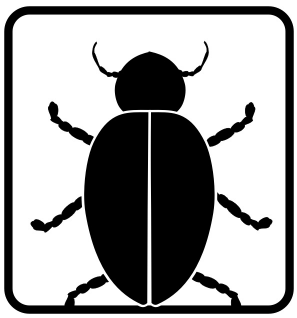
Section 27

Insects, Mites and Molluscs and Their Control

Insects



Insects are broadly classified into orders and families using physical characteristics. Some of the basic visual characteristics used in this classification include descriptions of:

- Wings: 0, 1 or 2 pairs
- mouth parts: chewing, sucking, rasping, sponging
- antennae: long, short, segmented, non-segmented, feathery, non-existent
- body segments and appendages: head, thorax, abdomen, legs (insects have 6 legs)
- relative size, colour, texture.

When confronted with insects in the field, it is often useful to note the type of damage (if any) that is being observed. Insects have different types of mouthparts: chewing, piercing-sucking, rasping and sponging. Each of these can cause very different types of damage to the plant, and can help you in determining the identity of the insect.

It is important to note that most insects are either beneficial or cause no damage to crops. Of the millions of species identified to date, less than 1% are considered agricultural pests. Many are predators or parasites that feed on other insects. They can be very important in reducing numbers of crop pests.

Insects typically begin their life cycle as an egg. Some insects are capable of giving birth to live young (eg. aphids). This allows their numbers to increase very quickly in the field. The next stage of development depends on the type of life cycle the insect has. An insect will complete 3 or 4 stages in the life cycle as it grows. Each change is referred to as a metamorphosis.

"Metamorphosis" describes the series of changes through which an insect passes from egg to adulthood. There are several forms:

- No metamorphosis (ametabolous)
- Simple or gradual metamorphosis (heterometabolous)
- Complete or complex metamorphosis (holometabolous).

Insect Development

Insects that have the "No metamorphosis" life cycle show no distinct external changes (except size) as they moult and develop. Life stages include: egg, "young", and adult. The young look much like the adult but are smaller and lack sexual characteristics (for example, silverfish, springtails).

In gradual metamorphosis, the insect completes 3 stages of development: egg, nymph or naiad, and adult (for example, grasshoppers, plant bugs, aphids). The nymph or naiad stage resembles a small adult in overall shape but generally lacks important features such as wings. Insects shed their skin several times as nymphs. The form that describes the given nymphal stage is referred to as an "instar". Nymphs have several instars before they become adults. With each successive moult, the nymph gradually develops the wing pads that will be present in the adult insect.

Insects that follow the complete metamorphosis life cycle have 4 stages: egg, larva, pupa and adult. The larva is the young, wingless feeding stage. Larvae do not look like the adults and may live in very different environments. "Maggots" are the larvae of flies, while "grubs" and "caterpillars" are the larvae of beetles and moths/butterflies, respectively. As with nymphs, there are several larval instars. The pupa is a resting stage during which a complete change of shape occurs. Adults may or may not feed. Beetles, moths, and ants are excellent examples of insects following this pattern of development.

Pesticides used in managing insect populations cover a wide range of chemistries and modes of action. It is important to recognize the stage of the insect because management tools are often specific to certain developmental stages. Depending on the product in question, the target life stage is typically the egg, newly hatched larva (smaller larvae are easier to kill) or the adult. Timing is often critical, particularly for internal feeders.

Insect Life Cycles

No Metamorphosis

egg → young → adult

(for example, Silverfish, Firebrats, Springtails)

Gradual Metamorphosis

egg → nymph → adult

(for example, Grasshoppers, all True Bugs, Earwigs, Thrips)

Complete Metamorphosis

egg → larva → pupa → adult

(for example, Bees, Wasps, Beetles, Moths, Butterflies, Flies)

Note: The number of moults in the young, nymph or larval stages vary with the insect species.

