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## Van Sangyan

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We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

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The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

**Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve**

**Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)**

**From the Editor's desk**

*Mango, the most important fruit of India, is grown in an area of 1.23 million ha with an annual production of 10.99 million tonnes, which accounts for 57.18 per cent of the total world production. This paper presents information on area and production, cultivars, hybrids and clone, agratechniques, disorders, insect pests and diseases, harvest and postharvest management, export problems and prospects of growing mango in India.*

*Mango (*Mangifera indica* L.) which is considered to have been originated from Indo-Burma region, is the most popular fruit in India and graded to be the choicest of all indigenous fruits. However, it suffers from a number of diseases at all stages of its development i.e. right from nursery stage to grown-up plants and even fruits at pre- and post-harvest stages are affected making them unsuitable for marketing and export. Among the major diseases, powdery mildew, die-back, anthracnose, bacterial canker, sooty mould, Phorria blight, red rust and mango malformation cause considerable damage to the mango crop. Although control measures of these diseases have been worked out but due to mismanagement and negligence by the orchardists, sometimes the diseases may reach upto their epidemic form.*

*In line with the above this issue of Van Sangyan contains an article on important insect-pests and diseases of mango and their management. There also useful articles viz. Forest trees: the victim of abiotic stress, Forestland for food security and nutrition, Ornamental horticulture and its prospects in India, जैविक खाद वानिकी प्रजातियों के लिये उपयोगी एवं ओजोन परत and Environmental impacts of urban green space.*

*I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.*

*Looking forward to meet you all through forthcoming issues*

**Dr. Pawan Rana**  
Scientist 'E' & Chief Editor

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## Important insect-pests and diseases of mango and their management

Nishar Akhtar<sup>1</sup> and Abdul Majid Ansari<sup>2,\*</sup>

<sup>1</sup>Department of Plant Pathology  
Birsa Agricultural University  
Ranchi-834006, Jharkhand, India

<sup>2</sup>Zonal Research Station (Birsa Agricultural University)  
Chianki, Palamau-822102, Jharkhand, India

\*Corresponding author e-mail: majid.gbp@gmail.com

### Pest

Pest is an any organism whose population increases to such an extent as to cause economic loss to crops or a nuisance and health hazards to man and his livestock. The word pest is derived from French 'Peste' and latin terms 'pestis' means plague or contagious disease .

Pests are organisms which impose burdens on human population by causing

- (i) Injury to crop plants, forests and ornamentals
- (ii) Annoyance, injury and death to humans and domesticated animals
- (iii) Destruction or value depreciation of stored products.

The pest can be anything, not only insect it can be a nematode, it can be mites, snails, slugs etc. and even mammals like rats and birds, but in this article we are mainly concentrating on the insects as a major pest. Now what is the extent of the loss that an insect can cause? So along with the other groups of organisms of the animals, the insects are believed to be contributing nearly 26% of the loss to the cropping ecosystem. So of course the weeds will take a major toll (33%) but the insects and the diseases (26%) are one of the major things and losses caused by rodents and others is around 15 %. It has been estimated that annually there will be around INR 60,000 crores lost due to damage by insects on various agricultural crops. So Pests include

insects, nematodes, mites, snails, slugs, etc. and vertebrates like rats, birds, etc.

### Concept of IPM

To understand what exactly the integrated pest management means and before going to the application part of integrated pest management it is very much essential to know the various concepts of integrated pest management that was given by Metcalf. It includes:

1. **Understanding the Agricultural Ecosystem:** The first and foremost important concept is to understand the agricultural ecosystem means, it contains various entities like forest agriculture ponds etc. Whereas agricultural ecosystem it is less diversified than forest ecosystem since it is susceptible to various unusual catastrophic events of pest instance this agricultural ecosystem it is continuously manipulated by human being because of various agronomic practices that are being followed for raising the crops so hence this agro ecosystem it is highly susceptible to the attack of various pest and diseases.
2. **Planning the Agro ecosystem:** The next important concept is it to planning the agro ecosystem before implementing the integrated pest management system in crop production we have to understand or we have to plan the agro ecosystem planning lies in the selection of varieties or hybrids so to give one example if we select some susceptible varieties which are actually

harboring higher intensity of pest in certain localities one should not select such variety because it intensifies the activity of pest control methods for example in cotton wherein sucking pest like leafhopper it is one of the important pest in cotton so it attacks heavily on the glabrous type of varieties than we have to select the pubescent type they are hairy thereby the attack of cotton sucking pest is less.

3. **Cost/ benefit and Benefit/ Risk:** Farmers are more concerned about Cost/benefit. It depends on the decisions that vary with the crop produce, method of production and geographical location of production unit. Cost/benefit should be  $>1$ . And another is Benefit/Risk which provides a means for assessing the relevant economic benefits versus the risk in pesticide control.
4. **Tolerance of Pest Damage:** It deals in detail about various parameters which are involved in decision making of pest management. It is the economic threshold level and economic injury level which are very much important and one should always manage the pest below the economic injury level thereby we are going to get higher amount of benefit out of the particular strategy so for example in ground nut leaf folder or defoliators are the important pest of groundnut but after seventy to eighty days if we record more than 50% of leaf damage, there will not be any much reduction in the yield and another example in case of sunflower the top six leaves they are very important in the production so even there is a lot of defoliation of lower leaves there not be much reduction in the yield thought.
5. **Leaving a pest residue:** So everybody should know the economic threshold level of different pest and what exactly the pest damage is wowing to interfere in the yield

thereby we are going to increase the pest and its natural enemies for multiplication and also one can protect the environment from being polluted with pesticides so the continuation of the earlier concept so at least we should leave some part of pest residue so that one can increase the multiplication of its natural enemies like parasitoids and predators thereby they are going to reduce the pest population below economic threshold so that's why always the concept of pest management is to suppress the pest but not eradication of the pest then another important concept that is timing of the treatments so most of its times this timing of the treatments

6. **Timing of the treatments:** Another important concept is timing of the treatments so most of its times, timing of the treatments refers to the pesticides because most of our farmers depend on pesticide use and we all know that unnecessary application of these pesticides are going to cause much hazards on the environment so we have to identify the crucial period of pest occurrence and its ultimate effect on the yield there by timing of insecticide it is more important thereby we can save a lot of pesticide application on the environment so single family application it is going save a lot of further application of pesticides so that's why only single spray if it is properly timed can prevent most of the damage due to insects and also one can avoid the excessive spraying also so for planting one can use various devices which are available like pheromone traps for recording the activity of adults thereby one can time the application of these pesticides.
7. **Public understanding and acceptance:** The technology that it is not acceptable or if it is not understandable by the end users then this is of no use or implementation

that's why education is much needed regarding the concept and understanding of the concepts and implementation of IPM programs. Since India is one country where in we have lot of the uneducated farmers that don't know what is best and when it has to be taken measures therefore the concept of the pest management has to be ascertain to the end users through involvement of many stakeholders or NGOs. So it is very much essential to understand the concepts of integrated pest management before putting this integrated pest management into the production system.

#### **IPM of Mango (*Mangifera indica*)**

It is also known as “King of fruits” for its strong aroma, delicious taste and high nutritive values. India ranks first in mango production. The area under mango cultivation is around 2567 Million ha with annual production of 19273 million tonnes. The important varieties that re being grown are Alfanso, Neelam, Dashari, Totapuri, Sindhu, Mallika, Baganpalli, Ratna etc. Mango is attacked by many pests at various stages of its development. So broadly these pests can be categorized based on their importance either at the national level or at the regional level.

So at the national level so if we look into it. Mangooppers take the first stage, where they cause mainly serious damage on the inflorescence. Then the mango mealy bug, fruit fly, stem borer, stone weevil and to certain extent the leaf webbers and the inflorescence midges and also the red ants.

At the regional importance, or at the certain areas in the mango growing states of the country, we do get occasionally the scales, the shoot webbers, termites and thrips.

Mango leafoppers of which there are mainly 3 species (*Ideoscopus clypealis*, *I. indicus* and *Armitodus atkinsoni*). So they

all occur together sometimes and in some cases some species are dominant. Among which the *Armitodus atkinsoni* is a bigger among the three species whereas *Ideoscopus clypealis* is the smallest one. And usually they are quite specific to mango and mainly attack at the flowering stage. During the off season these species are found resting at the bark, or on the branches, or on the leaves. And once the plants or the trees starts flowering especially during November to February, then the population will shift to inflorescence and then start causing damage. Both the nymphs and the adults are the damaging stage. And where they congregate along this inflorescence and then start sucking the sap from the inflorescence. As a result of which, so there will be a very poor fruit setting is noticed. And if the infestation is continued, then even the developing fruits are also attacked, and which results in the dropping of the fruits. Basically they actually cause two types of damage. One is a direct damage, so where they suck the sap directly from the inflorescence and the fruits. And another indirect damage is either through ovipositional punctures, or also by producing the honeydews. So by producing the honeydews, what happens a particular species of fungi will develop and which develops into a sooty mould on the leaves and also leads to the reduction in the photosynthesis processes? So in overall so if we don't control this pest, so there will be a severe loss in the field.

The mango mealy bug (*Drosicha mangiferae*) is another important pest. And both the nymphs and the adults are the damaging stage. And it is found throughout the cropping period or throughout the year and it is quite persistent, and the females usually lay the



eggs in the soil around the tree trunk. And after hatching the first instar nymphs which are normally referred as crawlers start climbing the trees and then they will distribute among to the various parts of the plant such as leaves, inflorescence, fruits etc. And then they start sucking the sap from there. On the leaves if they cause the damage leading to the yellowing of the

leaves. But most important is mainly on the fruits. So we can see the stalks which have been infested by the mango mealy bug. And which leads to the drying up of the fruits and as well as the dropping of fruits. This also causes the sooty mould development and which affects the photosynthetic activity.



**Mango Leaf Hopper**



**Mango Mealy Bug**

The mango fruit fly which are mainly 3 species (*Bactrocera dorsalis*, *B. correctus* & *B. Zonatus*) among which the *Bactrocera dorsalis* is quite prominent. And it is polyphagous and attacks all types of fruit crops. But on mango this pest is mainly considered as the pest of quarantine importance, as the many of the consignments, export consignments of the mango will get rejected due to the infestation by this pest. In fact the adult fly will insert the egg into the mango fruits at the developing stage. And the maggots which are white in colour they enter and then feed on the mango pulp. So as a result

for the internal marketing and the consumption, so it will not be a problem. But once such fruits go for the export purpose, then when these maggots are detected, then the whole consignment is going to be so rejected. So once they complete the maggot period, then they come out of the fruit by making a small exit holes, and they will drop to the ground and then they will pupate in the soil. So this exit hole will actually lead to a secondary infection, with some fungal development, and the rotting will takes place and the fruits will drop down.



Then another important pest of the quarantine is the mango stone weevil this is *Sternochetus mangiferae*. And this is quite specific to the mango, it does not attack any other fruit and it is quite common in the southern India. So during off season, so the adults of these, they are normally found in the bark and the branches of the tree. And once the fruiting will start developing, and then they will shift to the fruits. And they lay the eggs, in fact insert the eggs into the fruit, so at the normal stage, at the younger stage. And the grubs will enter through the pulp and enter into the stone, and then they start feeding on the cotyledons. So but externally again we don't see any kind of a symptom. For internal consumption or marketing it will not be a problem. But once it completes its grub stage and the adults comes out of the fruit. Then say the

whole fruit will get affected. And it will rot and the dropping of the fruit will takes place. So this also is a pest of quarantine. Like many a times if the majority of the consignment if it is infested by the stone weevil will be rejected. And certain varieties are there which are quite susceptible to this pest, which are sometimes late bearing varieties like 'neelam'.

