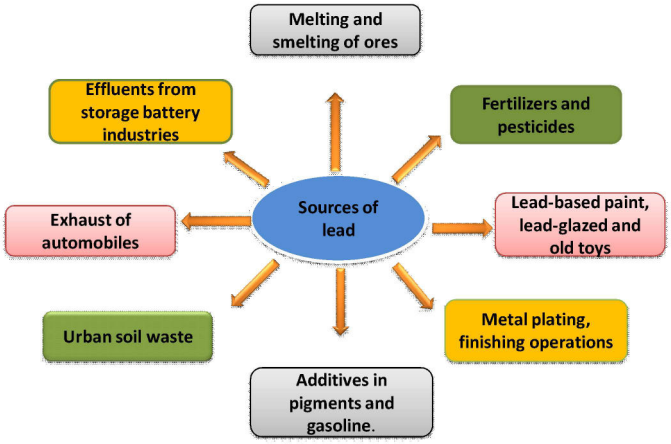


Figure 1: Sources of lead in the environment.

3.3 Drinking Water

Lead seldom occurs naturally in water supplies like rivers and lakes. Lead enters into drinking water primarily as a result of the corrosion or wearing away, of materials containing lead in the water distribution system and household or building plumbing. These materials include lead-based solder used to join copper pipe, brass and chrome plated brass faucets and in some cases, pipes made of lead that connect houses and buildings to water mains. In 1986, Government banned the use of lead solder containing greater than 0.2% lead, and restricted the lead content of faucets, pipes and other plumbing materials to 8.0%. Older construction may still have plumbing that has the potential to contribute lead to drinking water.

3.4 Sources of Airborne Lead

Amount of lead in the air has increased markedly due to anthropogenic activities. Atmospheric lead concentration in urban areas are 50 times higher than rural areas. Lead in air comes mainly comes from automobile emissions & industrial sources (e.g., smelters, waste incinerators, and lead-acid battery manufacturers). Atmospheric Lead can be in the form of gaseous compounds or particulate matters. Gaseous emissions are by combustion of tetraethyl lead and tetramethyl lead in automobile engines.

Sources of water-borne lead pollution

The source of lead was found to be lead pipe used in interior and exterior plumbing. The hard waters contain carbonate and sulphate ions which react with lead to form a water-insoluble protective coating of $PbCO_3$ and $PbSO_4$. Many industries utilizing lead releases lead contaminated water in the near by water-bodies leading to water pollution.

Lead-containing ceramic glazes have been a serious source of lead poisoning when used on containers of foodstuffs. It has been found that highly acidic liquids such as apple juice may dissolve the glaze and release lead into the liquid.

3.5 Children's jewelry and toys

Lead has been found in inexpensive children's jewelry sold in vending machines and large volume discount stores across the country. It also has been found in inexpensive metal amulets worn for good luck or protection. Some costume jewelry designed for adults has also been found to contain lead. It is important to make sure that children don't handle or mouth any jewelry.

3.6 The workplace and hobbies

People exposed to lead at work may bring lead home on their clothes, shoes, hair or skin. Some jobs that expose people to lead include: home improvement; painting and refinishing; car or radiator repair; plumbing; construction; welding and cutting; electronics; municipal waste incineration; lead compound manufacturing; manufacturing of rubber products, batteries, and plastics; lead smelting and refining; working in brass or bronze foundries; demolition; and working with scrap metal.

3.7 Lead-glazed ceramics, china, leaded crystal

Lead is used in industries for glazing ceramic pots. It may get into foods or liquids that have been stored in ceramics, pottery, china, or crystal with lead in it. Lead-glazed dishes usually come from other countries.

3.8 Imported food in cans that are sealed with lead solder

In 1995 the United States banned the use of lead solder on cans. But lead solder can still be found on cans made in other countries. These cans usually have wide seams and the silver-gray solder along the seams contains the lead. Cans containing lead may be brought to the United States and sold. Over time the lead gets into the food. Foods that are acidic cause lead to get into the food faster. Food and liquids

stored in lead crystal or lead-glazed pottery or porcelain. Food can become contaminated because lead can leach in from these containers.

4. Uses of lead

Lead has a number of uses but many of these are currently being phased out because of growing awareness of its toxicity and of the damage that uncontrolled dispersion in the environment has already caused. Lead is used in applications where it's low melting point, ductility and high density and resistance from corrosion is an advantage.