Mites

Mites differ from insects in that they only have two body parts: a fused head/thorax (cephalothorax) and an abdomen. The adult and most immature (nymphal) stages have four pairs of legs (a newly hatched mite – the "larva" - has three pairs). Mites do not have wings and are less than 1 mm in length. Mites have sucking mouthparts. Their feeding activities result in discoloured (eg. "bronzing", "russetting") fruit and/or foliage. They are often kept below threshold levels by beneficial insects and predatory mites; therefore, counts for pest mites should note the presence or absence of any predators.

Mite Development

Mites reproduce by laying eggs. Mites generally go through 3 life cycle stages: egg to larva/nymph to adult. As with insects, there are several nymphal instars. They are capable of rapid population increases, particularly under hot, dry weather conditions.

Molluscs (Slugs and Snails)

Slugs and snails are soft-bodied animals that move by means of a single ventral "foot". They have a distinct head with two pairs of tentacles. Snails have shells, while slugs do not.

Slugs and snails are active mainly during the evening and night, on cool overcast days or immediately following a rain. They spend most of the day hiding under damp refuse, rocks and other objects on the soil surface. They will often return to the same hiding place day after day, unless disturbed. The route they take out is usually retraced on the return trip, leaving a "slime trail".

Feeding damage often appears as ragged holes.

Mollusc Development

Slugs and snails reproduce by laying eggs. They have three stages in their life cycle: egg, nymph and adult.

Insect, Mite and Mollusc Control

Insects, mites and molluscs can reduce the quality and yield of many crops. They cause direct damage to the crop by feeding on the marketable portion of the plant, or cause indirect damage that may affect plant vigour and crop quality. They can also spread diseases from plant to plant and from field to field. They may also attack the harvested crop while it's in storage. The main reason to control these pests is economic – to maintain the potential value of your crops.

Insecticides, Miticides and Molluscicides

Insecticides, miticides and molluscicides are often described according to how they work (Site of Action).

How Insecticides, Miticides and Molluscicides Work

1. Stomach and Contact

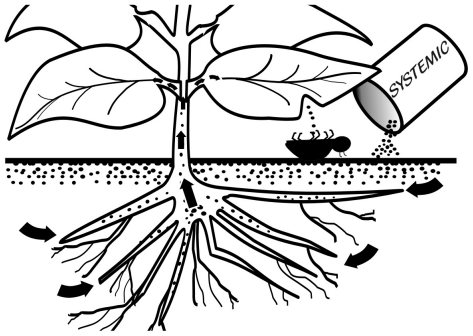
The earliest insecticides, called **stomach insecticides**, were poisons that were sprayed on the crop's leaves. These products poisoned the insects when they ate the treated crop.

New products, called **contact insecticides**, poison the insects on contact. Dust particles or spray droplets may hit the insect directly or be picked up as the insect moves across a sprayed area. The poison is taken in through the insect's body. Many of the older chemical classes (organophosphates, carbamates, pyrethroids) have broad-spectrum contact activity.

Today most insecticides are both stomach and contact insecticides. Good spray coverage is very important when applying this kind of insecticide. The better the spray coverage, the greater the chance that the insects will touch or eat the pesticide.

2. Systemic, Non-systemic and Translaminar Insecticides

Systemic insecticides can be applied to one part of the plant (such as the root or the leaf) and they will move throughout the plant to make the whole plant poisonous or toxic to insects. They are generally most effective on insects with piercing-sucking mouthparts that feed on the vascular tissues of the plant.



Non-systemic insecticides do not move throughout the plant. They stay where they were applied. The insect must eat or touch a portion of the plant that was treated with the insecticide.

Translaminar insecticides are locally systemic. This means that the material penetrates the leaf tissues, but unlike systemic products, does not move throughout the plant.

Points to remember about Systemic Insecticides

- Some systemic insecticides require a certain application method to be effective. Some must be applied to the root area. Others must be sprayed on the crop's leaves.

