

## UNIT IV

### ECOLOGICAL DIVERSITY AND AGRICULTURE

**Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insects and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.**

#### INSECTS AND AGRICULTURE

Insects are essential to agriculture, some as pollinators and others as predators of other insect species that feed on crops or spread viruses and other diseases. Herbivorous insects are responsible for destroying up to 20% of the world's total crop production annually and up to 50% is lost to a combination of pests and diseases.

Farmers employ many different strategies to try and limit these losses. Currently, pesticides are one of the primary methods of controlling insect pests, particularly insect larvae. However, many insecticides are non-specific and affect pollinators and beneficial species as well as pests, particularly when applied as an aerial spray.

Pesticides are progressively being restricted by European legislation due to concerns about negative impacts on biodiversity and non-sustainability.

Insect sex pheromones provide environmentally-friendly alternatives to pesticides for pest management in agriculture.

Beneficial insects provide regulating ecosystem services to agriculture such as Pollination and the natural regulation of plant pests.

Human cultures and civilizations have been maintained in countless ways through these beneficial insects, they regulate the pest population of many harmful pest species, produce natural products, and they dispose the waste and recycle the organic nutrients. It should be consider in thought that how much we depend on them for our survival and what kind of life would be without insects

#### **Requirements for Enhancing Beneficial Insects:**

The generalized intensification of agriculture and the use of broad-spectrum pesticides decrease the diversity of natural enemy populations and increase the likelihood of pest out breaks.

Indeed, pesticide use has been shown to be associated with a large decrease in natural pest control services. Thus, enhancement of agro ecosystem appears to be one of the best ways in which we can decrease the use of chemical pesticides for pest and disease control. And it will increase the sustainability of crop production.

Insect pollinators are flower visiting Insects that forage on flowering plants to obtain plant-provided food (nectar, pollen). Flower-visiting insects have the potential to transfer male gametes (contained in pollen) to the female gametes while foraging, resulting in pollination.

Insect-mediated pollination is an essential step in reproduction for the majority of the world's flowering plants, including numerous cultivated plant species i.e. Sunflower, Cucurbitaceous vegetables,

Alfalfa, Coriander, Cardmom, Gingelly, Apple etc. Many crops depend on pollination for seed production and fruit set to achieve good yield. Globally, an estimated 35% of crop production is a result of insect pollination.

The *Apis mellifera* L. (European honey bee) is responsible for the pollination services in majority of crops. Non-*Apis* bees also are important pollinators of crops, especially for crops in which honey bees are inefficient pollinators (e.g. alfalfa, squash).

A few non-*Apis* species are managed for crop pollination. Examples of managed non-*Apis* species include bumble bees, *Bombus impatiens* Cresson (Hymenoptera: Apidae) managed for cranberry (*Vaccinium* spp.) and greenhouse tomato (*Solanum lycopersicum* L.) pollination.

Although bees are considered the most effective insect-pollinator of most plant species, other insects have been recognized for their contributions to pollination.

Flower visiting flies (Diptera) have been documented as proficient pollinators of several crops including carrot (*Dacus carota* L.), mustard (*Brassica* spp.), leek, (*Allium ampeloprasum* L.), and almond (*Prunus dulcis*). Weevil *Elaeidobius kamerunicus* (Coleoptera: Curculionidae) plays great role in pollination of Oil palm.

### **Natural Enemies:**

Insect predators and parasitoids that attack and feed on other insects, particularly on insect pests of plants are considered natural enemies. Through this type of feeding, natural enemies contribute to a type of pest regulation referred to as natural biological control.

Predaceous natural enemies belong to several insect orders and are generally characterized as free-living, mobile, larger than their insect prey, and are able consume several preys throughout their life cycle. But the parasitoids mainly belong to two orders Hymenoptera and Diptera, and their host ranges are considered to be more specialized than that of predator.

