Chapter
6

INSECTS AND MITES

Insects and mites are common landscape pests. To manage them using IPM, you must:

- Identify them correctly
- Know their life cycles
- Know their biology
- Know the available treatments and their timing

The following section provides information on insect and mite biology. A range of available treatments is also discussed.

There are many species of insects. Many are beneficial and pollinate flowers, or prey on pests. A few species damage plants and become pests. Insects and mites are considered pests when they reach high enough numbers to cause damage (injury thresholds). When this occurs, they are usually controlled and steps are taken to prevent damage in the future.

However, it is often good to have pest species present in low (non-damaging) numbers. They can provide food for their natural enemies and other beneficial organisms. When pests are removed completely, their natural enemies starve or leave the area.

Adult insects have jointed bodies, jointed legs and an outer skeleton (exoskeleton). They have three main body sections: head, thorax, and abdomen. They have three pairs of legs. Most have two pairs of wings attached to the thorax. Insects breathe through spiracles (openings) in the outer skeleton. Most insects have compound eyes although some have simple eyes.

Mites are related to spiders. They have jointed bodies, jointed legs, and an outer skeleton. Mites differ from insects in that they have only two main body parts: a combined head and thorax section, and an abdomen. Adults have four pairs of legs although some only have three pairs of legs until they mature. All species of mites are wingless.

Insects and mites can damage plants through feeding or egg laying activities. Some insects such as flower thrips can damage plants when they lay their eggs inside the plant tissue.

Insects have a number of mouthpart types. Insects that damage landscape plants often do so by:

- Chewing (e.g. leaf beetles and caterpillars)
- Sucking (e.g. aphids)

Other insect mouthpart types include:

- Siphoning (e.g. butterflies and moths)
- Lapping (e.g. bees)

Mites feed by sucking plant sap. This causes damage that appears as browning or mottling of the leaves. Some species secrete a substance when feeding which causes galls to form on the plant (e.g., maple gall).

Learning Objectives

Completing this chapter will help you to:

- **Describe the body parts of insects and mites**
- **List major differences between insects and mites**
- **Give the two main types of insect life cycles**
- **Know common insect and mite pests. Know how to manage them using IPM**
- **Know the types of insecticides. Give an example of each**
- **Know what affects the effectiveness of insecticides**
- **Be familiar with the identification, biology and monitoring of common insects pests found in Atlantic Canada**

Life Cycles of Insects and Mites

Insects and mites change as they grow. They pass through three or four stages from egg to adult. Common stages are: egg, larva (or nymph for certain insects), pupa, and adult. A generation is the time that it takes for an insect to complete all of the life stages. Some species of insects and mites have one generation per year. Others can have two or more generations per year. For multi-generation species, the number of generations in a growing season will depend on climate and weather.

Insect Lifecycles

Metamorphosis is the change in insect shape and form as it develops from egg to adult. There are two main types of metamorphosis: complete metamorphosis and gradual (incomplete) metamorphosis.

Complete Metamorphosis

Insects that have complete metamorphosis (see Figure 6-1) begin as an egg. The **egg** hatches into a worm-like **larva** (e.g., caterpillar, maggot or grub). The larva is usually quite different from the adult in appearance. Larvae also eat food that is different from what is eaten by adults. Most larvae eat a large amount as they develop. As it grows, the larva sheds its skin (moults).

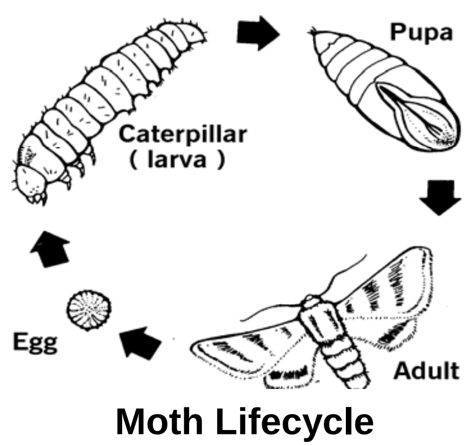

Figure 6-1: The moth lifecycle is an example of complete metamorphosis.

Some species can moult or shed its exoskeleton, three or more times during growth. Each stage between moults is called an instar. When a larva reaches full size, it transforms into a **pupa**. A pupa is a non-feeding stage that moves very little. Inside the pupal case, the larva becomes an **adult**. When the change is complete, the adult splits the pupal case open and comes out. The adult is the reproductive stage. In most species, adults have two pairs of wings. Some insects have no wings as adults. Flies have only one pair of wings.

Gradual or Incomplete Metamorphosis:

Insects that have gradual or incomplete metamorphosis (see Figure 6-2) start as an **egg**. The egg hatches into a **nymph** . The nymph looks like a small adult, but it has no wings or reproductive organs. The nymphs often live in the same habitat and eat the same food as adults. As the nymph grows, it moults. With each change, it looks more like an adult. On the last moult, the nymph develops into an **adult** with wings and reproductive organs.