The red ant, *Oecophylla smaragdina* is also a pest not because it causes any kind of a direct damage, but by the presence of this pest in the orchard will cause a nuisance. Because its habit of constructing the nest by webbing the leaves. And huge nested constructs and is quite ferocious. And it usually comes in the way of harvesting process. As a result this is also considered as a pest.



The mango stems borer (*Batocera rufomaculata*) which is an occasional pest, and mainly a pest which is seen in the old orchards or the neglected orchards. And this is a polyphagous, apart from mango it also attacks the other fruit trees. The adults are quite bigger in size. So they lay the eggs on the tree trunk and the grubs soon after hatching, so they enter into the stem or the branches and then start feeding on the internal content. And externally we see the cracking of the bark, and also the oozing of the gummosis what we call, and the accumulation of the pulp or the frost at the base of the plant which indicates the presence of the grub in the trunk or in the branch. And initially the younger plants which are less than 3 years old will normally severely affected. Sometimes the whole plant will die, or even the affected branch is going to be damaged or dried. Shoot Gall Psyllid (*Apsylla cistellata*) is another important pest of mango which is recently spreading and gaining economic importance. Psyllids are sap sucking insects which are 1-10 mm in size and brownish black in color that are not easily noticed due to camouflage. The nymph of the insect suck saps from the developing buds. As a result these buds develop into hard conical green galls and the nymphs pass winter inside these galls. Due to the gall formation there is no flower and fruit formation.

Some species of thrips are also quite serious specially *Scirtothrips dorsalis* and others. Here both nymphs and the adults are the damaging stage. And they attack all parts of the plant. In fact the leaves, when it attacks on the leaves we get a white silvery appearances. And for younger leaves we get the bronzing of leaves and the dropping of leaves. The inflorescence it attacks leads to the poor fruit set. And most important is on the fruits, because they scrape the skin of the fruit. Then such affected part will develop the corky appearance and it reduces the market value.

Then there is inflorescence midge (*Erosomyia indica* and *Dasineura amaramanjarae*). These two normally attacks the inflorescence. This has a mosquito like adult, which inserts the egg into the developing embryo of the flower. And as a result of which so the entire inflorescence will be affected leading to no fruits.

Mango leaf gall midge (*Erosomyia magniferae*) is another important pest of the mango. The eggs are laid on the underside of the leaves that after hatching maggots are produced. These maggots feed on the leaf tissue by boring into it. Due to feeding of maggot within the leaf tissue it causes the formation of small raised wart like galls on leaves. This resulted in the poor deformed and premature drop of the leaves.

**Mango Psyllid****Mango leaf gall midge**

Scale (*Chloropulvinaria polygonata*, *Aspidiotus destructor*) is another pest which usually attacks the leaves and as well as the fruits, but the severity is normally seen more on the fruits, where we can see these scales attached to the surface of the fruit, and suck the juice from the fruit as a result we get the withering of the fruit and also the fruit drop.

So, there is challenge to manage these insects through an integrated approach. The most important thing that we should look is that the sanitation. So the orchard should be kept as clean as possible, by removing lot of debris which are present, because which attracts lot of pests to it and another way through mechanical way by collecting some of the larvae like leaf webber larvae or fruit and then through eliminating those pests. In early stage during the vegetative stage mostly it involves the mechanical and the cultural methods. Whereas at the after three years of planting, which actually gets into the fruit bearing stage. Then we need to look

at a combination of all the types of mechanisms. Most important one is the banding of trees with alkathene sheets is quite essential in order to control the mango mealy bug. As these pests actually are the crawlers, which actually climb the tree trunk and then cause the damage. In order to prevent them to climbing the trees so these sheets are usually provided.

And further the collection and destruction of the infested and the fallen fruit at the weekly interval is quite effective against the fruit flies. For the physical operations, during the fruit formation stage, installation of the methyl eugenol trap @ 10-12 per acre will help in the mass trapping of the fruit flies and reducing their population. Some biological methods are also there such as for mango leaf hopper we can go for the application of the *Verticillium lecanii*, a fungal pathogen and for the mango mealy bug, the *Menochilus sexmaculatus* lady bird beetle is quite effective, so and also the fungal pathogen *Beauveria bassiana* is found to be quite

effective. In all these cases the conservation of the natural enemies is quite important through the judicious use of the pesticides. There are several chemicals have been indicated here which can be used against these particular pest depending upon the nature of feeding whether they are like the defoliators or they are the sucking pest. So we can choose between the contact and the systemic insecticide and then control the thing. The stone weevil, because of its quarantine importance, care should be taken in the regions where this pest is found to be a regular one and in a severe form. Most important is a cultural and to certain extent biological by conserving the natural enemies is important.

But the important one is the chemical. So especially we have to go for spraying an insecticide, when the fruits are at the marble size, because this is a stage where the adults will start laying the eggs and twice the application of such chemical at 15 days interval will effectively prevent the entry of or egg laying of these pests. Then during the off season these adults are mainly concentrated on the branches and the main trunk, hence spraying on these areas is going to eliminate the initial population. And there is also a heat treatment for the fruits or the vapour heat treatment for the fruits which kill the insects internally which is normally done at the quarantine places. And also the irradiation of the fruits will actually eliminate the stone weevil especially when the fruits are at the exporting stage.

For fruit fly, a series of the management practices we need to look, both cultural, mechanical and as well as chemical. So most important thing here is that, we have to go for the methyl eugenol trap, which should be regularly put and then collect the

adults and destroy them. And another important thing here is that breaking up of the soil in the undersurface of the trees, in order to expose the pupae in the soil and then spraying some chemicals like chlorpyrifos on the soil to destroy this pupal stage and reduce the population. The hot water treatment is recommended in order to kill the maggots, which are present inside the fruit and we can also go for the spraying up with the chemical along with the jaggery solution, which will attract the adults and kill them. Then irradiation of the fruit is another important management practice employed at the quarantine stage. So looking at the importance of these pests and their regional occurrence, one has to go for all the methods and manage these pests effectively.

#### **Mango diseases and their management**

Mango is mostly suffered by Anthracnose, Bacterial canker, Powdery mildew and Malformation. These are the most highly rated diseases of mango that cause severe loss to the crop every year.

Let us take Anthracnose at the beginning. It is a fungal disease caused by the pathogen *Colletotrichum gloesporioides*. The symptoms of the disease mostly manifested on the leaves and on the young twigs of mango plants followed by the symptoms under fruits. It is most evident when the young twigs mostly lost their leaves and they look burnt and this is the sign of Anthracnose infestation. The disease when it comes in the later stage it affects the fruits and it reduces the quality of the fruit and marketable quality is deteriorated because of this infestation.

The pathogen survives in soil and infected debris in the orchard. So management of the pathogen should be in the soil and infected plants. There are IPM practices

that are recommended for management of this particular disease and the practices include cultural and chemical. Disease leaves, flowers and twigs along with fruits that are lying on the orchard should be collected and they should be destroyed and pruned and burnt. This is a very very healthy practice because this reduces the inoculum level of the pathogen for occurring disease in the next season. Chemical sprays include carbendazim at 0.1% twice at 15 days interval during flowering and that controls the blossom infection. So this is very severe because once the blossom is infected we cannot expect fruit from the same tree that is why spraying at the blossom season is very very essential and carbendazim can take care of this particular pathogen. Then spray with copper fungicides at a rate of 0.3 percent for control of foliar infection proved effective. So since the pathogens survives in the fallen leaves or leaves on the plant itself that is why it is very essential that leaf should be sprayed with fungicides like copper fungicides. Post-harvest management of anthracnose includes dipping of fruits in carbendazim solution and in hot water at 52°C for 15 minutes. This saves the fruits from getting infected at post-harvest days. So these are the practices that are recommended for management of anthracnose in mango and that are how we can save a huge loss by taking adequate control measures.

Next is **Bacterial Canker** and it is caused by *Xanthomonas campestris pv. mangaiiferae indica*. This is another pathogen which is again very difficult to manage but we have developed techniques that are recommended for management of this particular bacterial pathogen. The symptoms of the disease appear on leaves mostly where one can see that brown spots

surrounded by yellow halo are a common symptom. The spots are usually limited by the veins in the margins. The bacterial pathogen can also infect the fruits and we can see some exudations coming out from these infected regions. These symptoms once it is evident it can be sure that it is infected by the bacterial canker pathogen *Xanthomonas campestris pv. mangaiiferae indica*. The pathogen is an epiphytic and it survives on mango buds and immature fruits. So taking care of the intact plant is essential for management of this particular pathogen.

The IPM practices recommend cultural and chemical measures that can lead to successful management of this particular pathogen. Cultural practices include regular inspection of the orchards, then adopting sanitation measures and seedling certification. These are preventive measures and once we adopt these measures we normally don't allow the pathogens to be established in a new orchard. Chemical control includes spraying at least three sprays of streptomycin or Agrimycin after first visual symptom at ten days interval. Although these chemicals are not very effective but at least they can reduce the severity of the disease to a great extent. Monthly sprays of carbendazim or copper oxychloride are also proved effective in controlling the disease. So along with the antibiotics carbendazim and copper fungicides can also be helpful in management of this particular pathogen. Spraying of copper-based fungicide has been found effective in controlling bacterial pathogen in large orchards. So these are the major recommendations that are suggested for adoption for management of bacterial canker in mango and by adopting these techniques we can

successfully manage bacterial canker to a great extent.

Next one is Powdery Mildew that is caused by a *Oidium mangiferae*. So it is very easy to detect because whitish powdery like growth on the leaf surface of the plants it is very evident and it can be easily detected by looking into the powdery mass that is present on the leaf surface. The whole plant gets affected as we can see that the young buds are also getting affected along with the fruits. So the entire foliage including the blossom gets affected by this particular pathogen. The pathogen is mostly air borne and it arrive the orchard from already established disease in some other mango plants.

IPM practices are adopted and cultural and chemicals methods are recommended for management of this particular disease. Cultural methods includes pruning of diseased leaves. Since powdery mildew is a foliage pathogen so once the disease appears on few leaves those leaves should be pruned out immediately, followed by malformed panicles which are the primary source of inoculum. So pruning of the

leaves infected leaves along with malformed panicles are the most recommended practices for management under cultural practices there are chemicals that are recommended for management of this particular disease and alternate spraying of wettable sulfur at the rate of 0.2% then Tridemorph at a rate of 0.1 percent and Carbendazim at a rate of 0.1 percent at 15 days interval are very very effective. So spraying of these chemicals can take care of the pathogen on the infected plants. The first place is to be given at the panicles emergence stage. So this is timing is very important to reduce the loss caused by this particular pathogen. Three sprays of systemic fungicides during flowering season at 12 to 15 days interval is also recommended. Since it is airborne it can reoccur even in the later stage of the flowering season and that is why it is essential to have a second spray after at 12 to 15 days interval during the flowering season. The first place recommended where there is 25% of flowers are open so this is the right stage of application where 25% of the flowers have opened up.



Mango sooty mould disease is of common occurrence and affects fruits, leaves and twigs of the plant. It is caused due to fungal growth of *Meliosa*

*mangiferae* Earle. *Capnodium ramosum* Cke. *C. mangiferae* Cke. & Brown and *Trichospermum acerinum* (Syd). Speng. The fungi produce

mycelium, which is usually superficial and dark. They grow on the flowers, both tender and old leaves, stems and fruits. They grow and thrive on the sugary secretions or honey dew secretions of the plant hoppers. Black charcoals like encrustations are formed on the surfaces of different parts of the plant. The photosynthetic ability of the plant is highly reduced because of the superficial growth of the fungi. If the attack is during flowering time it results in reduced fruit set and cause fruit fall. Black coating is also found on the fruits. Appearance of the affected fruits is lost and the price for such ugly fruits is usually low.