- The amount of chemical you apply to the plant is very important. Be sure to use the right amount to give the best control. As with all insecticides, follow the labelled rates to ensure that you are applying the correct dose. Ensure good coverage by using the recommended water volumes.

- You must allow enough time for the insecticide to move throughout the plant before the insects begin to feed on the crop.

3. Suffocating Insecticides/Miticides

Suffocating Insecticides/Miticides (usually oils) clog the breathing systems of insects and mites, and may also affect egg survival (for example, dormant oil for the control of scale insects).

4. Fumigants

Fumigants are insecticides that work in a gaseous or vapour form. The pests breathe the poisonous fumes. Fumigants are often used to kill pests in enclosed spaces or in soil (for example, grain bins).

5. Growth Regulators

Growth Regulators act like the insect's own hormones. They affect the normal development of the insect and it dies before it becomes an adult or before it can reproduce.

6. Pheromones

Pheromones are species-specific chemicals that insects use to communicate with one another over time and space. There are many types of pheromones in the insect world (alarm pheromones, aggregation pheromones, sex pheromones, other). Many female insects (and a few males) release sex pheromones to attract mates. By using synthetically produced sex pheromones in traps, growers and consultants can monitor for the presence and absence of specific pests, as well as first flight and peak adult activity. Synthetically produced sex pheromones are also successfully used in **mating disruption technology.** By blanketing the crop environment with artificial sex pheromone, males become confused and are unable to find females. As a result, mating does not take place and no fertilized eggs are produced. But remember, pheromones are highly specific and will only control the target species.

7. Repellents

Repellents are pesticides that repel pests, keeping them away from their hosts. They are usually used against mosquitoes and biting flies. Other examples include mothballs or crystals, and pet collars.

8. Sticky Pastes

Sticky Pastes are ointments that contain pesticides. Colours or other additives may be used to attract insects to the trap. Examples are insect strips, and wood preservatives.

9. Microbial Insecticides

Microbial Insecticides contain microbes (tiny organisms). After they are eaten, the microbe (or a poison the microbe produces) kills the insects. They are sprayed on plants and are only poisonous to certain insects.

Remember to read the label for complete instructions about how to use insecticides, miticides and molluscicides effectively.

How Well Do Insecticides, Miticides and Molluscicides Work?

A number of factors affect how well an insecticide, miticide or molluscicide works. These include:

Timing of Application

Monitoring is critical to the successful implementation of any pest management program. The best time to apply an insecticide, miticide or molluscicide depends on the type of product and the stage of development of the pest. Most pest controls are aimed at a specific stage of the life cycle, when the pest is most susceptible. Insecticides may only be effective against young larvae, or before internal feeders enter the plant, where they are often protected from contact poisons. In the case of mating disruption technology, for example, where the goal is to prevent the fertilization of eggs, the product MUST be applied prior to the onset of adult activity in the field. Monitoring will alert you to pest activity, will indicate when populations reach threshold levels and thus provide information on when and where treatment is warranted.

Resistance

Some insects, mites, and molluscs have developed resistance to certain pesticides or groups of pesticides. See the **Managing Pest Resistance** Section in this manual.

Weather conditions

Temperature, humidity and rain can affect the effectiveness of insecticides, miticides and molluscicides.

Review Questions

1. How do mites differ from insects?

2. Each change in an insect's life cycle is known as a metamorphosis.

   TRUE FALSE

3. An insect that goes through complete metamorphosis has the following stages in its life cycle:

   a) Egg; young; adult
   b) Egg; larva; pupa; adult
   c) Egg; nymph or naiad; adult
   d) Egg; young; nymph; adult

4. A stomach insecticide poisons the insects when they eat the treated crop.

   TRUE FALSE

5. Systemic insecticides:

   a) protect plants from environmental diseases.
   b) are applied in a gaseous form to penetrate the plant.
   c) stay where they are applied to concentrate protection.
   d) move throughout a plant to make it toxic to the insects.