Free-living adult parasitoids seek out a host, and depending on the parasitoid species, parasitize different life stages of their host (i.e. egg, larva, and pupa, adult). Parasitoids can lay an egg (solitary) or several eggs (gregarious) on or within their host and the immature parasitoid(s) feed on their host to complete development, kill their host, and emerge as free-living adult.

### **Weed Killers:**

Many insects feed upon unwanted weeds just the same manner they do with the cultivated crops. In many cases the occurrence of these insects has contributed much towards eradication of the weeds.

### **Soil Builders:**

Insects which live in soil make tunnels, creating channels for smaller organisms, water, air, and roots to travel through. Insects improves soil aeration, and earthworm activity can enhance soil nutrient cycle, the soil physical properties, such as soil structure and tilth and activity of other beneficial soil organisms.

Small Dung beetles makes tunnel walls with dung and also make dung balls that helps in maintaining the quality of the soil. Excreta of insets also enrich the soil.

**Examples-** Beetles, Ants, Cut-worms, Larvae of flies, Crickets, Termites, Wasps etc Scavengers: Insects which feed on dead and decaying matter of plants and animals are called as scavengers

### **Some Products from Beneficial Insects Production of Honey and Bee Wax:**

From thousands of year *Apis mellifera* L. (Honey bees) are important for gaining Honey and bee wax. And honey was the only sweetener, viscous fluid, produced by honeybees. It is collected from nectar from nectaries at base flowers. Also collected from nectar secreted by plant parts other than flowers known as extra floral.

It aims to enhance insect-derived ecosystem services from a conservation perspective (i.e. enhancing beneficial insects in agricultural landscapes that provide ecosystem services to crops.

Human cultures and civilizations have been maintained in countless ways through these beneficial insects, they regulate the pest population of many harmful pest species, produce natural products, and they dispose the waste and recycle the organic nutrients. It should be consider in thought that how much we depend on them for our survival and what kind of life would be without insects

**Production of Silk:** A unique natural fiber silk cloth, which usually derives from silkworm, *Bombyx mori*. This “domestic” silk is famous for its finishing and light colors. The silk can also harvest from the many other species e. i. *Antherea* spp., that found in the India, Japan and China’s forests.

The silk provided by willed spp e.i. *Eri*, *Muga*, *Tussah* and *Yamamai* are heavier and dark in color hence they are less valued than that of *Bombyx mori*. Silk can be dyed, spun, in to thread and woven in to fabric. Cloth of Silk is warm in winters, cool in summers, light in weight, and resistant to wrinkling.

**Production of shellac:** *Laccifer lacca*, is a scale insect that secret a hard encrustation over the body as a protective covering. It is of brown color usually and these insects grow on acacia trees

in India and Burma. Scale insects present on twigs are heated to extract the resins and then purify.

One gram of Lac is extracted from Up to 200 insects. In present the synthetic material such as Polyurethane and vinyl has been taken place of Lac, even after Lac is still in use as dyes, inks, polishes, sealing waxes, and as stiffening agents in the fabrication of felt hats. It is animal originated and commercial resin

**Production of Cochineal:** Cochineal pigments use in Painting: A scale insect *Dacylopius coccus* found in Mexico and Central America on prickly pear cacti. Cochineal pigment is extracted from these scale insects. For the first time it was used by Aztec Indians as medicines, body paints and as textile dye.

The cochineal pigment was important for the intensity and permanency of colors. It was very costly because of its scarcity, so it was used in only the finest fabrics. Now a day's aniline dyes have taken place of Cochineal in textile industries which is very economic. But the cochineal pigment is still giving the colors in foods, beverages, cosmetics (lipsticks) and art product.

Sufficient food production for a growing human population has become an issue of global concern. Almost all of the world's fertile land is currently in use and arable land areas cannot be expanded significantly.

The global challenge is to secure high and quality yields and to make agricultural production environmentally compatible. Insects have been hugely successful in terms of both species richness and abundance.

Insects make up the most numerous group of organisms on earth, around 66% of all animal species, and being good dis-persers and exploiters of virtually all types of organic matter, can be found almost everywhere, forming an important part of every ecosystem and are vi-tal within our food supply chains performing valuable ecosystem services.