For this both the insects i.e. plant hoppers and sooty moulds are to be simultaneously controlled by the eradication process. The insects can be managed by spraying with carbaryl or phosphomidon 0.03%. It is followed by spraying with a dilute solution of starch or maida 5%. On drying, the starch comes off in flakes and the process removes the black mouldy growth fungi from different plant parts. Spraying insecticide followed by spraying with

fungicide viz., Bordeaux mixture 1% is also recommended. Spraying of wettable sulphur methyl parathion + gum acacia (0.2+0.1+3%) at 15days interval reduces the sooty mould incidence.

#### **Red Rust (*Cephaleuros virescens*)**

The disease causes infection on leaves thus leads to the reduction in photosynthetic activity and defoliation of leaves and thereby reducing the vitality of the host plant. The disease is marked by the presence of the rusty red spots mainly on leaves and sometimes on petioles and bark of young twigs. . These spots are greenish grey in colour and velvety in texture which later turn into reddish brown. The circular and slightly elevated spots sometimes coalesce to form larger and irregular spots. The fungus also causes infection on stem and the affected portion of stem cracks. In case of severe infection, the bark becomes thick, twigs get enlarged but remain stunted and the foliage finally dries up. Two to three sprays of Copper Oxychloride (0.3%) should be used for controlling the disease.



**Sooty Mold of Mango**

**Rust of Mango**



The next disease is Mango Malformation. Although it is a disease which is caused by multiple factors but there is a fungal agent that is found associated with this disease and that is *Fusarium mangiferae*. It is a very very difficult pathogen to control because its actual causal agents are rightly not worked out. Although association of *Fusarium* has been proved to be associated in most of the cases but other factors has not been properly established. Here the panicle it becomes shortened and the leaves become very small and you can see that all these newly developed stems are malformed and this can be in the whole plant if the plants are affected at an early stage. So Mango malformation is a serious disease to the mango growers because once it is established in an orchard it is very hard to eradicate it from the field. The pathogen *Fusarium mangiferae* basically infect, it comes through infected seedlings and it can survive in soil. So management of this particular fungal pathogen that is associated with mango malformation is essential.

For that certain IPM practices are recommended and cultural practices have

proved to be the main reason for handling this particular problem. So cultural management include mango as we know that there is no definite control measures for this particular malformation of mango so control includes the following measures for mango malformation medicine. Avoiding scion stick from trees wearing malformed inflorescence for propagation is one of the most important cultural practices that need to be adopted. Then we can go for using certified saplings for propagation which ensures that there are no malformed seedlings are coming to the orchard and as soon as the disease symptoms are well expressed the affected terminals should be pruned along with a healthy portion of approximately 15 to 20 centimeter. So this is the most widely recommended and practiced cultural practice where the malformed tissues are cut out along with a portion of healthy tissues so that the inoculum or the causal agent that forms the mango malformation are completely wiped out from the existing plant.



So these were some of the major diseases of mango and the pathogens associated with them and we have seen that how these pathogens can be successfully

controlled by adopting mostly the cultural practices and in certain cases by application of certain chemicals.

## Forest trees: the victim of abiotic stress

Shephali Sachan

Tropical Forest Research Institute

(Indian Council of Forestry Research and Education, Ministry of Environment, Forests and Climate Change)

P.O., R.F.R.C., Mandla Road

Jabalpur - 482021, M.P.

About 430 million years ago in the Silurian times, the first plants invaded the land before the vertebrates invasion and later on, the vascular tissues and roots evolved making the pathways for the evolution of trees of current time. Trees are the dominant part of forests or in other words, forests are nowhere in identity without trees. Forests are boon for life on earth. Forest trees are the source of numerous tangible (e.g. timber, fodder, medicine, food, shelter, etc.) and intangible (e.g. pollution control, increase in soil fertility, control water runoff, carbon sequestration, regulate climate, cycle and store nutrients, and provide habitat for countless animal species and space for recreation etc.) benefits. But the current scenario of our life's has been now become a threaten for the forest ecosystem in every corner of the earth which has created a lot of disturbances in nature and still maintaining the continuity.

To make the life more easy and comfortable men have invented and discovered the number of tools and techniques which has increased the area of industrialization sector with the use of the variety of resources, harming the nature. The Intergovernmental Panel on Climate Change (IPCC), in its Fourth Assessment Report, concluded with more certainty that global climate changes is unequivocal and it is widely believed to result primarily from the effects of

emissions of carbon dioxide (CO<sub>2</sub>) and other greenhouse gases (GHGs) such as methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) generated from human activities. Forest resources are excavating at a very fast rate with the unexpectedly growing population which may increase by 9.2 billion upto 2050. The effect is particularly in lower income populations, predominantly within tropical/sub-tropical countries.

The current elevating situation, abiotic stress is the consequence of changing climatic conditions and global warming. Abiotic stresses impose huge damage to agriculture and forestry, giving rise to wastelands and wetlands areas in this constantly growing population period. There is only 3.5% of the global land area left unaffected by abiotic stress resulting about 70% reduction in crop production and also threatening the forest productivity worldwide.

Deforestation, grazing, mining and using the land for domestic and agricultural uses, adding in the reduction of forest trees in turn forest areas.

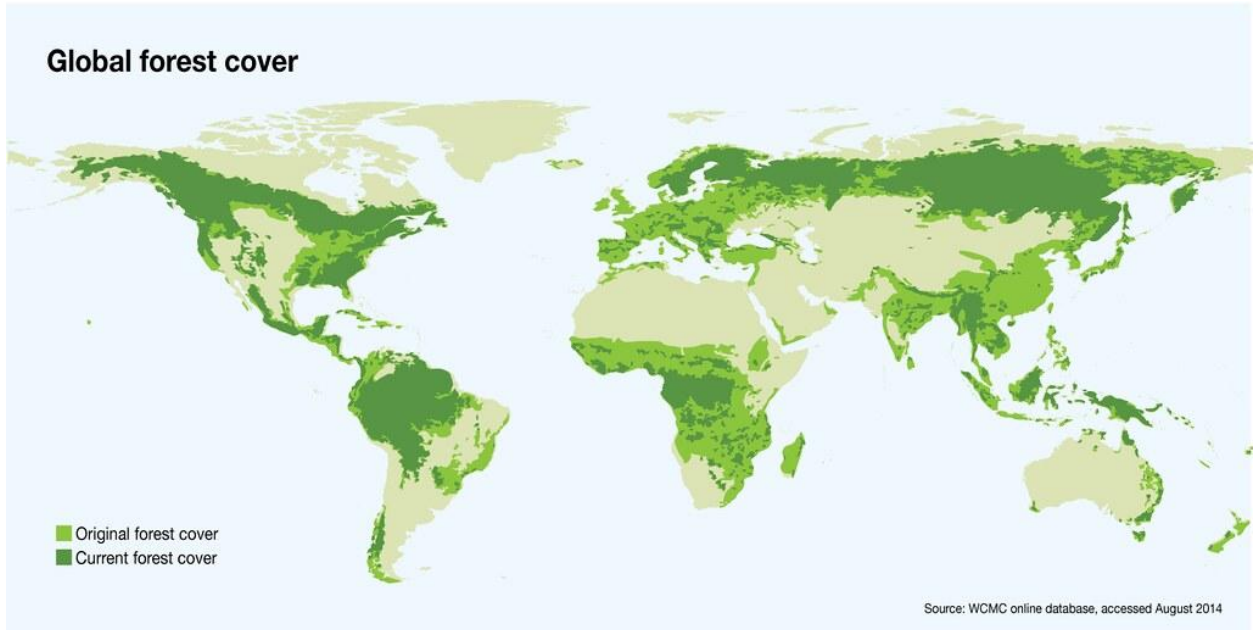
According to data from the U.N. Food and Agriculture Organization, forests cover makes 31 percent of the world's land surface, just over 4 billion hectares (One hectare = 2.47 acres.). This is down from the pre-industrial area of 5.9 billion hectares. The global net forest loss between 2000 and 2010 was 5.2 million

hectares per year. India, which is one of the ten most forest-rich countries of the world, i.e., Russia, Brazil, Canada, United States of America, China, the Democratic Republic of the Congo, Australia, Indonesia and Sudan, also under the influence of abiotic stresses. The percentage of forest cover to the total geographical area in India was 19.27% during 1987-1999. Although, this has increased to 21.34% upto 2015. This is the greatest achievement by India in spite of the situation of the continuously growing population and increasing demands of resources, still, many pathways have to be acquired to achieve the standard goal of making it 33%. Punjab, Haryana, Rajasthan, Uttar Pradesh, Gujarat and Bihar have the lowest percentage of Forests in India while North-eastern states and the UTs Andaman & Nicobars and the Lakshwadeepshas the highest percentages. Forest tree species are the most long-living organisms. The mid Devonian period marked the appearance of true trees with homoiohydric lifestyle. Within the plant kingdom, the forest tree species are the only creature which has the ability to remain flexible under the variety of changing environmental conditions and day to day terrestrial challenges. The number of complex interactions and reactions takes place inside their body in order to adapt and live upon any type of external changes. The environmental factors have the major impact on genetic constitution of the plant which decides its behaviour against any stress. Actually, both genetic and environmental factors control plant physiological, biochemical and morphological processes regulating the biomass production of forest trees.

Forest productivity is determined by genetic potential and is closely linked with environmental resources. Therefore, there are the variety of forest tree species which maintain to live under various abiotic stress-prone areas. Also, like every plant, these species are also bestowed with good economical importance. In this era of rising population and barren lands, there is an urgent need of plantations of forest tree species which should be suitable for various abiotic stress-prone areas with commercial values. In sequence to implement this idea, firstly, the screening of each and every forest tree species must be performed on the morphological, biochemical, physiological and molecular basis and develop the related markers under various categories and levels of abiotic stress along with genome sequencing in priority. Secondly, with the help of plant tissue culture genetic engineering the sensitive but threatened and economically valuable species, should be produced as a resistant variety. Thirdly, raising the plantations of forest tree species in various nurseries developed either by in-vitro (plant tissue culture) or ex-vitro method (seed germination process). Familybased quantitative trait loci (QTL) mapping can be also applied to search for associations between markers and phenotypes among genotypes with a contrasting response to abiotic stress. This will generate a strong and huge database of each forest tree species qualities like *Arabidopsis thaliana* and *Oryzasativa*. In this way the conservation step of both tangible and intangible benefits will be able to fulfil the requirement of sustainable development. The degraded, barren, waste and wet lands, the canal sides and coastal areas are demanding the plantations of forest trees in order to turn into productive

area. The forest contributes in the major part of carbon sequestration and oxygen production and by increasing them the climate change and global warming problems can be solved naturally. The

global contribution of forest sectors, universities and research institutes are required along with the helping hands of every common man to implement this idea successfully.



## Forestland for food security and nutrition

Sreedhar Bodiga<sup>1</sup> and Jagadeesh Bathula<sup>2</sup>

<sup>1</sup>Department of Basic and Social Sciences  
Forest College and Research Institute,  
Hyderabad @ Mulugu, Mulugu, Siddipet District-502279

<sup>2</sup>Department of Natural Resources Management  
Forest College and Research Institute  
Hyderabad @ Mulugu, Mulugu, Siddipet District-502279.