- Lead is used as electrodes in the process of electrolysis. Lead is used in solder for electronics, although this usage is being phased out by some countries to reduce the amount of environmentally hazardous waste. Lead is used in high voltage power cables as sheathing material to prevent water diffusion into insulation.
- Lead is used as shielding from radiation (e.g., in X-ray rooms). Molten lead is used as a coolant (e.g., for lead cooled fast reactors).
- Lead is added to brass to reduce machine tool wear. Lead, in the form of strips, or tape, is used for the customization of tennis rackets. Tennis rackets of the past sometimes had lead added to them by the manufacturer to increase weight.
- It is used to form glazing bars for stained glass or other multi-lit windows. Lead, or *sheet-lead*, is used as a sound deadening layer in some areas in wall, floor and ceiling design in sound studios where levels of airborne and mechanically produced sound are targeted for reduction or virtual elimination.
- Lead has many uses in the construction industry (e.g., lead sheets are used as architectural metals in roofing material, cladding, flashing, gutters and gutter joints, and on roof parapets). Detailed lead moldings are used as decorative motifs used to fix lead sheet. Lead is often used to balance the wheels of a car; this use is being phased out in favor of other materials for environmental reasons.
- Lead compounds are used as a coloring element in ceramic glazes, notably in the colors red and yellow. Lead is frequently used in polyvinyl chloride (PVC) plastic, which coats electrical cords.
- Lead is used in some candles to treat the wick to ensure a longer, more even burn. Because of the dangers, European and North American manufacturers use more expensive alternatives such as zinc.
- Some artists using oil-based paints continue to use lead carbonate white, citing its properties in comparison with the alternatives. Tetra-ethyl lead is used as an anti-knock additive for aviation fuel in piston-driven aircraft.

5. Environmental hazards of lead

5.1 Effects on plants :

Plants can take up high levels of lead from soils. Higher concentrations of lead can cause the negatively influence on the plant growth (Sharma et al., 2005). Through plant uptake, lead enters food chains. There are various effects which is caused by lead in the plants-

- The visual non-specific symptoms of Pb toxicity are rapid inhibition of root growth, stunted growth of the plant and chlorosis.
- Pb toxicity inhibits germination of seeds and retards growth of seedlings. Pb decreases germination percent, germination index, root/ shoot length, tolerance index and dry mass of roots and shoots.
- Pb phytotoxicity leads to inhibition of enzyme activities, disturbed mineral nutrition, water imbalance and change in hormonal status and alteration in membrane permeability.

A generalized view of the effects of Pb toxicity on key physiological processes in plants is presented in figure 2.

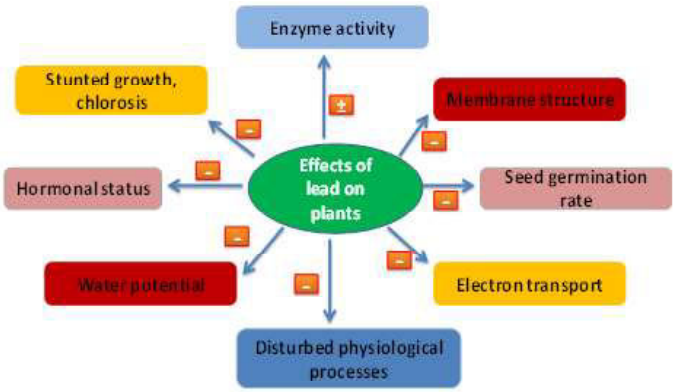


Figure 2. A generalized view of lead toxicity in plants. '+' and '–' signs indicate positive and negative effects respectively.

5.2 Effects on humans of lead

Lead interferes with a variety of body processes and is toxic to many organs and tissues including the heart, bones, intestines, kidneys, and reproductive and nervous systems. It interferes with the development of the nervous system and is therefore particularly toxic to children, causing potentially permanent learning and behavior disorders. Symptoms include abdominal pain, confusion, headache, anemia, irritability, and in severe cases seizures, coma, and death.

Table1: Effects of lead toxicity on plants, humans and animals. (a) chlorosis on plant leaf, (b) head pressing behavior in cattle, (c) lead infected vultures and (d) characteristic finding of lead poisoning in humans- dense metaphyseal lines.

- Plumbism- Lead poisoning or plumbism is defined as a toxic condition caused by the ingestion or inhalation of the metallic element lead, which is found in many places, including the air, soil, water, houses, ceramic cookware, and solder used in metal cans and pipes. Lead poisoning occurs when blood lead levels are equal to or greater than 10 ?g/dl (micrograms per deciliter). These enter the body by respiration (of dust, fumes, or sprays) or by ingestion of food or other substances that contain lead.
- Neurotoxicity: Lead uptake through the blood-brain barrier and into the brain proceeds at an appreciable rate, consistent with its action as a potent central neurotoxin. The effects of lead on the brain, including mental retardation and cognitive deficit, are mediated by its interference with three major neurotransmission systems: the dopaminergic, colinergic and glutamatergic systems (Dart et al., 2004; Needlemann, 2004).
- Children with high levels of lead in their bodies can suffer from damage to the brain and

nervous system, behavior and learning problems, such as hyperactivity, slowed growth hearing problems and headaches (Chisolm and Harrison, 1956).

- Adults with higher level of lead can suffer from reproductive problems (in both men and women), high blood pressure and hypertension, nerve disorders, memory and concentration problems, muscle and joint pain, anemia, constipation and abdominal spasm.

5.3 Effect of lead on animals

Humans are not alone in suffering from lead's effects; plants and animals are also affected by lead toxicity to varying degrees depending on species. Animals experience many of the same effects of lead exposure as humans do, such as abdominal pain, peripheral neuropathy, and behavioral changes such as increased aggression.