Insects have been predominantly perceived as competitors in the race for survival. Herbivorous insects damage 18% of world agricultural production. Despite this damage less than 0.5 percentage of the total number of the known insect species are considered pests.

Insect pests are created through the manipulation of habitats by humans, where crops are selected for larger size, higher yields, nutritious value, and are cultivated in monocultures for maximum production. This provides a highly favorable environment for the population increase of herbivorous insects.

To ensure stable crop yields we need to change the management strategies of agro ecosystems. We need to manage these systems in such a way that insects performing valuable ecosystem services are also incorporated into the system.

When you think about bugs on your crops, you probably think of the pesky little buggers feasting on your fields and orchards. Rightly so, since they can decrease yields, blemish the produce, and transmit plant diseases.

But, what about the other 95% of insects out there that don't cause trouble? You might be surprised to find out how much they can actually help you out! Here are some steps that you might consider taking to help them help you.

Include a variety of native plants (including flowering varieties) in and around crops to attract different types of natural enemies. This will help provide food and shelter for a variety of beneficial insects.

In small-scale agricultural settings, it may be possible to break up your plantings. Consider inter-planting a variety of crops to attract and shelter a variety of natural enemies.

After harvesting field crops, consider planting the area(s) with a variety of cover crops to provide habitat for some types of beneficial insects.

Practice Integrated Pest Management (IPM): identify the pest, decide how much damage can be tolerated, and select control methods that will be most effective while minimizing risks.

If you choose to use a pesticide, consider selecting one that will target your pest specifically, rather than using a broad-spectrum product. Biological pesticides, for example, often target a specific insect or group of insects.

Avoid treating plants that are in bloom. Pollinators and other beneficial insects may be visiting flowers. Don't forget, this includes flowering "weeds."

If possible, avoid applying pesticides to plants when natural enemies are present and active in the area.

Make sure that your plants will get the right amount of nutrients, water, air circulation, and sunlight. Healthy plants are often less susceptible to damage from insects and disease.

### Insects are Important to Agriculture

Insects are directly beneficial to humans by producing honey, silk, wax, and other products. Indirectly, they are important as pollinators of crops, natural enemies of pests, scavengers, and food for other creatures. There are at least 50 important crops that are grown in the United States that depend on insects to pollinate them.

Bee keeping also helps industry by producing honey with European honey bees (genus *Apis mellifera*). Honey bees produce such an abundance of honey, far more than the hive can eat, that

humans can harvest the excess. Bees have been producing honey, as they do today, for at least 150 million years.

Americans eat an average of 275 million pounds of honey each year. Beehive products also include wax that get made into candles, polish, and floor wax. The bad temper of the Africanized bee (Killer Bees), coupled with its ability to dominate a honey bee region and reduce honey bee production, puts beekeepers on edge.

Include a variety of native plants (including flowering varieties) in and around crops to attract different types of natural enemies. This will help provide food and shelter for a variety of **beneficial insects**.

In small-scale agricultural settings, it may be possible to break up your plantings. Consider inter-planting a variety of crops to attract and shelter a variety of natural enemies.

After harvesting field crops, consider planting the area(s) with a variety of cover crops to provide habitat for some types of beneficial insects.

Practice **Integrated Pest Management (IPM)**: identify the pest, decide how much damage can be tolerated, and select control methods that will be most effective while minimizing risks.

If you choose to use a pesticide, consider selecting one that will target your pest specifically, rather than using a broad-spectrum product. **Biological pesticides**, for example, often target a specific insect or group of insects.

Avoid treating plants that are in bloom. Pollinators and other beneficial insects may be visiting flowers. Don't forget, this includes flowering "weeds."

If possible, avoid applying pesticides to plants when natural enemies are present and active in the area.

Make sure that your plants will get the right amount of nutrients, water, air circulation, and sunlight. Healthy plants are often less susceptible to damage from insects and disease.

OBSERVE OPTIMIZE OUTSPREAD