Forestry, the second largest land use class in India can intensely affect the socio-economic status and cultural transformation. Forest produce contributes directly and indirectly to the household income, food security and appropriate nutrition, in addition to the ecosystem services. Local people can use them to meet household needs in terms of food, fuel wood, shelter, income, medicine. Forests also contribute to the dietary diversity of many households and communities living in the fringe villages in predominantly subsistence economies in remote areas. Wild foods from the forests are important for food security in times of food shortage, famine, or when saved stocks are exhausted, as the poorest often are the most reliant on forests for food. Forests with mixed-use landscapes and crops/trees afford diverse foods with variety of nutrients compared to monocultures with single crop plantations. The communities who live in areas close to forests tend to have greater access to wild fruits, leafy greens, grubs, snails and bush meat. Forest foods of both plant and animal origin provide a wide variety of nutrients: carbohydrates, such as starches, fructose and other soluble sugars, protein, fats and micronutrients (vitamins and minerals). Different parts of the same species are consumed as food by different population groups. Processing techniques also vary from one population group to

another, determining the nutritional content and quality of the food eaten. The households that plant or harvest agro-forests on their land may benefit from increased access to fruits and nuts from trees. In addition, farming techniques used in more heavily forested areas may result in more nutritious diets because they often involve mixing complex mosaics of multiple crops.

The most direct way in which forests and trees help ensure food security is through their contributions to diets and nutrition. Plants and animals found in forests provide households with important nutrient-rich foods. They often form a small but crucial part of otherwise bland and nutritionally poor diets, adding variety and improving the taste and palatability of staple foods. Dietary diversification has the potential to increase intake of foods rich in micronutrients and thus meet the greater physiological needs during infancy, pregnancy, lactation and catch-up growth. Forest foods combine foods from plant and animal origin. Plant foods are often classified into fruits and seeds, nectars and saps, stems and tubers, leaves and mushrooms. Animal foods can be of invertebrate (insects and insect larvae) or vertebrate (bush meat or fish) origin.

Forest foods contribute to diet diversity and consequently may improve the quantity and quality of food intake. Seasonality is an important constraint for

foraging and determines, to a great extent, variations in the diet of indigenous people. Seasonality constraints have therefore generally been built into traditional farming systems. Forest foods also provide a safety net before harvest when food supplies are low, and during famines or natural disasters. In many agricultural communities, people rely on a staple crop, the seasonality of which implies periods of food shortage -usually referred to as "lean season" or "hungry season" which affects the priority of the poorest households. In lean periods, when few cultivated varieties of food are available, storage facilities are empty and/or money is in short supply, hunting and gathering helps alleviate seasonal hunger. This explains while the peak collection of forest fruit does not occur during the main fruiting season, when fruits are most plentiful, but rather when they are most needed, that is when cultivated food supplies dwindle and the requirements for agricultural labour are limited. Some forest foods are also consumed in times of scarcity as a substitute for staple foods.

Growing body of evidence suggests that deforestation and conversion of forest land to agricultural fields pose a threat to communities that receive their dietary requirements from forests. The alarming expansion of large-scale industrial production systems threatens the contributions of forests and tree-based agriculture systems to food security, diets and nutrition in the tropical regions of the world. In this regard, the complexity of forest management is increasing due to the growing and often conflicting demands for

forest-derived goods and services. Globalization and increasing accessibility to global markets for many, but marginalization and increased asymmetry for others, have presented significantly different opportunities and challenges.

Although existing evidence is limited, a considerable body of work suggests that forests support both food security and contribute to improved nutrition across the globe. Wild fruits and vegetables are a crucial source of micronutrients in many rural and smallholder communities, and often provide a major contribution to cash income at the household level. Bush meat and fuel wood for subsistence and income generation contribute both directly and indirectly to food security and nutrition. There is now an urgent need for research that can provide broader perspectives and allow of cross-site comparisons of the contributions of forests and tree-based agricultural systems to food security, livelihoods, healthy diets and nutrition.

With food security and nutrition high on the agenda in many political and scientific spheres, it is crucial to understand the contribution of forests and trees to a food secure and nutrition-sensitive future. Despite this, the role of forests in supporting human food security and nutrition remain largely under-researched and less understood in the Indian context. Greater attention to the direct and indirect benefits of forest in food security, livelihoods and nutrition should enhance local and global efforts to end hunger and improve the nutrition of communities living in forested areas as well as those living in areas remote areas.

## Ornamental horticulture and its prospects in India

Asmita<sup>1</sup> and Abdul Majid Ansari<sup>2,\*</sup>

<sup>1</sup>Department of Horticulture

Birsa Agricultural University

Ranchi-834006, Jharkhand, India

<sup>2</sup>Zonal Research Station (Birsa Agricultural University)

Chianki, Palamau-822102, Jharkhand, India

\*Corresponding author e-mail: majid.gbp@gmail.com

### Introduction

Flowers are an integral part of human civilization and culture. India has a long tradition of floriculture. References to flowers and gardens are found in ancient Sanskrit classics like Rig-Veda, Ramayana and Mahabharata. It is said that in India man is born with flowers, lives with flowers and finally dies with flowers. In our society no any social function is completed without the use of flowers. Flowers symbolize purity, peace, beauty, love and passion. For Indians especially those who are religious mind, flowers have a great significance. Floriculture in India is being viewed as a high growth Industry. Government of India has identified floriculture as a sunrise industry and accorded it 100% export oriented status. Commercial floriculture is becoming important from the export angle. The liberalized economy has given an impetus to the Indian entrepreneurs for establishing export oriented floriculture units under controlled climatic conditions. Agricultural and Processed Food Products Export Development Authority (APEDA), is responsible for export promotion and development of floriculture in India. All India Coordinated Research Project (AICRP) on Floriculture was established during IV Five-Year Plan in the year 1970-71 to carryout nation-wide interdisciplinary research by linking ICAR

Institutes with State Agricultural Universities (SAU's).

### Present scenario: India's position

India is the second largest producer of flowers after China. As per National Horticulture Database, 2015-16 the area under floriculture production in India was 249 thousand hectares with a production of 1659 thousand tonnes loose flowers and 484 thousand tonnes cut flowers. The major loose flower growing states are Andhra Pradesh, Tamil Nadu, Karnataka, Madhya Pradesh, Gujarat, Maharashtra, Haryana, West Bengal, Himachal Pradesh, Chhattisgarh, Utter Pradesh, Orissa, Sikkim etc. while, West Bengal, Karnataka, Maharashtra, Andhra Pradesh, Orissa, Utter Pradesh, Uttaranchal, Arunachal Pradesh, Himachal Pradesh, Jharkhand etc. have emerged as major cut flower states. Carnation from Himachal Pradesh, Gerbera from Uttrakhand, Anthurium from Mizorum and orchids from Sikkim have also made a significant contribution in recent times.

India's total export of floriculture was Rs. 507.31 crores/ 78.73 USD Millions in 2017-18. The major importing countries were United States, Netherlands, United Kingdom, Germany, and United Arab Emirates. There are more than 300 export-oriented units in India. More than 50% of the floriculture units are based in Karnataka, Andhra Pradesh and Tamil



Nadu. With the technical collaborations from foreign companies, the Indian floriculture industry is poised to increase its share in world trade. Major export destinations of the flowers and flower products from India are United States, Netherlands, Germany, United Kingdom, United Arab Emirates, Japan and Canada. Six Agri-Export Zones have been set up in the states of Sikkim, Tamil Nadu, Uttaranchal, Karnataka and Maharashtra. APEDA has also take number of measures to facilitate floriculture exports. Besides setting up cold storage and cargo handling facilities at the key airports of New Delhi, Mumbai, Hyderabad, Bangalore, Chennai, Trivandrum and Cochin, Proposals are under consideration for setting up of such facilities at Goa, Calicut and Coimbatore Airport.

**Table 1: Flower producing state in India (NHB, 2017)**

State	Share (%)
Tamil Nadu	19
Karnataka	13
West Bengal	12
Madhya Pradesh	10
Gujarat	8
Andhra Pradesh	6
Uttar Pradesh	5
Maharashtra	5
Chhatisgarh	5
Assam	4
Others	14

### Prospect

India has a blooming future as far as floriculture is concerned. Domestic floriculture industry is currently growing at an annual growth rate of 10 % per annum. Flower consumption in the cities and major town is reportedly growing at a rapid rate. The research will provide in-depth knowledge and opportunities in this

field for the management graduate and contribute to economic development. Following sector under floriculture is likely to boost floriculture production of India in the coming future.

### Cut flowers

Cut flowers are flowers or flower buds often with some stem and leaf that have been cut from the plant bearing it. The important floricultural crops in the international cut flower trade are rose, carnation, chrysanthemum, gargera, gladiolus, gypsophila, liastris, nerine, orchids, archilea, anthurium, tulip, and lilies. Rose is the principal cut flower grown all over the country. The larger percentage of the area in many states is used for growing scented rose, mainly to be sold as loose flowers. These are used for offerings at places of worship, for the extraction of essential oils and also used in garlands. For cut flower use, the old rose varieties, such as Queen Elizabeth, Super Star, Montezuma, Papa Meiland, Christian Dior, Eiffel Tower, Kiss of Fire, Golden Giant, Garde Henkel, and First Prize are still popular. In recent times, with production for export gaining ground in the country, the latest varieties like First Red, Grand Gala, Konfitti, Ravel, Tineke, Sacha, Prophyta, Pareo, Noblesse, Virsilia, and Vivaldi are also being grown commercially. Gladiolus is the next most important cut flower crop in the country. With improved agronomic techniques and better management, the northern plains of Delhi, Haryana, Punjab, Uttar Pradesh, as well as Maharashtra and Karnataka have emerged as the major areas for production of Gladiolus. Tuberosa, a very popular cut flower crop in India is grown mainly in the eastern part of the country i.e. West Bengal, and also in northern plains and parts of southern India. Both single and

double flower varieties are equally popular. Tuberosa flowers are also sold loose in some areas for preparing garlands and wreaths. The other main cut flowers include Asters, Gerbera, Carnation, Anthodium, Liliun, and Orchid. Production of Orchids is restricted mainly in the north-eastern hill regions, besides parts of the southern states of Kerala and Karnataka.



**Fig 1: Cut flowers**

### Loose flowers

The flowers which are usually harvested without stalk and used for worship, Gajara, Veni and Garland are called loose flower. Marigold, Jasmine, Crossandra and Gaillardia are the loose flowers. Rose, tuberosa, chrysanthemum are also used as loose flowers. Tamil Nadu ranks first in loose Flower productions which may be due to aesthetic preference of women for their hair. The major production comes from Karnataka, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Rajasthan, West Bengal, Bihar, Jharkhand, Kerala and Telangana while the major markets are in Chennai, Bengaluru, Kolkata, Hyderabad, Kadiyam, Pune, Mumbai and Delhi. The marketing network for loose flowers comprises of growers, middlemen,

wholesalers, retailers and the consumers. A small portion of loose flowers is being exported to Middle East, UK and USA for the expatriate Indians.



**Fig 2: Marigold as loose flowers**

### Cut greens

Cut greens are the leaves or part of leaves along with stems, branches with or without decorative flowers or fruit. A cut green provide contrast in floral arrangements and complements the beauty of flowers. It fills voids or gaps in floral design and also brings life to the bouquets. A recent statistic from Holland indicated that 25-30% of bouquets now consist of foliage compared to 5%, 15 years ago. Cut greens have many advantages over cut flowers. One can get year round production of a particular crop as compared to most cut flowers. It also have lesser risk of damage to quality while transport so, longer shelf life. There is also no strict time limit for storage. Florida is the nation's leader in sales of cut cultivated greens. The leading markets for foliage in the EU are the UK, Germany, France, Italy, The Netherlands, Poland and Spain. *Rumohra adiantiformis* is the leading tropical foliage species, accounting for an estimated 30% of the total turnover of wholesalers and the auctions. The leading developing country suppliers of dried foliage are India, China and South Africa, accounting for 19%, 11% and 11% of EU imports respectively.