5.3.1 Wildlife

Lead, one of the elements that causes toxicity in waterfowl which has been known to cause death of wild bird populations. When hunters use lead shot, waterfowl such as ducks can ingest the spent pellets later and be poisoned; predators that eat these birds are also at risk. Cattles show head pressing behavior. Turkey vultures "Cathartes aura" and California condors can be poisoned when they eat carcasses of animals shot with lead pellets. Other threats to wildlife include lead paint, sediment from lead mines and smelters, and lead weights from fishing lines. Lead in some fishing gear has been banned in several countries (Buekers et al., 2009)

5.3.2 Aquatic Birds:

Lead poisoning in aquatic birds may occur when spent lead shot is mistaken for gravel (which is normally consumed to aid in digestion) and ingested. Birds may also be exposed to lead when feeding on fish attached to lead fishing gear such as sinkers or jig heads. In addition to loons, frequent victims of lead poisoning include swans, pelicans, geese, ducks, cormorants, cranes, and herons.

6. Mechanism for environmental cleanup

6.1 Phytoremediation using hyperaccumulator plants

Phytoremediation is an eco-friendly technology of using plants, grown in polluted soil and water to remove metals. The use of plants provides a number of advantages compared to common remedial technologies such as excavation and offsite disposal, thermal desorption, incineration, and physical and chemical degradation. There are many plant species reported which can absorb the heavy metals from soil and water. These plants are known as hyperaccumulator plants like Brassica juncea, Zea mays, Tagetes erecta L., Thlaspi caerulescens, Amaranthus, Helianthus annuus, Brassica chinensis, maize, willow, poplar, water hyacinth plant, Moringa sps. have been identified as phytoremediator plants. Phytoremediation represents a set of innovative technologies (phytotechnologies) that takes advantages of the specific extractive and metabolic capabilities of plants.

6.2 Bioremediation using microbes

A diversity of bacteria, fungi, and algae has been characterized as to their capacity to degrade lead. Researchers have endeavored to utilize microbes to facilitate the removal of both organic and inorganic contaminants from the environment, especially from soil. There are some of lead resistance bacteria such as Escherichia sp., Sphingomonads, Pseudomonas sp., Bacillus subtilis, Arthrobacter and Ochrobactrum which can remove the metals.

References

- Buekers, J., Redeker, E.S., E. Smolders. 2009. Lead toxicity to wildlife: Derivation of a critical blood concentration for wildlife monitoring based on literature data. Science of the Total Environment, 407(11): 3431-3438.
- Sharma, P., Dubey. R.S. 2005. Lead toxicity in plants, Toxicidade de chumbo em plantas. Brazilian Journal of Plant Physiology, 17(1).
- Dart, R.C., Hurlbut, K.M., Boyer-Hassen, L.V. 2004. Lead. In: Dart RC, editor. Medical Toxicology. 3rd ed. Lippincot Williams and Wilkins.
- Needleman, H. 2004. Lead poisoning. Annu Rev Med. 55:209-22.
- Chisolm,J., Harrison H. 1956. The Exposure of Children to Lead. J Am Acad Pediatrics. 18:943-958.
- Mahaffey, K.R. (1990). Environmental lead toxicity: nutrition as a component of intervention. Environ Health Perspect, 89:75-78.
- Oncel, I., Keles, Y., Uslum, A.S. (2000). Interactive effects of temperature and heavy metal stress on the growth and some biochemical compounds in wheat seedlings. Environ Pollut. 107, 315-320.

Climate change impact on Agriculture leads to loss in India's GDP

Dr. Atul Tiwari
Department of Biotechnology
Dr. M.PS. Group of Institutions, Sikandra, Agra

Rising temperature affects flowering and leads to pests and disease buildup. Flood and excess rain over a short duration of time cause extensive damage to crops. Extreme weather events have caught attention of agrarian experts and scientists alike and they are now focusing on natural farming to arrest the impacts of climate change.

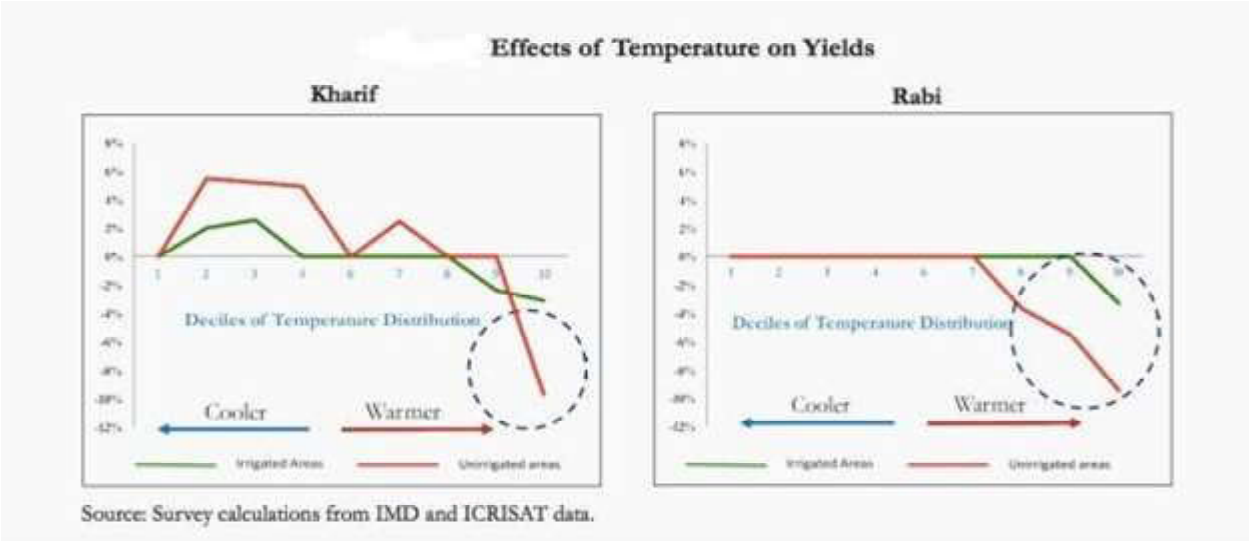
Impact of climate change on Agriculture:

