Lectures Economic Entomology
PhD graduate students
Second Course
2023-2022

Instructor: Dr. Muslim A. Eletby, Associate Professor

Email: muslim.abdel_wahed@uobasrah.edu.iq

Department of Plant Protection
College of Agriculture
University of Basrah
Iraq

Lecture-1-Introduction Economic Entomology: Tuesday 21/3/2023

Introduction

Economic Entomology: -This is the scale of Entomology which is related to the study of insects either benefiting or harming to human or his products or in other definition (Insects which cause loses or happen benefit to human).

The general definition of pest: -

There are many definitions

1- This is a plant or animal detrimental to human or human concern.

2 -These organisms that cause nuisance to human. either directly or indirectly through their concern.

3 - These organisms which are competitor of humanity.

4-These undesirable organisms for human.

Taxonomy of pests

1- Vertebrate pests: -Birds (Pigeons, sparrow, crows) Mammals (Mice, rate, other rodents)

2-Invertebrate pests:-(Insects, arachnids, nematodes, gastropod and molluscs)

3-Weeds and plant diseases.

Why insect pests considered the most important group of pests?

This is because of their prevailing population with animal kingdom.

In this part of study, we are studying the economic insect pests attacking Horticultural plants (vegetable crops and fruit crops). See in Iraqi fauna (book Economic Entomology manual by Dr. Abdulla F. Al-Azawi)

Insects as Crop Pest

Farmers in the tropics lose up to 50% of their crops to pests including insects and plant pathogens compared with just 25–30% in Europe and the United States. Part of the problem is that pests are a year-round problem in the tropics, and farmers are often poorer and rarely have access to safe and effective pesticides, robust varieties of plants and adequate irrigation. As global temperatures rise, pests that are now confined to the tropics may spread to cooler parts of the world. Farms

at mid-latitudes may face a doubling of crop loss due to pests by the end of this century, with up to 40 percent of global crop production already lost to pests, according to FAO estimates, any migration into new land could see the scale of that destruction shoot higher. Insects injure plants by chewing leaves, stems and roots, sucking juices, egg laying or transmitting diseases. Less than 1 percent of insects are pests, but that small fraction can do expensive damage. Insects cause damage in a variety of ways.

