

Course overview:

The courses designed to provide students with an overview of pest insects and pest management strategies, emphasizing ecological principles and their applications within the major agro-ecosystems of fruit trees cultivation.

Pest insect biology and management of the fruit production systems in temperate regions will be considered, as apple, grape, cherry, plum, peach, strawberry and other small fruit. Specific attention will be given to beneficial insects, biological control and IPM strategies.

The course will cover the following topics: Overview on general entomology; Key pest insect species of apple, grape, cherry, plum, peach, strawberry and other small fruit; Synthetic insecticides and Integrated Pest Management; Biological Control, Beneficial Insects in Organic Farming and Botanical Insecticides; Pollination Services.

Student learning outcome:

Detailed information has been provided on all major pests of crops as regards their taxonomic position, distribution, host range, life history, nature and symptoms of damage, seasonal abundance and their management. However, for minor pests their taxonomic position, nature and symptoms of damage and management have been covered with additional information wherever necessary. Major and minor pests have been differentiated by their text format.

Detailed Review of some basic terms about Economic entomology

Pests:

In layman terms pest is the organisms that disturbs the human life.

Scientific definition of pest is that those organisms which damage our cultivated plant, our forest, storage, domestic product including other aesthetic qualities are called pest.

In agricultural concepts, the pests are those organisms which harbor in cultivated crops that reduce quantity and quality of crops.

Entomology:

This is the branch of zoological science which deals with insect's morphology, physiology and their life cycle as well their importance to be studied.

Economic entomology:

This is the branch of entomology which deals with the economic aspects of insects on crop.

Insects:

It is generally defined as the animals of phylum arthropods of class insecta having

Characters of Class insecta:

1. Body divided into head, thorax and abdomen
2. Possess three pairs of legs, hence the name Hexapoda
3. Presence of one or two pairs of wings
4. A pair of antennae
5. Respiration by means of internal air tubes known as trachea
6. Genital opening situated at the posterior end of the body
7. Presence of metamorphosis (incomplete/complete) during development
8. Possess exoskeleton made up of hard cuticle which plays important role for survival.
9. Excretion is mainly by malpighian tubules which help in maintaining ionic Balance

Characters contributing to the success of insect.

1) Exoskeleton: The insect body has an outer exoskeleton or body wall made up of cuticular protein called as chitin. It is responsible for protection from, Desiccation or water loss, from the body Physical or mechanical injuries and to maintain shape and size of the body, providing area for muscle attachment, Giving strength to the body appendages

2) Small size: Insects, due to their small size, require less space (for shelter), food and energy for their survival and can easily escape from their natural enemies.

3) Functional wings: Two pairs of wings are mainly helpful for taking flight from one place to another in search of food, shelter or to find a mate, to oviposit or to get protection from their natural enemies.

4) High fecundity: Fecundity is defined as the egg laying capacity of a female insects. It helps to increase the population at faster rate.

- 5) Method of reproduction:** Insects can reproduce both sexually as well parthenogenetically.
- 6) Short life cycle:** Most of insects have very short life cycle i.e. 2 to 4 weeks which help insects to complete more number of generations in a definite period of time.
- 7) Complex metamorphosis** under hormonal control permits two distinct life-styles in most species.
- 8) Specificity of food:** There is diversity in food habits among different species of insects. As they differ in their preference for particular type of food, there will not be any competition among them. Less competition for food increases their chances of survival and further multiplication.
- 9) Morphological adaptations:** The body color and shape of some insects make them look like part of the plant, thereby protecting themselves from natural enemies: **stick insects** and **leaf insects**
- 10) Physiological adaptations:** Some insects produce or release poisonous or unpleasant odors from their body or possess warning coloration by imitating certain distasteful insects. **Eg: Stink bugs** have specialized exocrine glands located in the thorax or abdomen that produce foul smelling hydrocarbons. Some **blister beetles** (Meloidae) produce **cantharidin**, a strong irritant and blistering agent.
- 11) Behavioral adaptations:** It is a defense strategy adopted by some insects through feigning death or imitating the voice of dangerous insects or mimicry. **Eg: Colorado potato beetles** when disturbed draw their legs beneath and drop to the ground and pretend as if dead.

Economic importance of insects

The relationship between insects and humans is long and complex. Since antiquity, insects have infected us with disease, attacked our crops, infested our food stores, and pestered our animals. And although we derive considerable benefit from their services, including pollination, honey and wax production, and the biological control of pests and weeds.

A. Beneficial insects:

1. Pollinators of crops (Bees, wasps, butterflies, moths, hoverflies, beetles)

Many plants depend on insects to transfer pollen as they forage. Plants attract insects in various ways, by offering pollen or nectar meals and by guiding them to the flower using scent and visual cues. This has resulted in strong relationships between plants and insects. The value of crop production from pollination by native insects is estimated to be about \$3 billion in US alone. When we talk about pollinators the ones that come to mind are honeybees and butterflies, but there are also many other insects that perform this job for flowering plants, as well. There are flies, wasps, beetles and even some other insects that most people know nothing about, such as Hemiptera and thrips. There are many important pollinating insect species in the order: Hymenoptera (bees, wasps, and ants), Lepidoptera (butterflies and moths), Diptera (flies) and Coleoptera (beetles).