While speaking at the Natural Farming Summit hosted by the Sri Sri Institute of Agricultural Sciences & Technology Trust (SSIAST) in Bangalore from May 9-10, B. Venkateshwarlu, former director at International Central Research Institute for Dry land Agriculture (CRIDA), Hyderabad, said, ''Climate change affects all the three aspects of food security: availability, access and absorption. When production decreases, availability of food decreases. Climate change hits poor the most. They don't have income to buy the food, so their access to it is affected. This, in turn, has an impact on health and affects absorption.''

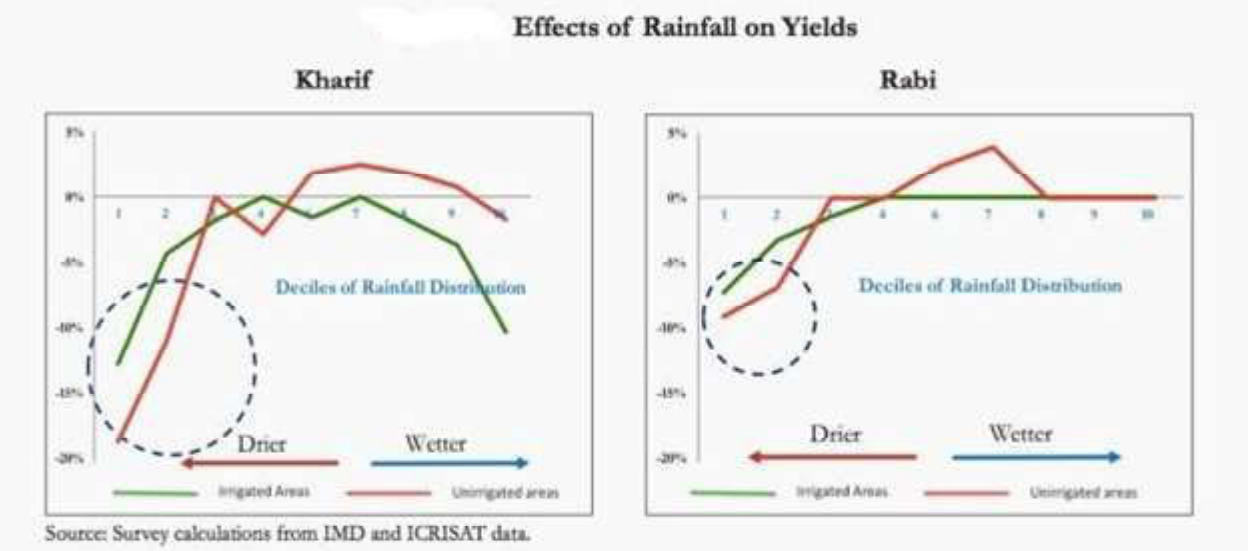
According to him, climate change has about 4-9 per cent impact on agriculture each year. As agriculture contributes 15 per cent to India's GDP, climate change presumably causes about 1.5 per cent loss in GDP.

How different crops react to climate change:

Highlighting the impact of climate change on crops, he explained how rice, wheat, maize and sorghum are the worst hit by this phenomenon. By 2030, rice and wheat are likely to see about 6-10 per cent decrease in yields. He also gave examples of crops like potatoes, soybean, chickpea and mustard, on which climate change will have a neutral or positive impact.



Source: Survey calculations from IMD and ICRISAT data.



The economic survey noted that such impact is more adverse in unirrigated lands compared with irrigated areas. ''Extreme shocks have highly divergent effects between unirrigated and irrigated areas (and consequently between crops that are dependent on rainfall), almost twice as high in the former compared with the latter,'' the survey said.

Economic survey 2018 given the fact that around 52% (73.2 million hectares area of a total 141.4 million hectares net sown area) of India's total land under agriculture is still unirrigated and rain-fed, the sector could be in trouble.

The change in agricultural productivity patterns as a result of climate change could reduce annual agricultural incomes by between 15% and 18% on average, and between 20% and 25% particularly for unirrigated areas, the survey says.