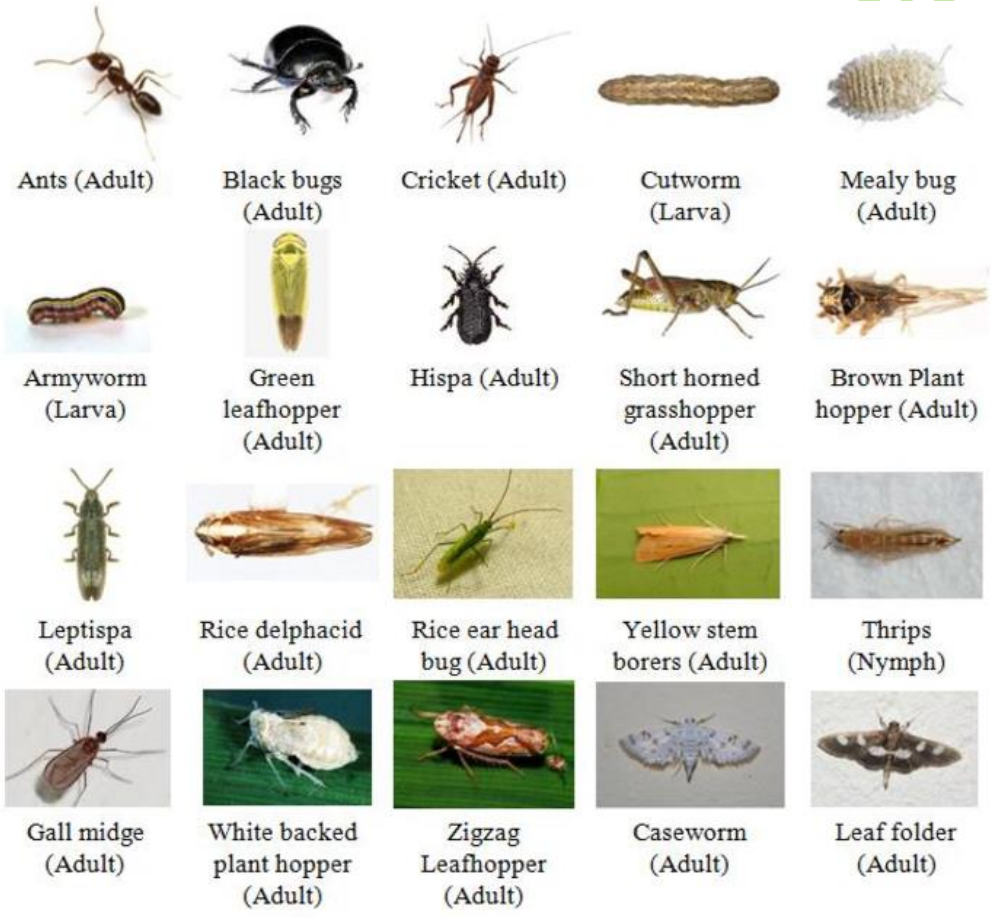

Fig. 3. One image from each of the twenty species of paddy field insect pests.

How insect pests injure Plant?

Insect pests injure vegetables by

1- chewing any part of plant (leaves, stem, root, fruit) such as grasshopper, locusts, mole crickets, beetles and worms.

2- sucking juice stink bugs, leafhoppers, spider mites, and aphids (plant lice).

3-by egg laying.
4- by making mines, to many orders {Diptera, Coleoptera, Lepidoptera, and Hymenoptera}.
5- by transmitting diseases insect are viral diseases and followed by parasitic fungi, bacterial diseases and finally diseases caused by protozoa.

Injury by Chewing Insects- Insects take their food in a variety of ways. One method is by chewing off external plant parts. Such insects are called chewing insects. It is easy to see examples of this injury. Perhaps the best way to gain an idea of the prevalence of this type of insect damage is to try to find leaves of plants with no sign of insect chewing injury. Cabbageworms, armyworms, grasshoppers, the Colorado potato beetle and the fall webworm are common examples of insects that cause chewing injury.

Injury by Piercing-Sucking Insects- Another important method which insects use to feed on plants is piercing the epidermis (skin) and sucking sap from cells. In this case, only internal and liquid portions of the plant are swallowed, while the insect feeds externally on the plant. These insects have a slender and sharp pointed part of the mouthpart which is thrust into the plant and through which sap is sucked. This results in a very different but nonetheless severe injury. The hole made in this way is so small that it cannot be seen with the unaided eye, but the withdrawal of the sap results in either minute white, brown or red spotting on leaves, fruits and/or twigs; leaf curling; deformed fruit; or a general wilting, browning and dying of the entire plant. Aphids, scale insects, squash bugs, leafhoppers and plant bugs are examples of piercing-sucking insects.

Injury by Internal Feeders- Many insects feed within plant tissue during a part or all of their destructive stages. They gain entrance to plants either in the egg stage when the female thrust into the tissues with sharp ovipositors and deposit the eggs there, or by eating their way in after they hatch from the eggs. In either case, the hole by which they enter is almost always minute and often invisible. A large hole in a fruit, seed, nut, twig or trunk generally indicates where the insect has come out, and not the point where it entered. The chief groups of internal feeders are indicated by their common group names: borers; worms or weevils in fruits, nuts

or seeds; leaf miners; and gall insects. Each group, except the third, contains some of the foremost insect pests of the world. In nearly all of them, the insect lives inside the plant during only a part of its life and emerging sooner or later as an adult. Control measures for internal feeding insects are most effective if aimed at adults or the immature stages prior to their entrance into the plant. A number of internal feeders are small enough to find comfortable quarters and an abundance of food between the upper and lower epidermis of a leaf. These are known as leaf miners. Gall insects sting plants and cause them to produce a structure of deformed tissue. The insect then finds shelter and abundant food inside this plant growth. Although the gall is entirely plant tissue, the insect controls and directs the form and shape it takes as it grows.

Injury by Subterranean Insects- Subterranean insects are those insects that attack plants below the surface of the soil. They include chewers, sap suckers, root borers and gall insects. The attacks differ from the above ground forms only in their position with reference to the soil surface. Some subterranean insects spend their entire life cycle below ground. In other subterranean insects, there is at least one life stage that occurs above the soil surface; these include wireworm, root maggot, pill bug, strawberry root weevil, and corn rootworm. The larvae are root feeders while the adults live above ground.

Injury by Laying Eggs- Probably 95% or more of insect injury to plants is caused by feeding in the various ways just described. In addition, insects may damage plants by laying eggs in critical plant tissues. As soon as the young hatch, they desert the plant causing no further injury.