**Fig 3: Cut greens**

#### **Dry flowers**

Dried flower products are in very high demand and add an enriched value to the flourishing industry. The main characteristics of dried floral products are novelty, longevity, aesthetics, flexibility and year round availability. The top ten dried ornamental genera are Helichrysum, Helipterum, Limonium, Nigella, Gypsophila, Delphinium, Amaranthus, Papaver, Carthamus and Rosa. The demand of dried ornamental plants has increased manifold during the last decade. The main advantage associated with dried ornamentals is its relatively non-perishable nature, cheaper, eco-friendly, biodegradable and lighter weight as compared to the fresh ornamental plants. Dry flowers constitute nearly 15% of the global floriculture business. The United Kingdom is the biggest flowers for dried flowers. Australia, India, South Africa, China and Thailand are the leading exporters of dried flowers, while United Kingdom, United States of America, Japan, Germany, Italy, The Netherland and

Spain are leading importers country. In India flower export has increased after liberalized EXIM policy. The contribution of dried ornamentals in total export is about 71% at present. The main exporting material from India includes lotus pods, dried flowers of camellia, dahlia, marigold, wood rose, wild lilies, paper flower and naturally dried plant parts from Himalayan region.



**Fig 4: Dry flowers**

#### **Turf industry**

Turf grasses are considered to be an integral part of landscape ecological systems which provide aesthetic value. Turf grasses are narrow leaved grass species that form a uniform, long-lived ground cover that can tolerate traffic and low mowing heights. Of the estimated 7,500 grass species, 50 species are mainly cultivated for turf and are able to form a high density under continuous defoliation caused by mowing. Turf grass industry has become equally important due to rapid urbanization, expanding buildings, emphasis on outdoor living and recreation and improved life style of the average citizen. The demand for turf grass is increasing day by day as new specialized parks, golf courses and stadia are emerging in different locations of the country. Sporting events like cricket matches, hockey, golf course matches, other sports, etc. would synergize the demand for

specific grasses for the stadia to be constructed for the event.



**Fig 5: Turf**

### **Essential oil**

Essential oils are one of the most valuable products that are being used mankind since ages. Essential oils are highly concentrated substances extracted from various parts of aromatic plants and trees. It is derived from the word essence that refers to the distinct scent of the plant. It is life-blood of the plant, protecting it from bacterial and viral infections. The use of essential oils for therapeutic, spiritual, hygienic and ritualistic purposes goes back to a number of ancient civilizations including the Chinese, Indians, Egyptians, Greeks, and Romans who used them in cosmetics, perfumes and drugs. India has rich biodiversity in many essential oil plant species. But, it is mainly concentrated on rose and jasmine for essential oil extraction. The major flower crops important for essential oil extraction include rose, jasmine, tuberose, vanilla etc. Brazil, China, USA, Egypt, India, Mexico, Guatemala and Indonesia are the major producers of essential oils. The major consumers are the USA (40%), Western Europe (30%) and Japan (7%).



**Fig 6: Essential oil**

### **Bonsai**

The word Bonsai is originated from Japanese language ‘bon’ and ‘sai’ which means shallow container and plant respectively. A ‘bon’ is a tray-like pot typically used in bonsai culture. Bonsai is a Japanese art of growing miniature trees in confined containers with specific formation and themes is a thriving business in the big cities of our country. The art of making bonsai has originated from China while, popularized by Japanese. The most common styles include formal upright, informal upright, slanting, semi-cascade, cascade, raft, literati, and group/forest. Less common forms include windswept, weeping, split-trunk, and driftwood styles. Both flowering and foliate trees, shrubs can be converted into bonsai and are sold for a fancy price depending on the age and complexity. It is one of the highly fetching avenues for the Indian growers and supposed to have a wide market in the future due to globalization and urbanization.



**Fig 7: Bonsai**

**Specialty flowers:** Specialty flowers are the cut flowers, which are not widely known and also grown in small pockets but have high prospects in the international market. These are a high value crops and are cut flower species other than major cut flowers. Heliconia, Red Ginger, Bird of

Paradise, Liliun, Acacia, Rice flower, Wax Flower, Gypsophila and Statice comes under the category of specialty flowers. Specialty cut flowers are a niche product for small and medium sized farmers with limited resources who mainly sell at local markets. Specialty flowers have a huge potential to increase income for both small and large farmers. The demand of specialty flowers has increased due to increase in globalization, Change in living standard, customers demand for new flowers and liberalization of industrial and trade policies. The advantage of growing specialty flowers new colours, forms, long stem, good vase life and high production per square foot etc.



**Fig 8: Heliconia and Bird of Paradise as Speciality flowers**

### **Nutraceutical compounds**

A nutraceutical is a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with food. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease. *Interestingly, seeds of lotus (Nelumbo nucifera)* are edible, medicinally versatile and used as an important raw material of age-old traditional medical practices like Ayurveda and folk medicine. Marigold and calendula flowers are some of the

richest sources of lutein which the human body cannot synthesize. The pigments extracted from the flowers are mixed in the poultry feed to intensify the yellow colour in egg yolk and flesh colour of broiler chicken. The pigments are also used in the food industry as natural colour. Marigold is commercially grown in large scale on contract farming for the extraction of these pigments in southern India by companies like EID Parry Ltd in Tamil Nadu, AVT McCormik Ltd in Kerala. The economic production and availability of

nutraceuticals is a highly desirable objective to improve the health of the people of the country, especially that of the poor people. Now, the nutraceuticals related research for improving its quality and quantity is an important area for ongoing biotechnological investigations.



**Fig 9: Nutraceuticals**

### **Aromatherapy**

Aromatherapy can be defined as the art and science of utilizing naturally extracted aromatic essences from plants to balance, harmonize and promote the health of body, mind and spirit. It is practice of using the natural oils extracted from flowers, bark, stems, leaves, roots or other parts of a plant. Aromatherapy as used today originated in Europe and has been practiced there since the early 1900s. Aromatherapy uses plant materials and aromatic plant oils, including essential oils, and other aromatic compounds for the purpose of altering one's mood, cognitive, psychological or physical wellbeing. Several essential oils including lavender rose, orange, bergamot, lemon, sandalwood, and others have been shown to relieve anxiety, stress, and depression. The modes of application of aromatherapy include aerial diffusion for environmental fragrance or aerial disinfection, direct inhalation for respiratory disinfection, decongestion, expectoration as well as

psychological effects and topical applications for general massage, baths, compresses, therapeutic skin care. The inhaled aroma from these "essential" oils is widely believed to stimulate brain function. Essential oils are distilled from plants, and approximately forty are commonly used in aromatherapy; among the most popular are lavender, rosemary, eucalyptus, chamomile, marjoram, jasmine, peppermint, lemon, ylang ylang, and geranium. Some of the popular aromatherapy products: Basil, Bergamot, Citronella oil, Clove oil, Geranium oil (used as a diuretic, astringent and antiseptic), Jasmin (aphrodisiac qualities), lavender oil (antiseptic for minor cuts and burns, relieve headache and migraine symptoms, insomnia), lemon oil, sandalwood (aphrodisiac qualities), tea tree oil (antimicrobial, antiseptic, and disinfectant qualities), thyme oil (fatigue, nervousness and stress) and yarrow oil (cold and influenza, reduce joint inflammation).

### **Plug plant production**

Many bedding and annual flowers are produced in highly automated greenhouses in the west to produce billions of plants for the corporate and public landscaping. Due to increasing fuel costs and labour costs in the west there is little scope for further expansion of these hi-tech industries in the developed world. Due congenial environment across our country we have the unique advantage of diversifying in to large scale production of seedlings of annual flower crops as well as the vegetable crops.



**Fig 10: Plug plant production**

### **Plant tissue culture**

Plant tissue culture has a great impact on both agriculture and industry, through providing plants needed to meet the ever increasing world demand. It has made significant contributions to the advancement of agricultural sciences in recent times and today they constitute an indispensable tool in modern agriculture. Commercial tissue culture was born in India in 1987 when A.V. Thomas and Company Kerala (AVT) established their first production unit in Cochin for clonal propagation of superior genotypes of selected cardamom plants. Plant tissue culture activities in India are at present confined to production of ornamental and flowering plants, which have a large global export market. Demand for flowers is increasing globally. India is expected to emerge as a strong player in the consumer market of biotechnology products in the coming years. In India there are more than 90 tissue culture units producing mostly foliage and flowering potted plants. Our tissue culture laboratories can produce wide range of bulbs in micro propagation way and that can be bulked in the fields of cold climate areas like Kashmir in economical way. Also there is good possibility to export mini bulbs to European countries.



**Fig 11: Tissue cultured plants**

### **Genetic engineering**

Genetic engineering has a huge potential for developing transgenic in floricultural crops, since floricultural crops are mainly grown for aesthetic purpose and are non-edible. Genetic engineering can make possible a number of improved crop varieties in flower crops with high novelty, production of disease-free plants (virus) and resistance against pests etc. The transformation process has been evolved over many years and the first transgenic plants were produced in petunia over 20 years ago and now it is possible to transform many floricultural crops like rose, chrysanthemum, begonias, carnation etc.

### **Fillers**

Fillers are used in flower arrangements and bouquets as background. Suitable crops used as fillers are gypsophila, limonium, ferns, asparagus, wax flower, asclepias, molucella, solidago, dimorphotheca, cycads, anthurium foliage, thuja leaves etc. Both foliage and flowering fillers are widely used.



**Fig 12: Fillers used in bouquet**

### **Value added products**

Value added Floriculture is a process of increasing the economic value and consumer appeal of a floricultural commodity. Value-addition ensures high premium to the grower while providing more acceptable quality products for the domestic and export market. A number of value added floricultural products are marketed in the domestic and international market which are given below.

### **Pot pourri**

Pot pourri is a mixture of dried, sweet-scented plant parts which includes flowers, leaves, seeds, stems and roots. Naturally scented plants used in traditional potpourri include rose flowers, hips or oils, rosemary leaves and flowers, orange peels, lemon peel, mint leaves and flowers, jasmine flower and oil, fennel seed, cloves, cedar wood shavings, jujube flowers and blooms, lavender flowers and leaves, cinnamon bark and cassia bark.



**Fig 13: Pot pourri**

### **Gulkand**

Preserving rose petals in sugar is known as Gulkand. It is prepared by mixing rose petals and sugar in the ratio of 1:1. Gulkand is an ayurvedic tonic. Its benefit includes reduction in eye inflammation and redness, strengthening of the teeth and gums, and the treatment of acidity. Gulkand has cooling properties, thus it is beneficial in alleviating all heat related problems like tiredness, lethargy, itching, aches and pains. It also helps in reducing burning sensations in the soles and palms.



**Fig 14: Gulkand**

### **Rose water**

Rose water is prepared by boiling the rose flowers in water and condensing the steam. It is largely used as sherbets, eye lotions, eye drops and for sprinkling on guest on auspicious occasions. The rose water is generally exported to Australia, Bahrain, Canada, Ethiopia, Fiji, France, Kuwait, Malaysia, Nepal, U.K., USA etc from our country.

### **Pankhuri**

Pankhuri is prepared by drying the rose petals in shade and is used in the preparation of cool summer drinks and incense.