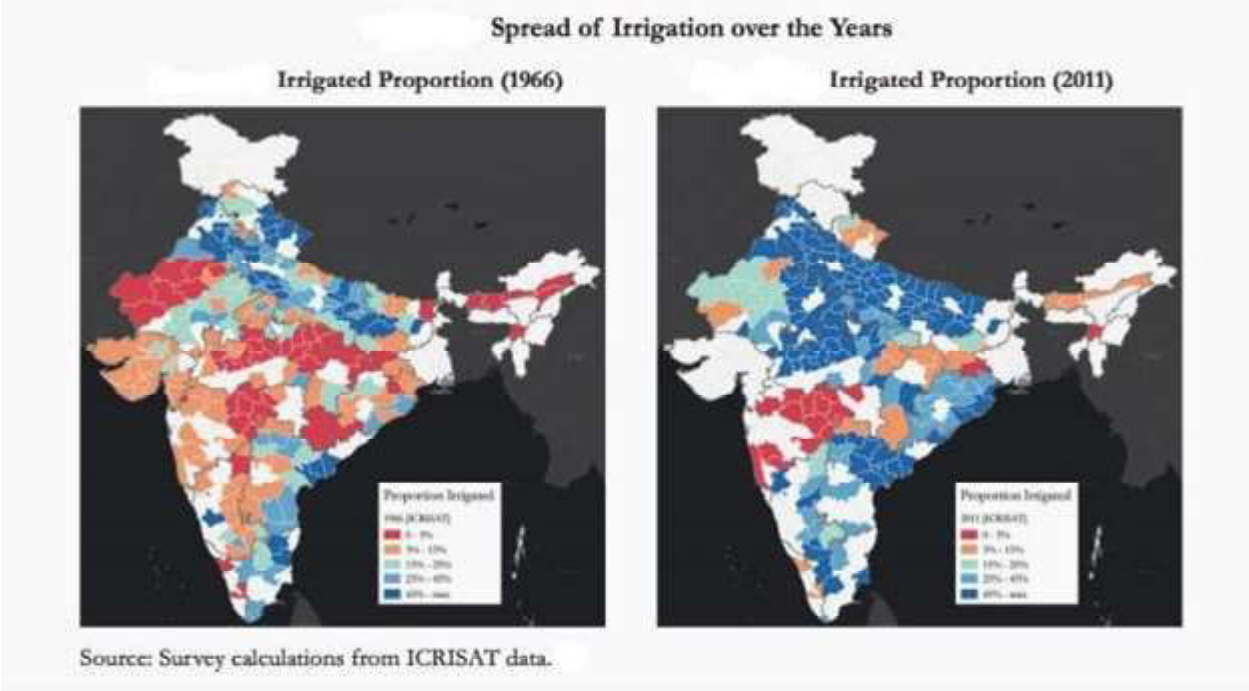
Climate change models, such as the ones developed by the Intergovernmental Panel on Climate Change (IPCC), predict that temperatures in India are likely to rise by between 3 degrees Celsius and 4 degrees Celsius by the end of the 21st century. "These predictions, combined with our regression estimates, imply that in the absence of any adaptation by farmers and any changes in policy (such as irrigation), farm incomes will be lower by around 12% on an average in the coming years, and unirrigated areas will be the most severely affected, with potential losses amounting to 18% of annual revenue,'' the survey said. (Table:1)

Table 1. Impact of Weather Shocks on Agricultural Yields
(percentage decline in response to temperature increase and rainfall decrease)

	Extreme Temperature Shocks	Extreme Rainfall Shocks
Average Kharif	4.0%	12.8%
Kharif, Irrigated	2.7%	6.2%
Kharif, Unirrigated	7.0%	14.7%
Average Rabi	4.7%	6.7%
Rabi, Irrigated	3.0%	4.1%
Rabi, Unirrigated	7.6%	8.6%

Source: Survey calculations.

The Indian government, therefore, intends to focus on improving irrigation in India. ‘‘Minimizing susceptibility to climate change requires drastically extending irrigation via efficient drip and sprinkler technologies (realizing ‘more crop for every drop’), and replacing un-targeted subsidies in power and fertilizer by direct income support,’’ the survey suggested.



Adapting to global warming:

Emphasizing the need to convince the government that we can produce enough food using natural farming, he called for using climate-tolerant crop varieties like the Swarna rice. This variety of rice, considered tolerant to water logging, used to be grown in India in the past. The important mitigation options, according to him, include:

- Efficient water and nutrient management options to enhance use efficiency
- Evaluation of carbon sequestration potential of different land use systems
- Understanding opportunities offered by conservation agriculture and agro-forestry

Identifying cost-effective methane emission reduction practices in ruminants and in rice paddy.