Soil Insects- The soil insects include wireworms, white grubs, fire ants, cutworms, seed maggots and the sweet potato weevil. These insects can be damaging because they feed on the roots, stems and tubers of plants. Often soil insects, especially cutworms, are common in uncultivated soil sites that have had grass and weeds growing the previous season. These undisturbed areas often harbor high populations of soil insects. Once seeds or transplants are planted, soil insects are difficult to control and may begin feeding immediately on the crop. There is a real need for producers to inspect fields for soil insects prior to planting. One or two soil insects per square foot of soil can cause serious damage.

Oftentimes soil insects are clumped in a field, that is, they may be in one area and not in another. Low areas or those areas with the most vegetation often hold the most insects. Controlling soil insects is much easier if done prior to planting. Most insecticides for the control of soil insects should be applied 6 weeks before planting and incorporated into the top 6 inches of the soil. Liquid or granular materials may be used.

Chewing Insects- Many chewing insects have a complete life cycle. Therefore, depending on species, there may be one or two damaging stages. Grasshoppers have a chewing-type mouthpart but have an incomplete life cycle. Chewing insects include all species of beetles, grasshoppers and moths and butterfly larvae (most often called worms). Chewing insects damage foliage, stems and fruit. They may become as numerous as to completely defoliate plants. Eggs of most insects are laid on the plant, and the larvae upon hatching begin to feed. Others may invade the crop by "marching in" or by flying into the field. Control of chewing insects is basically twofold. One, the grower must watch for eggs and small larvae that begin to feed; two, he must watch for the adults and control them when necessary. Control of these insects is important in the early infestation of the plant. Often, the insect after hatching may bore into the fruit or stem and be hidden from pesticide applications. These insects often become numerous because producers do not begin treatment early enough. It is vital that fields be watched and these insects controlled at the earliest possible moment.

Sucking Insects- Sucking insects include aphids (plant lice), stink bugs, squash bugs, leafhoppers and spider mites. Spider mites are not insects but are just as damaging and numerous as are some insects. Sucking insects have an incomplete life cycle. After hatching from the egg, they may begin to feed and move about on the plant. They are usually attracted to the most succulent part of the plant. Aphids usually are found in the terminal or on flowers. Stink bugs and squash bugs readily feed on the tender fruit. These insects damage the plant by reducing the vigor or by injecting a toxin or disease-causing organisms into the plant. Heavy feeding may cause flowers to abort or the leaves to turn yellow and fall off. Feeding on the fruit may cause cat facing injury, hard spots or twisted and misshapen fruit. Control is easiest to obtain soon after the insects hatch from eggs. This is when the insects are the smallest and most vulnerable to the pesticide. Look for egg clusters, so that timing of the insecticide can be more accurate.

Most true bugs have large eggs that can be seen without the aid of a magnifying glass. They are often on the undersurface of leaves and laid in tight groups and glued together, or in the case of squash bugs, they may be laid singly but in a loose fitting group and not glued together.

Factors Governing the outbreak of Pests-

The word pest derived from French word 'Paste' and Latin term 'Pastis' means plague or contagious disease. Pest is any animal which is noxious, destructive or troublesome to man or his interests.

Categories of Pests

- Based on occurrence and locality

A) Based on association with the crop-

- **Regular pests:** Pests that occur more frequently on a crop having close association with particular crop. Example- Rice stem borer, Mustard aphid, Chilli thrips.




- **Occasional pests**: Pests that occur rather infrequently and have close association with a particular crop. Example- Rice horn caterpillar, Rice case worm Based on the Seasonality.



- **Seasonal pests:** Pests that occur on a crop during a particular season of the year. Example- Red hairy caterpillar in groundnut in Saurashtra and maize in Dahod in June – July.



- **Persistent pests:** Pests, which occur persistently on a crop almost throughout the year. Example- Thrips on chillies.


- **Sporadic pests:** Pests, which occur in a few isolated localities during some period. Occasionally causing serious damage. Example- Rice ear head bug, Mango shoot borer.

Based on intensity of infestations-

- **Epidemic pests:** Pests, which occur in severe form in a region or locality at a particular season. Examples- RHC in maize in Dahod in monsoon.

Endemic pests: Pests, which occur regularly and confined to a particular area of locality. Examples- Mustard aphids in North Gujarat, Rice Gall midge in Madurai district.

A

B

- **Migrant pests:** These pests are highly mobile and can infest crops for short periods of time through movement. Examples- Locust Others A. Exotic Pests: Non-Native or Non-Indigenous Pests not known to occur in the state or country.