2. Predators of pests (Dragonflies, beetles, bugs, lacewings, wasps)

The arthropods predator of insects and mites include beetles, true bugs, lacewings, flies, spiders, wasps, and predatory mites. Insect predators can be found throughout plants, including the parts below ground, as well as in nearby shrubs and trees. Some predators are specialized in their choice of prey, others are generalists. Some are extremely useful natural enemies of insect pests. Unfortunately, some prey on other beneficial insects as well as pests.

Major characteristics of arthropod predators:

- • Adults and immature stages are often generalists rather than specialists.
- • They generally are larger than their prey.
- • They kill or consume many preys.
- • Males, females, immature stages and adults may be predatory.
- • They attack immature and adult prey.

Important insect predators include lady beetles, ground beetles, rove beetles, flower bugs and other predatory true bugs, lacewings and hover flies. Spiders and some families of mites are also predators of insects and mite pests. Natural enemies play an important role in limiting potential pest populations.

3. Parasites of pests (Hymenoptera and Diptera)

Parasitoids are insects with an immature stage that develops on or in an insect host, and ultimately kills the host. Adults are typically free-living, and may be

predators. They may also feed on other resources, such as honeydew, plant nectar or pollen. Because parasitoids must be adapted to the life cycle, physiology and defenses of their hosts, many are limited to one or a few closely related host species.

The most valuable insect parasites belong to the following groups:

- • Tachinid Flies (Diptera)
- • Ichneumonid Wasps (Hymenoptera)

These parasites live in or on one host insect pest which is killed after the parasite completes its development. Parasite (also called parasitoid) adults are free-living; the immature stage lives on or inside a host and kills the host before the host completes its development. Parasites lay one or more eggs on the outside of the host body or they insert the eggs inside their host. The immature parasite feeds on the host and requires only a single individual prey to complete its development. Free-living adults may feed on nectar from flowering plants or obtain nutrients by piercing the body of host insects and withdrawing fluids (host-feeding). Parasites are often considered more effective natural enemies than predators because many have a narrower host range, require only one host to complete development, have an excellent ability to locate and kill their host and can respond rapidly to increases in host populations.

4. Productive insects (Silkworm and Honeybees)

Sericulture

Is an agro-based industry. It involves rearing silkworms for the production of raw silk, which is the yarn obtained out of cocoons spun by certain species of insects. The major activities of sericulture comprises of food-plant cultivation to feed the

silkworms. Five varieties of silkworms are reared in India for producing this natural fiber. *Bombyx mori*, the silkworm, feeds on the leaves of mulberry to produce the best quality of fiber among the different varieties of silk produced in the country.

Apiculture or beekeeping

Is the rearing and management of honeybees is called apiculture. The genus *Apis* is comprised of a comparatively small number of species including the western honeybee *Apis mellifera*, the eastern honeybee *Apis cerana*, the giant bee *Apis dorsata*, and the small honeybee *Apis florea*..

B. Injurious insects:

They can be classified into the following categories.

- **Pests of agriculture and forestry (Locusts, caterpillars, bugs, hoppers, aphids etc.)**

Locusts are among the most destructive of all insect pests. Farmers in Asia and Africa are still plagued by swarms of desert locusts. Their threat is so great that regional and international organizations monitor desert locust populations and launch control measures when necessary. Locusts are particularly destructive in hot, dry regions when a sudden increase in their numbers, combined with food shortage, forces them to migrate. They migrate in huge swarms, devouring virtually every green plant in their path.

- **Household pests (carpet beetles, furniture beetles, cloth moth, termites and silverfish)**

Common household pests include ants, termites, bed bugs, carpet beetles, furniture beetles, book lice, house flies, fleas, cockroaches, silver fish, clothes moths and spiders - the list seems almost endless. Common household pests enter our homes for shelter and food, and also to nest and breed. Common household pests can cause damage to our homes especially clothes, eatables and furniture. Household pests can also be a threat to health of our families by spreading bacteria, diseases or allergens in our homes. Household pests can be irritating, annoying or irritating and annoying. They can be controlled by spraying insecticides or by fumigants and by maintaining hygiene.

• **Insects of medical and veterinary importance (Mosquitos, flea, beetles, flies)**

Mosquitoes can spread diseases such as malaria, yellow fever, dengue fever. Tsetse flies spread sleeping sickness. Lice suck human blood and can cause sores, which if left untreated can become infected which may lead to blood poisoning. Horseflies and black flies suck blood and have painful bites, which can become infected. Houseflies spread germs and spoil meat by laying eggs in it. Bubonic Plague (or Black Death) was the worst disease epidemic in human history. The plague is passed to humans by the bite of the Oriental rat flea (*Xenopsylla cheopis*), which picks up the disease-causing bacteria from rats.

Pests of stored grains

The most common insect pests of stored cereal grains are: Rice Weevil (*Sitophilus oryzae*); Lesser Grain Borer (*Rhyzopertha dominica*); Rust Red Flour Beetle: (*Tribolium* spp.); Sawtooth Grain Beetle: (*Oryzaephilus surinamensis*); Flat Grain Beetle: (*Cryptolestes* spp.); Indian Meal Moth (*Plodia interpunctella*); Khapra beetle (*Trogoderma granarium*); Rice moth (*Corcyra cephalonica*). Insect management for stored grain depends upon good sanitation and grain storage practices. Clean storage areas to reduce the potential for insect migration into the new grain.