QUICK- FUEL

Vartika Srivastava, Dr. Anchal Sharma

A new technique for turning food waste into a source of energy uses a two step process that extracts all of the energy from the waste. Converting food waste into an energy source, it involves anaerobic digestion where bacteria slowly break down the organic matter and the resulting methane is captured and used as fuel. The technique developed at Cornell first utilizes hydrothermal liquefaction to essentially pressure cook the food scraps to make a bio-oil that can be refined into a bio-fuel. The food waste that remains after removing the oil is a watery liquid. This is fed to an anaerobic digester to convert the waste into methane over a few days. This two-step approach quickly produces a usable energy source that can be used to generate electricity or heat and doesn't let any go to waste.

Anaerobic digestion, takes weeks to turn the food waste into energy, “The aqueous product from hydrothermal processing is much better than anaerobic digestion than using the raw biomass directly. Combining hydrothermal processing and anaerobic digestion is more efficient and faster. Food waste makes up the largest share of what one-third of the world’s food is lost or wasted. While finding ways to prevent food waste is incredibly important, having a way to keep the food from being waste in the end is also very valuable, this processing instead producing clean energy could go a long way to reducing our carbon footprint and reliance on fossil fuels.

"A fresh approach in Agriculture in India: Micro-irrigation"

Dr. Atul Tiwari
Department of Biotechnology
Dr. M.PS. Group of Institutions, Sikandra, Agra

India's current irrigation coverage of 48.7% of total sown area means two-quarters of the population engaged in farming are dependent on monsoon rainfall.

Micro-irrigation projects under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), critical to making India drought-proof and producing "more crop per drop", have steadily met targets since the launch of the scheme by the National Democratic Alliance (NDA) government in 2015, according to a recent review.

An analysis of the mission by HT, however, shows only a handful of states account for the overall leap. PMKSY is aimed at boosting investment in irrigation and improving efficiency of water use.India's current irrigation coverage of 48.7% of total sown area means two-quarters of the population engaged in farming are dependent on monsoon rainfall, which often exacerbates agrarian distress even during a partial drought.

At the national level, coverage of micro-irrigation networks beat its target for 2015-16: 572,000 hectares against a target of 500,000 hectares. In 2016-17, the coverage was 839,000 hectares against a target of 800,000 hectares.

Partial data for 2017-18 shows the government "is on course to achieving or outdoing its target", agriculture secretary SK Pattanayak said. The target in 2017-18 was 1.2 million hectares and partial data from states showed that 926,432 hectares had been covered.

"The achievement (for 2017-18) is likely to enhance as compilation and reporting of works undertaken in the financial year are still being uploaded," the review report seen by HT states.

States haven't been able to make equal progress. All northeastern states have made zero progress. Unequal progress means meeting long-term goals can be challenging.

Just five states - Andhra Pradesh, Karnataka, Gujarat, Maharashtra, and Tamil Nadu - account for 78% of the coverage expansion during 2017-18.

Among the laggards, Bihar was able to add just 86 hectares while Himachal Pradesh added 1,107 hectares. Punjab added 274 hectares. Top performer Andhra expanded micro-irrigation coverage in 186,444 hectares while Karnataka added 164,967 hectares. Gujarat stood third, bringing 143,134 hectares under the irrigation network.

One reason for some states lagging behind is that they were not able to release their share of funds, an official said, requesting anonymity. For centrally sponsored schemes like PMKSY, the Centre contributes 60% of funds while states have to provide 40%.

"One major reason for unequal uptake of central schemes is that some states aren't able to allocate their 40% share in state budgets. In irrigation, this delays the drawing up of state and district-level plans, creating backlogs," said Ashok Lahiri, a former adviser to the erstwhile Planning Commission.

Out of a total 140.13 million hectares of sown area, India's net irrigated area is 68.38 million hectares while 71.74 million hectares are un-irrigated. To bridge this gap, the government launched the PMKSY in 2015-16 by combining ongoing schemes. Under the more crop per drop component of the PMKSY, small farmers get paid to the tune of 55% of cost of micro-irrigation systems; other farmers get 45% of the unit cost.

The agriculture mission: How the Modi government is shaping the future of farming and farmers

Under then agriculture minister Rajnath Singh, in 2004 for the first time in the history of independent as well as colonial India, a National Commission on Farmers (NCF) was set up by the Government of India for looking into the problems of farm families and suggesting methods for making farming more remunerative as well as attractive to the younger generation.

This commission's report in 2006 not only contained suggestions for the advancement of agriculture but also for the economic wellbeing of farming families. An important goal set for farmers' welfare by NCF is to improve the economic viability of farming by ensuring that farmers earn a "minimum net income" and that agricultural progress is measured by the advance made in improving that income.

Other significant goals include mainstreaming the human and gender dimension in all farm policies and programmes and giving explicit attention to sustainable rural livelihoods; completing the unfinished agenda in land reforms and initiating comprehensive asset and aquarian reforms; and developing a social security system and support services for farmers.

Furthermore, protecting and improving the land, water, biodiversity and climate resources essential for sustained advances in the productivity, profitability and stability of major farming systems by creating an economic stake in conservation. Strengthening the biosecurity of crops, farm animals, fish and forest trees would safeguard the work and income security of farmer families, and the health and trade security of the nation. Likewise fostering community-centred food, water and energy security systems in rural India would help ensure nutrition security at the level of every child, woman and man.