B) Based on damage potential-

- **General Equilibrium Position: -** The average population density of insect over a long period of time, around which the pest population tends to fluctuate due to biotic and a biotic factors and in the absence of permeant environmental changes. It is unaffected by temporary interventions of pest control.
- **Damage Boundary: -** The lowest level of damage which can be measured.
- **Economic Injury Level: -** The lowest pest population density that will cause economic damage. It is the level before which the control measures are initiated.
- **Economic Threshold Level: -** The population density at which control measure should be initiated against an increasing pest population to prevent economic damage. Economic threshold level is always a pest density lower than that of the Economic threshold level.
- **Key pests:** These are the most severe damaging pests. The damage is always above the DB and Economic threshold level. General Equilibrium Position lies always above Economic threshold level. Human intervention may bring the population temporarily below the Economic Injury Level, but it rises back rapidly and repeated sprays may be required to minimize damage. Examples- cabbage diamond back moth.
- **Major pests:** These are pests with the population crosses Economic threshold level quite frequently and require repeated control measures to avoid economic damage. Damage >10%). General Equilibrium Position lies very close to Economic Injury Level or coincides with Economic Injury Level Examples- Cotton jassid, Rice stem borer.
- **Minor pests:** These are pests with population rarely crosses Economic Injury Level and fluctuates around Economic threshold level. But these pests are easily control by available control measures and a single application of insecticides. (5-10% damage). General Equilibrium Position is usually below the Economic Injury Level. These are occasional pests. Examples- Cotton strainers, Rice hispa.

- **Negligible Pest:** Population never increases high enough to cause economic injury. That cause less than 5% loss in yield, are said to be negligible pests.
- **Potential pests:** These pests normally do not cause any economic damage. Hence, they are not pests at present but any change in the ecosystem may make them to cause economic damage (Damage > 5%). General Equilibrium Position always less than economic Injury Level.
- **Sporadic pests:** General Equilibrium Position generally below Economic Injury Level. Sometimes it crosses Economic Injury Level and cause severe loss in some places/periods Examples- Sugarcane pyrilla, White grub, Hairy caterpillar.
- **Secondary pests:** These pests are usually kept under adequate control by natural enemies, but can increase and produce economic losses if the natural enemies are disrupted by agricultural practices.
- **Severe pest:** They have Economic Injury Level below the General Equilibrium Position. Regular and constant interventions with insecticides are required to produce marketable crops. Economic Injury Level decreases as the. value of crop increases. It also depends on the stage of the crop, stage of the pest etc.

A pest insect is one that is judged by man to cause harm to himself, his crops, animals or his property. In farming an insect may be classified as a pest if the damage it causes to a crop or livestock is sufficient to reduce the yield and/or quality of the 'harvested product' by an amount that is unacceptable to the farmer. Insects may be classed as pests because they cause damage directly to harvestable products, e.g. codling moth larval damage to apples, or because they cause indirect damage or harm in other ways, e.g. by causing a nuisance to livestock or humans or as vectors of plant or livestock diseases. There are a myriad of ways in which insects can cause harm and they have done so for the thousands of years that man has occupied the earth. Likewise, man's attempts to control or manage the harm caused by insects have a long and varied history. Knowledge of this history adds an important dimension to the study of pest management because it can provide insights into the driving forces that have forged current pest management practices which in turn will provide some idea of the forces likely to be acting in the future. Pest is a general term used to

describe any organism that is harmful to our health and properties including crop and livestock. The term, in its broader sense also includes microorganisms, parasitic plants and weeds. Pest outbreak factors affecting natural insect population the way that the numbers of an insect species change represent the balance of birth and deaths over a given time period Birth rate is influenced by

1. Weather and climate.
2. The food quality received by the adult's.
3. The degree of crowding of the individuals.

Crowding affects birth rate partly through affecting the quality of the food but also by more direct influences such as stimulating restlessness of individual's death rate is influenced by climate, natural enemies, diseases and crowding. The crowding may lead to cannibalism or starvation. Moreover, crowding may also lead to emigration which, like death, leads to a reduction in the number of individuals in an area. With natural enemies for own survival Directly Differential effect on organism and natural enemies Mortality e.g. Frost, storms Natality e.g. Fecundity, development rate Growth and condition of food plant indirectly with other species e.g. for food, ovipositor sites within the species e.g. Overcrowding, starvation.