

The abdomen contains two types of appendages, the cerci and genitalia. The genitalia or ovipositor (egg laying apparatus) provides the information about the egg laying habit/ability of insects i.e. whether the eggs are laid in the soil, on plant tissue, leaves or veins etc. If we know the place of laying eggs, we can easily remove/ destroy the eggs and thus control the insects.

### **2.3.2 Internal morphology**

The study of internal morphology provides information for effective control of insects. Knowledge about body cavity and tracheal system greatly helps in the control of insects. Many parasites/ parasitoids live in the body cavity of certain insects and thus help in the biological control of various crop pests. The fumigants (volatile insecticides at ordinary temperature) enter in the body of insects through spiracles and kill them. So, the type and application of insecticide greatly depends upon the internal morphology of insects.

### **2.3.3 Metamorphosis**

The metamorphosis tells us about the following:

- i. Different stages of an insects pest (i.e. through how many stages it passes in its life cycle)
- ii. Which stage is harmful
- iii. Which stage can easily be controlled
- iv. Where different stages are found (at which place they are living)

Information about the above mentioned points helps in control of insect pests.

### **2.3.4 Life history**

The study of life history is also very important for the control of insect pests because it gives us the information about the:

- a. Host plants of a particular insect pest.
- b. The duration of various life stages.
- c. Habits and behavior of the insect pests.

If we have the information about the above points, we can easily control the insect pests.

## **2.4 PRINCIPLES OF INSECT CONTROL.**

There are three basic principles of insect control:

### 2.4.1 Biotic potential

It is the hidden power of insects to live successfully even under unfavorable conditions of environment. This phenomenon is called biotic potential. Biotic potential is subdivided into reproductive potential and survival potential.

### 2.4.2 Environmental resistance

The sum of all factors affecting the life of insects is called the environment. Environmental factors which tend to reduce the population of insects are called the environmental resistance. The environment consists of the following two types of factors:

Physical or abiotic factors

Biological or biotic factors

#### A. Physical or abiotic factors:

1. **Temperature:** The insects can only live successfully under favorable or optimum condition of temperature. If the temperature is very high or very low, most of the insects are killed. The favorable temperature for most insects is 30-35 °C.
2. **Humidity:** The insects can only live successfully under favorable or optimum condition of humidity. Very high or very low humidity kills most of insects and thus reduces their population. The most favorable relative humidity for insects is 55-60 %.
3. **Light:** Many insects cannot survive and reproduce in darkness. As a result their population reduces.
4. **Rainfall:** High rains mostly kill the insects by physical beating. The insects are also drowned in rain water in fields.

#### B. Biological or biotic factors:

There are three important biological factors which reduce the population of insects;

1. **Competition:** The competition in the insects may arise for food, space, shelter, mating etc. competition is of two types:
  - a) When the individuals of the same species compete with one another, it is called intra-specific competition.
  - b) When the individuals of different species compete with one another, it is called inter-specific competition.

The above both types of competitions reduce the insects population.

**2. Parasites and predators:**

**Parasites:** the insects which live either on or in the body of other insects for getting food are called parasites. Parasites are of two types.

- Parasites which live on the body of insects are called ectoparasites or external parasites.
- Parasites which live in the body of insects are called endoparasites or internal parasites

The insects on which the parasites live are called hosts insects.

**Predator:** The insects which catch and eat away the other insects are called predators.

The insects which are eaten by the predators are called preys.

Both the parasites and predator are harmful to insects and greatly reduce their population.

- 3. Disease:** Many organisms like protozoa, bacteria, nematodes, fungi, virus etc. cause diseases in the insects and kill them and thus greatly reduce their population.

**2.4.3 Biological equilibrium**

It has been seen that the population of insects almost remains constant at specific time of the year. This is called biological equilibrium. Here naturally the question arises why population does not go very high or very low? When the factors like temperature, humidity, light, over-crowding, food etc. become unfavorable, then the population of insects decreases beyond a certain limit. These factors are called forces of destruction. On the other hand, when the population goes down beyond a certain limit, increased reproduction and strong survival help the insects to increase the population due to availability of food, less predators and parasitoids and less competition. These are called factors or forces of creation. As a result of these two forces, the population remains almost constant; this is called as biological equilibrium.