In terms of the goal of attracting youth to farming, NCF suggests making it both intellectually stimulating and economically rewarding, by conferring the power and economy of scale to small and marginal farmers both in the production and post-harvest phases of farming. Emphasis is also put on restructuring agricultural curriculums and pedagogic methodologies for enabling every farm and home science graduate to become an entrepreneur and to make agricultural education gender sensitive.

Finally there is the goal of making India a global outsourcing hub for the production and supply of inputs needed for sustainable agriculture, and products and processes developed through biotechnology and ICT.

But although the NCF report was submitted in 2006 very little action was taken until the present government headed by Prime Minister Narendra Modi took office. Fortunately over the last four years, several significant decisions have been taken to improve the status and income of farmers.

Designation of the agriculture ministry as the agriculture and farmers' welfare ministry has stressed keeping farmers' welfare as the measure of agriculture progress. Issuance of soil health cards to

all farmers has been critical because soil health is basic to plant health and plant health is basic to human health.

Both budgetary and non-budgetary resources have been allocated for promoting micro-irrigation through the Pradhan Mantri Krishi Sinchayee Yojana. Conservation and sustainable use of indigenous breeds of cattle is being encouraged through a Rashtriya Gokul Mission. The Prime Minister also inaugurated the first ever International Agrobiodiversity Congress.

Promotion of the electronic national agriculture market is helping bring together different agriculture markets. Likewise the creation of Gramin Agriculture Markets will provide scope for direct sales to consumers in both retail and bulk form. Notable in this context is also the introduction of the Agricultural Produce and Livestock Marketing Act, 2017 and Agricultural Produce and Livestock Contract Farming Services Act, 2018 supported by electronic Negotiable Warehouse Receipt system for increased institutional credit to the farm sector.

Also notable is the determination of MSP on the basis of NCF recommendations and assured procurement at MSP of more crops. Integration of protein rich pulses and nutri-rich millets into welfare programmes including PDS, mid-day meals and ICDS is important too.

Activities like apiculture, mushroom cultivation, bamboo production, agro-forestry, vermicomposting and agro-processing are being promoted to generate additional jobs and income for farm families. The prime minister has also suggested that we should develop methods by which farmers' income can be doubled within five years. Plus several corpus funds are being set up to complete ongoing irrigation productions, modernise the infrastructure in dairy cooperatives, and strengthen the adoption of inland and marine aquaculture.

Above all, the recent announcement of a remunerative price based essentially on the recommendation of NCF is a very important step to ensure the economic viability of farming. To underline, government has ensured in its notification that from kharif 2018 onwards MSP of the notified crops would be minimum of 150% of the cost of production; it ranges from 150-200% for coarse cereals.

As for farmers' agitations still continuing, a major demand is the waving of loans and the implementation of the NCF recommendations on MSP. Both these problems are now receiving attention and appropriate action.

These are only some of the steps being taken to realise the concept of Jai Kisan. If all the above schemes are implemented effectively by the state and central governments, the future of farming and farmers can be shaped to also help India become a leader in both food and nutrition security. In addition the Prime Minister has launched a National Nutrition Mission with a three year budget of Rs 9,000 crore. His emphasis on agriculture as the prime industry of rural India urges doing everything possible to make agriculture both a source of income and the pride of our nation.

The agriculture mission doubling farming income: How the Modi government is shaping the future of farming and farmers

August 6, 2018, 2:00 am IST MS Swaminathan in TOI Edit Page | Edit Page, India | TOI

Under then agriculture minister Rajnath Singh, in 2004 for the first time in the history of independent as well as colonial India, a National Commission on Farmers (NCF) was set up by the Government of India for looking into the problems of farm families and suggesting methods for making farming more remunerative as well as attractive to the younger generation.

This commission's report in 2006 not only contained suggestions for the advancement of agriculture but also for the economic wellbeing of farming families. An important goal set for farmers' welfare by NCF is to improve the economic viability of farming by ensuring that farmers earn a "minimum net income" and that agricultural progress is measured by the advance made in improving that income.

Other significant goals include mainstreaming the human and gender dimension in all farm policies and programmes and giving explicit attention to sustainable rural livelihoods; completing the unfinished agenda in land reforms and initiating comprehensive asset and aquarian reforms; and developing a social security system and support services for farmers.

Furthermore, protecting and improving the land, water, biodiversity and climate resources essential for sustained advances in the productivity, profitability and stability of major farming systems by creating an economic stake in conservation. Strengthening the biosecurity of crops, farm animals, fish and forest trees would safeguard the work and income security of farmer families, and the health and trade security of the nation. Likewise fostering community-centred food, water and energy security systems in rural India would help ensure nutrition security at the level of every child, woman and man.

In terms of the goal of attracting youth to farming, NCF suggests making it both intellectually stimulating and economically rewarding, by conferring the power and economy of scale to small and marginal farmers both in the production and post-harvest phases of farming. Emphasis is also put on restructuring agricultural curriculums and pedagogic methodologies for enabling every farm and home science graduate to become an entrepreneur and to make agricultural education gender sensitive.