### **Floral gifts**

The advent of internet and cheap air travel has opened up the avenues to place and deliver floral arrangements as personal



gifts across the country. Floral bouquets are presently prepared at the major production centres and are shipped to major cities in the country as value added services to cater the needs of the floral gifts sector.

Garlands, gajra/veni, wreath, buttonhole, corsage, floral jewelry, greeting cards, book marks, paper weights, wall hangings, floral tea, floral dyes and petal embedded handmade paper are the other value added products of floriculture sector.

### **Conclusion**

The current annual growth rate of 10% in floriculture sector in India clearly indicates that it will bloom in the next millennium. The value of exports of floriculture products from India has shown very significant growth since last decade. If India has to achieve the ambitious export target of more than Rs.1, 000 crores per annum a paradigm shift is required. The key issues that need to be addressed in the Indian context are: Economies of scale, Product range/ Latest varieties, Year round exports, Quality control and Certification and Cold chain management. APEDA has been addressing these issues through various forums on a concerted basis given its mandate to promote floriculture exports from India. With such initiatives and subsidies by central and state government, Floriculture could well be the next big boom after Information Technology.

## जैविक खाद वानिकी प्रजातियों के लिये उपयोगी

ममता मेश्राम

वन अनुसंधान केन्द्र - कौशल विकास

(भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार)

पोआमा- छिन्दवाड़ा (म.प्र.)

रासायनिक खादों एवं कीटनाशकों के अंधाधुंध प्रयोग के कारण भूमि की उर्वरता समाप्त होने के कगार पर आ गयी है। कई क्षेत्रों के उपजाऊ भूमि खराब होने लगी है और इसके कुछ प्रभाव भी सामने आये। बढ़ती हुई जनसंख्या के साथ भोजन की आपूर्ति के लिये मानव द्वारा खाद उत्पादन की होड़ में अधिक से अधिक उत्पादन प्राप्त करने के लिये तरह-तरह की रासायनिक खादों, जहरीले कीटनाशकों को उपयोग होता रहा, जिससे कई भूमि में पाये जाने वाले छोटे-छोटे जीवजंतु तथा जीवाणु पर विपरीत प्रभाव हुआ है। रासायनिक खाद के उपयोग से शुरूआत में खेती की उपज तो बढ़ी लेकिन किसान की अपनी प्राकृतिक खाद बनाने वाली जमीन जीवाणु रहित होती जा रही है। परिणाम स्वरूप आज खेती उतनी लाभदायक नहीं हो रही जितने कुछ वर्षों पहले थी। हम लोग रासायनयुक्त साग-सब्जी, अन्न, फल आदि खाने को मजबूर हैं। जिससे रोज नई-नई बीमारियाँ जन्म ले रही हैं। मानव शरीर पर प्रतिकूल प्रभाव पड़ रहा है।

रासायनिक खाद के उपयोग से पानी की खपत भी बढ़ी, जिससे सिंचित खेती में पर्यावरण प्रदूषण की समस्या उत्पन्न हुई। क्योंकि रासायनिक खाद का मात्र 15-20 प्रतिशत हिस्सा ही फसलों द्वारा उपयोग में लाया जाता है। शेष रासायन भूमि में पानी के साथ बहकर नीचे चले जाते हैं तथा भूमिगत जल को प्रदूषित करते हैं। जिससे पानी में नाइट्रेट की मात्रा बढ़ जाती है और वह पीने लायक नहीं रह पाता। इसलिये इस प्रकार उपरोक्त सभी समस्याओं से निपटने के लिये गत वर्षों की निरंतर टिकाऊ खेती के सिद्धांत पर खेती करने की सिफारिश की गई। इस विशेष प्रकार की खेती को अपनाने के लिये बढ़ावा दिया जाने लगा जिसे हम जैविक खेती के नाम से जानते हैं। विभिन्न विधियों द्वारा निर्मित जैविक खाद जैसे फसलों के अवशेष; हरी खाद नाडेप; केचुआ खाद; जानवरों मल-मूत्र से निर्मित खाद इत्यादि में गौण व सूक्ष्म पोषक तत्व भी उपलब्ध रहते हैं। मृदा में उपस्थित कार्बनिक पदार्थ, मृदा में उपस्थित सूक्ष्म जीवाणुओं के लिए यह भोजन का स्रोत होता है तथा मृदा के भौतिक गुणों को निर्धारित करने में सहायक सिद्ध होता है।

जैविक खेती से भूमि की उपजाऊ क्षमता में वृद्धि के साथ-साथ भूमि की गुणवत्ता में सुधार आता है। भूमि की जल धारण क्षमता बढ़ती है। वर्तमान में कृषि के साथ-साथ वानिकी में वर्मी कम्पोस्ट का प्रयोग अत्याधिक मात्रा में किये जाने पर बल दिया जा रहा है। वर्मी कम्पोस्ट बनाने में सबसे महत्वपूर्ण एवं मुख्य भूमिका केचुएं की होती है। इन्हीं केचुओं की विष्टा या मल को वर्मी कम्पोस्ट कहा जाता है। इस प्रकार सुव्यवस्थित रूप से सड़ी गोबर की खाद की खाद के माध्यम से निर्मित की गई खाद को जैविक खाद के नाम से काफी प्रभावित हो चुकी है। केचुएं के पेट में होने वाली रासायनिक प्रक्रिया से भूमि में पाये जाने वाले सूक्ष्म तत्वों में से सबसे प्रमुख एन0पी0के0 की उपलब्धता बढ़ जाती है। विभिन्न परीक्षण द्वारा पाया गया कि मिट्टी के केचुएं द्वारा प्रजनन लगभग 7 गुना फास्फोरस 11 गुना और पोटाश 13 गुना वृद्धि हो जाती है। इसी प्रकार एक टन गोबर खाद से नाइट्रोजन 5 किलोग्राम, फास्फोरस 2 किलोग्राम, पोटेशियम 5 किलोग्राम, कैल्सियम 10 किलोग्राम, मैगनीशियम 3 +5 किलोग्राम, आयरन 300 ग्राम, मैगनीज 250 ग्राम, जिंक 100 ग्राम, कॉपर 20 ग्राम, बोरॉन 25 ग्राम, मोलिब्डेनम 2 ग्राम, गोबर से मित्र जीवाणुओं की संख्या बढ़ती है जो पौधों को ज्यादा पोषक तत्व उपलब्ध कराते हैं।

केचुआ ही एक ऐसा जीव है तथा ऐसी खाद बना सकता है जोकि वास्तव में रासायनिक खाद का एक

विकल्प बन सकता है। इस तरह केचुआ खाद की उपयोगिता को देखते हुए वानिकी की कुछ महत्वपूर्ण प्रजातियों के पौधों की वृद्धि को अनुपचारित मिट्टी के साथ पौध वृद्धि का आंकलन करते हुए उक्त अन्य मिश्रणों के साथ पौध वृद्धि का तुलनात्मक अध्ययन रोपणी में उपयोग किये जाने पर बल दिया जा रहा है, इसी को ध्यान में रखकर एक परियोजना को प्रस्तावित किया गया।

### प्रयोग का उद्देश्य

जैविक खाद (गोबर खाद, केचुआ खाद) के लाभदायक परिणामों को देखते हुए वानिकी प्रजातियां हर्षा, बहेड़ा, महुआ एवं भिलवा पर विभिन्न अनुपात में जैविक खादों के साथ प्रयोग का अध्ययन।

### प्रयोग विधि

इसका प्रभाव देखने के लिये एक परियोजना ली गई एवं परियोजना में गोबर खाद एवं वर्मी कम्पोस्ट का प्रयोग विभिन्न अनुपातों में किया गया। हर्षा, बहेड़ा, महुआ एवं भिलवा के बीजों को 24 घंटे पानी में भिगोकर पॉलिथिन में रोपित कर पौध वृद्धि का आंकलन किया गया। पॉलिथिन में कम से कम 2 किलोग्राम मिश्रण भरा गया। प्रयोग में पॉलिथिन में मिट्टी रेत एवं गोबर खाद तथा मिट्टी रेत एवं केचुएं खाद का मिश्रण विभिन्न अनुपात निम्नानुसार लिये गये।

- मिट्टी रेत एवं केचुआ/गोबर खाद का 1:1:1 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 1:1:2 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 1:1:3 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 1:2:1 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 1:2:2 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 1:2:3 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 2:1:1 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 2:1:2 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 2:1:3 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 3:1:1 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 3:1:2 के अनुपात में मिश्रण लिया गया।
  - मिट्टी रेत एवं केचुआ/गोबर खाद का 3:1:3 के अनुपात में मिश्रण लिया गया।
- पौध वृद्धि का तुलनात्मक अध्ययन किया गया एवं दो वर्ष के निरंतर अध्ययन के पश्चात् पाया गया कि महुआ प्रजाति के पौधों की वृद्धि मिट्टी रेत एवं केचुआ खाद को 1:1:2 के अनुपात में, बहेडा प्रजाति के पौधों की वृद्धि मिट्टी रेत एवं केचुआ खाद को 2:1:1 के अनुपात में, हर्रा प्रजाति के पौधों की वृद्धि मिट्टी रेत एवं केचुआ खाद को 2:1:1 के अनुपात में व भिलवा प्रजाति के पौधों की वृद्धि मिट्टी रेत एवं केचुआ खाद को 3:1:2 के अनुपात में, महुआ प्रजाति के पौधों की वृद्धि मिट्टी, रेत एवं गोबर खाद को 1:1:1 के अनुपात में बहेडा प्रजाति के पौधों की वृद्धि मिट्टी रेत एवं गोबर खाद को 2:1:2 के अनुपात में, हर्रा प्रजाति के पौधों की वृद्धि मिट्टी रेत एवं गोबर खाद को 1:1:2 के अनुपात में, भिलवा प्रजाति के पौधों की वृद्धि मिट्टी रेत एवं गोबर खाद को 1:1:1 के अनुपात में उपरोक्त परिणामों से यह स्पष्ट होता है कि हर्रा, बहेडा, महुआ के पौध वृद्धि वृद्धि के लिये पॉलिथिन

में भरे जाने वाले मिश्रण में जैविक खाद का प्रयोग काफी अधिक हुआ है इन समस्त अवलोकनों के पश्चात् निष्कर्ष के तौर पर यह ज्ञात हुआ कि केचुआ खाद एवं गोबर खाद का उपयोग वानिकी प्रजाति पौध की वृद्धि के लिये निम्न अनुपातों के लिए उपयुक्त है।

## ओजोन परत

ममता पुरोहित, पूर्णिमा श्रीवास्तव एवं राजेश कुमार मिश्रा

उष्णकटिबंधीय वन अनुसंधान संस्थान

(भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद, पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार)

जबलपुर

ओजोन परत की खोज सन् 1913 में फ्रेंच फिजिक्स वैज्ञानिकों Charles Feby एवं Henri Buisson ने की। ओजोन परत में 97 से 99 प्रतिशत तक हानिकारक अल्ट्रावायलेट किरणों को सोखने की क्षमता होती है। ये हानिकारक अल्ट्रावायलेट किरणें पेड़-पौधों, प्राणी जगत एवं मानव समुदाय पर लम्बी अवधि तक हानिकारक प्रभाव छोड़ती हैं। ओजोन परत को समझने के लिए यह आवश्यक है कि हम ओजोन परत एवं पृथ्वी को चारों ओर से घेरने वाले वायुमण्डल के बारे में जानें जिसमें बहुत सी परतें होती हैं और प्रत्येक परत का अपना महत्वपूर्ण कार्य है। पृथ्वी को घेरने वाले इस वायुमण्डल में ओजोन परत एक महत्वपूर्ण परत है। जिसमें ओजोन अणु प्राकृतिक रूप से पाये जाते हैं। ओजोन एक विलक्षण प्रकार की आक्सीजन है जिसमें सामान्य आक्सीजन के दो परमाणु के स्थान पर तीन परमाणु होते हैं। ओजोन परत सामान्यतया उस समय विकसित होती है जब कुछ विशेष प्रकार के इलेक्ट्रिकल डिस्चार्ज या विकिरण आक्सीजन अणु में (O<sub>2</sub>) दो परमाणुओं को अलग कर देते हैं जो स्वतंत्रतापूर्वक फिर अन्य अणु से फिर जुड़कर ओजोन बनाते हैं। ओजोन परत खरबों वर्षों से सूर्य से आ रही प्रबल अल्ट्रावायलेट किरणों से पृथ्वी गृह पर जीवन की रक्षा कर रही है परन्तु