Finally there is the goal of making India a global outsourcing hub for the production and supply of inputs needed for sustainable agriculture, and products and processes developed through biotechnology and ICT.

But although the NCF report was submitted in 2006 very little action was taken until the present government headed by Prime Minister Narendra Modi took office. Fortunately over the last four years, several significant decisions have been taken to improve the status and income of farmers.

Designation of the agriculture ministry as the agriculture and farmers' welfare ministry has stressed keeping farmers' welfare as the measure of agriculture progress. Issuance of soil health cards to all farmers has been critical because soil health is basic to plant health and plant health is basic to human health.

Both budgetary and non-budgetary resources have been allocated for promoting micro-irrigation through the Pradhan Mantri Krishi Sinchayee Yojana. Conservation and sustainable use of indigenous breeds of cattle is being encouraged through a Rashtriya Gokul Mission. The Prime Minister also inaugurated the first ever International Agrobiodiversity Congress.

Promotion of the electronic national agriculture market is helping bring together different agriculture markets. Likewise the creation of Gramin Agriculture Markets will provide scope for direct sales to consumers in both retail and bulk form. Notable in this context is also the introduction of the Agricultural Produce and Livestock Marketing Act, 2017 and Agricultural Produce and Livestock Contract Farming Services Act, 2018 supported by electronic Negotiable Warehouse Receipt system for increased institutional credit to the farm sector.

Also notable is the determination of MSP on the basis of NCF recommendations and assured procurement at MSP of more crops. Integration of protein rich pulses and nutri-rich millets into welfare programmes including PDS, mid-day meals and ICDS is important too.

Activities like apiculture, mushroom cultivation, bamboo production, agro-forestry, vermicomposting and agro-processing are being promoted to generate additional jobs and income for farm families. The prime minister has also suggested that we should develop methods by which farmers' income can be doubled within five years. Plus several corpus funds are being set up to complete ongoing irrigation productions, modernise the infrastructure in dairy cooperatives, and strengthen the adoption of inland and marine aquaculture.

Above all, the recent announcement of a remunerative price based essentially on the recommendation of NCF is a very important step to ensure the economic viability of farming. To underline, government has ensured in its notification that from kharif 2018 onwards MSP of the notified crops would be minimum of 150% of the cost of production; it ranges from 150-200% for coarse cereals.

As for farmers' agitations still continuing, a major demand is the waving of loans and the implementation of the NCF recommendations on MSP. Both these problems are now receiving attention and appropriate action.

These are only some of the steps being taken to realise the concept of Jai Kisan. If all the above schemes are implemented effectively by the state and central governments, the future of farming and farmers can be shaped to also help India become a leader in both food and nutrition security. In addition the Prime Minister has launched a National Nutrition Mission with a three year budget of Rs 9,000 crore. His emphasis on agriculture as the prime industry of rural India urges doing everything possible to make agriculture both a source of income and the pride of our nation.

Recharge your Knowledge

Don't wait any longer

SUBSCRIPTION FORM

My Details !

Name of Individual/Institution .....

Address(correspondence).....

.....**Pin**.....

Mobile..... **enclosing Cheque/DD of ₹** .....

..... **Drawn on** ..... **in favour of Biotech Rainbow for the subscription of plan**.....

SUBSCRIBE ONLINE FROM www.isgbrd.co.in

Term	Online		Print	
MEMBERSHIP	INDIVIDUAL	INSTITUTION	INDIVIDUAL	INSTITUTION
1 YEAR	₹ 1,000	₹ 2,000	₹ 2,100	₹ 4,000
2 YEAR	₹ 1,800	₹ 3,500	₹ 3,100	₹ 7,500
3 YEAR	₹ 2,500	₹ 5,000	₹ 4,100	₹ 11,000
LIFE MEMBERSHIP	₹ 7,500	Not Applicable	₹ 15,000	₹ 30,000

Note : * For senior citizen life membership ₹ 5,100 for upto age of 60 or 75 years (for Emeritus Professors & Scientists).

Terms and Conditions:

1. Print Subscription is valid in India only. Outside India Subscriber should subscribe Digital Subscription.
2. Please fill the form in CAPITAL letters.
3. The mode of payment should be cheque/DD favouring "Biotech Rainbow". Please write your name and contact details on the reverse of cheque/DD.
4. Favour of Indian Society of Genetics, Biotechnology Research and Development at Agra, A/C No. 3023101003907; IFSC : CNRB0003679; Branch : Canara Bank, Shastripuram, Agra-282007.
5. Your subscription will commence from the next available Issue. Please allow four weeks to process the order.
6. For Multiple Subscriptions use seprate forms (Photocopies allowed).
7. Biotech Rainbow will not entertain cancellation of subscription after commencement of the same. No request for refundwill be entertained.
8. In case of changing address, kindly send us in writing one month in advance.
9. Subscription cost includes first class courier charges wherever applicable.

Contact Address

PRAKRITI PRERAK
5-E Nikhil Estate,
Delhi Public Road,
Shashtripuram,
Agra-282007.

email:biotechrainbow@gmail.com

email:isgbrd@gmail.com