आज मानव की विवेकहीन गतिविधियों एवं मानव निर्मित हानिकारक रसायनों जिनमें क्लोरीन या ब्रोमीन होती है, के कारण यह जीर्ण-शीर्ण होती जा रही है। अल्ट्रावायलेट किरणों से मानव और पालतु पशुओं में त्वचा का कैंसर, मोतियाबिन्द, शरीर के रोग प्रतिरोधक तंत्र आदि को नुकसान पहुँचता है। ये किरणें एक कोशीय प्राणि एवं जलीय पारिस्थितिक तंत्र को भी नुकसान पहुँचाती हैं। यह माना जाता है कि ओजोन परत में प्रति 01 प्रतिशत की कमी होने से त्वचा केन्सर में 02 – 05 प्रतिशत तक वृद्धि हो जाती है।

पृथ्वी की सतह से 10 किलोमीटर ऊपर तक पायी जानेवाली पहली परत को ट्रोपोस्फियर कहते हैं। बहुत सी मानव गतिविधियाँ जैसे पर्वतों पर चढ़ना, गुब्बारे छोड़ना, पतंग उड़ाना तथा छोटे वायुयानों की उड़ान आदि इस क्षेत्र में होती हैं। ट्रोपोस्फियर के ठीक ऊपर 15 से 60 किलोमीटर तक पायी जानेवाली दूसरी परत स्ट्रेटोस्फियर होती है। पृथ्वी की सतह से लगभग 20 से 30 किलोमीटर ऊपर स्ट्रेटोस्फियर के निचले क्षेत्र में ओजोन परत स्थित होती है। ओजोन परत की मोटाई लगभग 03 से 05 किलोमीटर तक होती है जो मौसम और भौगोलिक स्थिति के अनुसार प्रायः घटती-बढ़ती रहती है। ओजोन अणु पृथ्वी के ठीक ऊपर पाये

जानेवाले स्ट्रेटोस्फियर में गैसीय परत बनाते हैं। स्ट्रेटोस्फियर का निचला क्षेत्र जिसमें ओजोन की अपेक्षाकृत अधिक सांद्रता होती है ओजोनोस्फियर कहलाता है। यह ओजोनोस्फियर पृथ्वी की सतह के ऊपर 15 से 35 किलोमीटर तक पाया जाता है। ओजोन परत में ओजोन की सांद्रता प्रायः 10 पार्ट्स प्रति मिलियन होती है जबकि वायुमण्डल में ओजोन की औसत सांद्रता लगभग 0.3 पार्ट्स प्रति मिलियन होती है। उष्णकटिबंध (Tropics) में ओजोन की अत्यधिक सांद्रता ऊँचाई (Altitudes) पर 26 से 28 किलोमीटर तक तथा ध्रुवों (Poles) पर 12 से 20 किलोमीटर तक पायी जाती है। ओजोन के अनिवार्य गुणों में इसमें पायी जाने वाली वह क्षमता है जो 290 नैनोमीटर से कम वेवलेन्थ के सौर विकिरण को पृथ्वी की सतह पर पहुँचने से रोकती है। इस प्रक्रिया में यह अल्ट्रावायलेट विकिरण को भी अवशोषित करती है जो भूमि व जल में बहुत सी जातियों-प्रजातियों के लिए हानिकारक है। ये अल्ट्रावायलेट किरणें पृथ्वी पर जीवन को नुकसान पहुँचाती हैं या खत्म कर देती हैं। यद्यपि अल्ट्रावायलेट किरणों का अवशोषण स्ट्रेटोस्फियर को गर्म कर देता है परन्तु यह पृथ्वी गृह पर जीवन की उन्नति के लिए महत्वपूर्ण है। ओजोन परत को ह्रास पहुँचाने वाले मुख्य पदार्थ (ODS)

#### क्लोरोफ्लोरोकार्बन्स (CFCs)

यह ओजोन परत को नुकसान पहुँचाने वाले मुख्य पदार्थों में बड़ी मात्रा में उपयोग किया जाने वाला पदार्थ है। ओजोन परत के पूरे ह्रास में 80 प्रतिशत से ज्यादा ओजोन ह्रास इसके कारण होता है। सन् 1995 के पहले बिल्लिंगों व कार में उपयोग होनेवाले घरेलू उपकरण जैसे – फ्रीजर,

रेफ्रीजिरेटर और एअर कंडीशनर में यह शीतलक की तरह उपयोग किया जाता था। वर्तमान में यह पदार्थ प्रायः ड्राईक्लीनिंग एजेंट्स, हॉस्पिटल स्टैरीलैन्ट्स और इंडस्ट्रियल साल्वेंट्स में उपयोग किया जाता है। यह पदार्थ फाम उत्पादों जैसे कुशन और गद्दों और घरों में इंसुलेशन के लिए भी उपयोग किया जाता है।

#### हाइड्रोफ्लोरोकार्बन्स (HFCs)

ये क्लोरोफ्लोरोकार्बन्स के स्थान पर वर्षों से उपयोग किये जा रहे हैं परन्तु ये ओजोन परत को उतना नुकसान नहीं पहुँचाते हैं जितना कि क्लोरोफ्लोरोकार्बन्स पहुँचाते हैं।

#### हेलोन्स

सिनेरियों में ये विशेष तौर पर चुने हुए अग्नि बुझाने वाले अग्निशामकों में उपयोग किया जाता है।

#### कार्बन टेट्राक्लोराइड

ये भी चुने हुए अग्निशामकों एवं घोलकों में उपयोग किया जाता है।

#### मिथाइल क्लोरोफार्म

सामान्यतः यह विभिन्न उद्योगों में शीतल साफ-सफाई (Cold cleaning), वाष्प में गिरावट (Vapour degreasing), रासायनिक प्रसंस्करण, चिपकने वाले पदार्थ (Adhesive) तथा कुछ एरोसोल्स में उपयोग किया जाता है।

#### क्लोरीन एवं ब्रोमीन

क्लोरीन और ब्रोमीन के फ्री रेडिकल्स ओजोन अणु के साथ क्रिया कर उसकी आण्विक संरचना को नष्ट कर देते हैं जिससे ओजोन परत का ह्रास हो जाता है। क्लोरीन का एक परमाणु ओजोन के 1, 00, 000 से ज्यादा अणुओं को तोड़ सकता है। ऐसा विश्वास किया जाता है कि ब्रोमीन का

परमाणु, क्लोरीन के अणु से 40 गुना ज्यादा विनाशकारी होता है।

**ओजोन परत ह्रास के गंभीर प्रभाव**

**मानव स्वास्थ्य को नुकसान**

ओजोन परत के ह्रास से मानव समुदाय प्रबल अल्ट्रावायलेट किरणों के सामने पूरी तरह से एक्सपोज़ हो जायेगा। इस अतिखुलेपन या ओवरएक्सपोज़र के कारण हानिकारक अल्ट्रावायलेट किरणों से मोतियाबिन्द, त्वचा का केन्सर, सनबर्न, रोगप्रतिरोधक तंत्र का कमजोर होना और शीघ्र बुढ़ापा आना आदि स्वास्थ्य संबंधी शिकायतें होने लगेंगीं।

**पालतु जानवरों पर प्रभाव**

अत्यधिक अल्ट्रावायलेट विकिरण के कारण पालतु जानवरों में त्वचा एवं आँत का केन्सर होगा।

**समुद्री जीवन को खतरा**

कुछ निश्चित प्रकार के समुद्री जीवन जैसे प्लैंक्टोन्स के तीक्ष्ण अल्ट्रावायलेट किरणों के सामने एक्सपोज़ होने से उनके जीवन बहुत अधिक प्रभाव होगा। प्लैंक्टोन्स का जलीय भोजन श्रृंखला में महत्वपूर्ण स्थान है। ओजोन परत के ह्रास होने से यदि प्लैंक्टोन्स की संख्या घटेगी तो समुद्री भोजन श्रृंखला बहुत से मायनों में तितर-बितर हो जायेगी। समुद्री जीवन की कुछ अन्य निश्चित प्रजातियाँ तीक्ष्ण अल्ट्रावायलेट किरणों में अत्यधिक एक्सपोज़ होने के कारण अपनी प्रारंभिक अवस्था में ही बहुत ज्यादा प्रभावित होंगी। समुद्री जीवन के अल्ट्रावायलेट किरणों में अत्यधिक एक्सपोज़ होने से मछुआरों की आमदनी भी कम होगी।

**कुछ निश्चित पदार्थों पर प्रभाव**

ओजोन परत के ह्रास होने से प्लास्टिक, रबर, फेब्रिक, लकड़ी जैसे पदार्थों में अत्यधिक अल्ट्रावायलेट विकिरण के कारण बहुत ज्यादा अवनति (Degradation) होगी।

**पर्यावरण नष्ट होना**

तीक्ष्ण अल्ट्रावायलेट किरणों में अत्यधिक एक्सपोज़र के कारण बहुत सी संवेदनशील अनाज प्रजातियों जैसे गेहूँ, ज्वार, मक्का, ओट, चावल तथा सब्जी प्रजातियों जैसे ब्रोकली, टमाटर, फूल गोभी आदि में प्रकाश संश्लेषण, पुष्पन तथा वृद्धि की गति धीमी हो जाती है। वनों को भी समान रूप से ओजोन परत के ह्रास के गंभीर प्रभाव सहन करना पड़ेंगे।

**ओजोन परत के ह्रास को रोकने के समाधान**

**पेस्टीसाइड का उपयोग बन्द करना**

यद्यपि पेस्टीसाइड ही वो रसायन हैं जो खेतों को कीटों और हानिकारक खरपतवारों से मुक्त करते हैं परन्तु ओजोन परत के ह्रास में इनकी बहुत बड़ी भूमिका होती है। अतः खेतों को कीटों और खरपतवारों से मुक्त करने के लिए प्राकृतिक विधियों का उपयोग करना होगा। इसके लिए पर्यावरण हितकारी रसायनों को उपयोग में लाना होगा तथा खरपतवारों को हाथ से उखाड़कर नष्ट करना होगा।

**निजी वाहनों का उपयोग कम करना**

ओजोन परत के ह्रास को कम करने के लिए सबसे सरल तकनीक यह है कि सड़क पर वाहनों की संख्या को सीमित किया जाये। इन वाहनों से बहुत ज्यादा ग्रीन हाउस गैसों निकलती हैं जो अन्ततः धुंध (Smog) बनाती हैं। यह धुंध ओजोन परत के ह्रास में उत्प्रेरक के रूप में कार्य करता है।



### साफ-सफाई के लिए पर्यावरण हितकारी उत्पादों का उपयोग

घर व घर में काम आनेवाले विभिन्न सामानों की साफ-सफाई के लिए जो उत्पाद उपयोग किये जाते हैं उनमें ऐसे हानिकारक रसायन होते हैं जो वायुमण्डल में पहुँचकर ओजोन परत को नुकसान पहुँचाते हैं। अतः इस स्थिति से बचने के लिए साफ-सफाई हेतु पर्यावरण हितकारी प्राकृतिक उत्पादों का उपयोग करना चाहिए।

### नाइट्रस ऑक्साइड का निषेध करना

नाइट्रस ऑक्साइड एक जाना पहचाना नुकसानदायक रसायन है। ओजोन परत के ह्रास में इसकी भूमिका को अनदेखा नहीं किया जा सकता परन्तु आज भी इसका उपयोग किया जा रहा है। अतः ओजोन परत के ह्रास होने की दर को कम करने के लिए शासन को नाइट्रस आक्साइड के उपयोग को बहिष्कृत करना चाहिए।

वैज्ञानिकों के शोध परिणामों के सामने आने पर लोगों में ओजोन परत के महत्व को समझने की जागरुकता आई है।

वैज्ञानिकों के शोध अध्ययन बताते हैं कि मानव द्वारा निर्मित कुछ रसायन जैसे

क्लोरोफ्लोरोकार्बन्स स्ट्रेटोस्फियर तक पहुँचकर रासायनिक क्रियाओं की एक प्रगाढ़ श्रृंखला द्वारा ओजोन परत को नुकसान पहुँचाते हैं। इन शोध अध्ययनों के परिणाम स्वरूप सन् 1989 में बनायी गयी ग्लोबल संधि पर जो मांट्रियल प्रोटोकाल के नाम से जानी जाती है द्रुत गति से हस्ताक्षर किये गये। यह संधि पत्र मानव द्वारा निर्मित नुकसानदायक रसायनों जैसे क्लोरोफ्लोरोकार्बन्स के उपयोग को सीमित करने के लिए बहुत मदद करता है परन्तु इस प्रोटोकाल में नाइट्रस आक्साइड के बारे में कोई चर्चा नहीं है।

वैज्ञानिकों के शोध परिणामों के सामने आने पर लोग इसके महत्व को समझने लगे और इसकी सुरक्षा के लिए हर संभव प्रयास कर रहे हैं। वैज्ञानिक स्ट्रेटोस्फियर की ओजोन में कमी को सन् 1970 के शुरुआत से ही निरीक्षण कर रहे थे। ओजोन परत के महत्व एवं उसकी सुरक्षा पर प्रकाश डालने के लिए पूरे विश्व में 16 सितम्बर को अंतर्राष्ट्रीय ओजोन दिवस के रूप में मनाया जाता है।

## Environmental impacts of urban green space

Rekha Agarwal

Government Science College  
Old Robertson College, Estd.-1836  
Jabalpur (MP)

Urban life style is associated with chronic stress, insufficient physical activity and exposure to anthropogenic environmental hazards. Urban green space, such as parks, playgrounds, and residential greenery, can promote mental and physical health and reduce morbidity and mortality in urban residents by providing psychological relaxation and stress alleviation, stimulating social cohesion, supporting physical activity, and reducing exposure to air pollutants, noise and excessive heat. Urban development projects can be costly and have health impacts. An evidence-based approach to urban planning is therefore essential. However, the evidence for physical and non-physical health benefits of urban green space is unclear. There is weak evidence for the links between physical, mental health and well-being, and urban green space. Environmental factors such as the quality and accessibility of green space affects its use for physical activity. User determinants, such as age, gender, ethnicity and the perception of safety, are also important. However, many studies were limited by poor study design, failure to exclude confounding, bias or reverse causality and weak statistical associations. Most studies reported findings that generally supported the view that green space have a beneficial health effect. Establishing a causal relationship is difficult, as the relationship is complex. Simplistic urban interventions may therefore fail to address the underlying

determinants of urban health that are not



remediable by landscape redesign.

Numerous scientific studies have demonstrated the benefits that green spaces have in people's lives. In fact, various studies found links between exposure to green spaces such as parks and forests and various health improvements, including slower physical and mental decline, decreased risk of breast cancer and, most recently, reduced risk of developing metabolic syndrome. However, very little is known about the mechanisms that mediate this positive impact.

The presence of green space is not the main factor that increases the frequency of physical activity, walking and cycling. Perceived greenness, time spent in local green spaces, and the feeling that these spaces are important for health-related activities is factors associated with more time spent performing physical activity.

Greenspace (sometimes 'green space') is an umbrella term used to describe either maintained or unmaintained environmental areas, which can include nature reserves, wilderness environments and urban parks. Often, particularly in urban contexts,

greenspaces are purposefully designated for their recreational or aesthetic merits.

Global urbanization has reduced access to and engagement with greenspace, but there is good evidence of a positive relationship between levels of neighborhood greenspace and mental health and well-being. Individuals have less mental distress, less anxiety and depression, greater wellbeing and healthier cortisol profiles when living in urban areas with more greenspace compared with less greenspace. Large differences in disease prevalence are reported when comparing residents of very green and less green settings, even after controlling for socioeconomic status. Quantity of nearby greenspace buffers life stresses – a finding demonstrated across ages and cultures, having been observed both in an adult population from the Netherlands and in a childhood population from rural upstate New York, USA. However, causality is difficult to determine, as self-selection may contribute to the positive relationship between greenspace and better health, because healthier individuals tend to move to or stay in greener neighborhoods. Nonetheless, individuals who move house from a less green to a more green area have been found to show significantly better mental health in the three post-move years, implying a sustained improvement. Greenspace in the living environment is also associated with lower income-related health inequality, and in the short-term individuals who report high negative mood are more likely also to select a natural area, rather than other types of area, as their favorite place. Research indicates that potential mechanisms underpinning the positive relationship between greenspace and health are likely to include sensory-perceptual and immunological processes,

air quality, physical activity, stress and social integration.

If well-designed, urban green space—such as street trees, parks, green roofs, and facades—can help achieve reductions in temperature and air pollution in urban areas while simultaneously delivering diverse additional benefits such as biodiversity habitats and enhanced living and recreation areas. Urban heat islands can increase urban temperatures by up to 12 °C compared to non-urban areas. This can exacerbate heat stress in city dwellers. Trees can provide shade and reduce the demand for air conditioning during warm periods, thus reducing energy demand and promoting sustainability. A meta-analysis of the literature on the effect of urban parks on air temperature showed an average cooling effect of approximately 1 °C. This effect exists up to 1 km from the park boundary with factors such as canopy density and the nature of air flows determining whether this cooling effect is achieved in practice. The inclusion of water bodies in the green areas may enhance cooling effects. Furthermore, green space may help to reduce the risk of flooding in periods of heavy rainfall by increasing water retention and infiltration, and reducing runoff. Although green space is often presented as a solution to problems caused by climate change, it is also affected by it. Stressors—such as changed hydrology, low soil quantity and quality, fires and wind events, each detrimental to green space—may be aggravated by more frequent and intense weather events. Also relevant here, is the likelihood that some urban tree species will not adapt well to a changing climate and the vulnerability of unhealthy urban trees to insects and diseases.

Creating more green space in cities may increase the sequestration of CO<sub>2</sub> to an, albeit limited, extent. The literature revealed that tree photosynthesis in urban green space is able to offset a fraction of the CO<sub>2</sub> emitted from internal combustion engines potentially helping to mitigate the effects of climate change. Realistically, however, the extent of any possible mitigation may be relatively inconsequential given that levels of urban green space is generally quite limited. Green infrastructure holds potential to promote the reduction of CO<sub>2</sub> emissions indirectly by changing behavior, for example by facilitating beneficial mobility choices such as walking and cycling. This has additional potential to reduce the other traffic-related air pollutants in the urban environment. Through another mechanism, urban green spaces may act as buffers and provide valuable oases where air quality is higher than surrounding areas. Although a topic of debate, some commentators state that trees and other vegetation may reduce levels of some pollutants, including gases and particulate matter. Given their large surface resistance, trees have the potential to reduce air pollution by dry deposition, leading to improvements in human health and well-being, although this impact seems to be limited. Paradoxically however, trees may also contribute to air pollution by releasing hydrocarbons and reducing the opportunity for dispersal of certain pollutants such as low-level ozone. Careful selection of species, design of planting configurations with regard to airflows, shade, other impacts, and maintenance of urban vegetation all need to be optimized to generate the benefits to air quality. Furthermore, the cooling effect of vegetation, through shade and evapotranspiration, can help generate

airflows, and disperse the concentration of pollutants.

Well-designed urban green space can buffer noise, or at least the negative perception of noise emanating from non-natural sources, such as traffic, thus providing relief from city noise. Vegetation has been considered as a means to reduce outdoor noise levels, mainly in areas with high volumes of traffic. It can impede noise propagation by absorbing or diffracting noise. A different effect of green and blue space on noise perception is the effect of “natural” noises in masking noise from for example traffic (e.g., sounds of water fountains or birds).

The WHO discussed the health effects of increased exposure to sunlight by spending time in green space. This may have both positive effects (vitamin D from sunlight, improved sleep) as well as negative effects (exposure to dangerous levels of ultraviolet (UV) light, causing skin cancer). Exposure to sunlight is especially important for northern Europeans whose environment lacks high levels of sunlight for significant parts of the year, and for older people, since the ability to synthesize vitamin D decreases with age.

Urban green space may also have adverse impacts on health. Health risks from green space include vector-borne diseases, which are transmitted by arthropods, such as ticks (e.g., tick-borne encephalitis and Lyme disease), mosquitoes (e.g., Chikungunya fever and Dengue fever), or sand flies (e.g., visceral leishmaniasis). Lyme disease, in particular, has increased in Europe in the 21st century, and this has been associated with urban green space and increased populations of animal hosts, such as deer, as well as with climate change and milder winters in northern Europe. Furthermore, contamination of

urban green space with dog or cat feces poses another risk. Many trees and plants release pollen, which can aggravate allergies. An increasing proportion of the urban population is susceptible and allergic to tree-derived pollen. Therefore, identifying tree species that are most responsible for allergic reactions is important.

Living close to green space may be associated with elevated exposure to pesticides and herbicides especially if they are used in inappropriate ways and at excessive levels. Another risk of using urban green space, is the risk of accidents and injuries, resulting from tree or tree or branch fall or trips slips and falls by individuals and drowning, by people engaged in physical activity.

Providing green space that is accessible, attractive, well maintained, with room for socialization, and where people feel safe may provide the opportunity and motivation for people to use green space more often. Informing and educating people about urban green space and organizing supportive activities in green

space that benefit health may increase people's capabilities to use it. Since the attractiveness of a place and of the activities offered depends on life stage, lifestyle factors, and individual values, it is important to take these into account and involve potential users in the design. Particular attention should be paid to groups who may benefit most from green space, such as deprived communities, children, older people, people with a mental illness, and pregnant women. A broad multidisciplinary collaboration and a combination of actions are needed to improve the use of green space and for this to have a long-lasting effect. Creating well-designed green spaces and encouraging people to use it can provide a triple win, by improving environmental sustainability, improving health, and improving health equity. Despite a large number of inspiring policies and practices, only a few have been evaluated. More evaluation, both qualitative and quantitative, is needed to provide further insight into what works.



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**P.O. RFRC, Mandla Road**  
**Jabalpur – 482021, M.P. India**  
**Phone: 91-761-2840484**  
**Fax: 91-761-2840484**  
**E-mail: vansangyan\_tfri@icfre.org, vansangyan@gmail.com**  
**Visit us at: <http://tfri.icfre.org> or <http://tfri.icfre.org>**