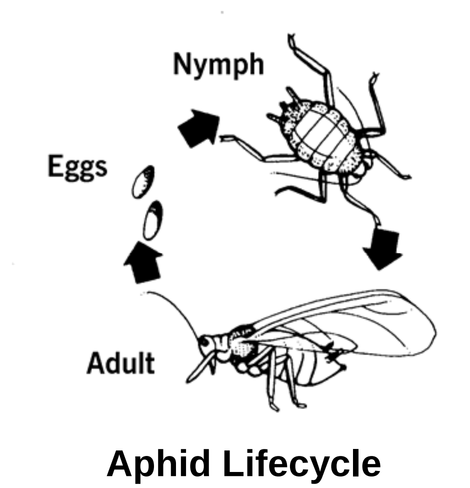

Figure 6-2: The aphid lifecycle is an example of gradual or incomplete metamorphosis.

Mite Life Cycles

Mites develop in four stages: egg, larva, nymph and adult. The adult is the reproductive stage.

Managing Insects and Mites

To manage insects and mites using IPM, ensure the pest is correctly identified and consider:

- The biology of the pest
- Its natural enemies
- The host plant
- The environmental conditions favoring development
- The available treatments (biological, physical, chemical)
- The risk of the treatment chosen to humans and animals
- How the pest can be prevented in the future

For additional information see **Chapter 2: Human Health; also Applicator Core Manual Chapter 7: Integrated Pest Management.**

A general IPM approach for insects in turf and landscape is described below. See the fact sheets at the end of this chapter for information on prevention, identification, monitoring, injury and action thresholds, treatments, and evaluation that apply to common pests in Atlantic Canada.

Prevention

In turf and landscape settings a variety of cultural practices are often used to prevent pest damage from occurring. Either the landscape or turf manager or the client can perform many of these tasks. If they are to be done by clients, the clients need to know the value of these practices and how they fit into the IPM program.

To prevent pest problems in ornamental and turf plants:

- On new sites, start with a good site design and planting plan.

- Make changes in existing sites to improve design.

- Make sure soil conditions are right for the intended plants.

- Evaluate and correct drainage, fertility, pH, soil texture and depth.

- Choose landscape plants (e.g., turf grass species) that suit the site and intended use. Choose resistant varieties where possible.

- Look at sun and shade, soil type, drainage, wind patterns, exposure, climate, and microclimates.
- Choose diverse species of families of trees and shrubs. This avoids monocultures that promote pest problems.

The 20-10 Planting Rule

To ensure diversity in the landscape, choose no more than 20% of plants from any one plant family. Have no more than 10% from any one genus. For example, 20% of shrubs and trees can come from the family Rosacea. No more than 1 in 10 plants should come from each genus (e.g., Pyracantha, Spiraea, Rubus, or Malus). For general use turf areas plant a mixture of turf grass species.

Select and Maintain Healthy Plants

Choose well grown planting stock that has been properly tended. Check the roots and foliage of new stock for pests before buying. Maintain healthy plants by doing the following:

- Give plants a good start through proper planting.
- Do not over-fertilize trees and shrubs.
- Use slow release nitrogen fertilizers on turf.
- Install irrigation that can be set to meet the water needs of landscape turf, shrubs, and trees.
- Prevent insects and diseases from damaging trees and shrubs. Use proper pruning methods to speed wound healing.
- Protect trees from injury by mowers, line trimmers, and construction.

Figure 6-3: Poorly maintained turf and landscape areas are more attractive to pests and are more likely to be damaged.

Insect Identification

The majority of insects found in landscape and turf areas are not pests. However, a number of insect species do attack the plants that are grown in Atlantic region landscapes. Of these only a few species do enough damage to warrant treatment.

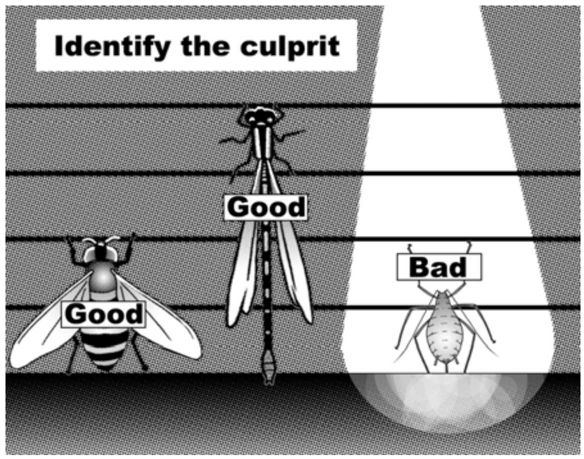

Figure 6-4: Many insects are found in the turf and on landscape plants but only a few species can actually cause damage.

It is as important to identify beneficial insects and mites as it is to identify pests. There are more beneficial species than pest species. An unknown insect is not likely to be a pest. Recognizing beneficial species allows you to decide if treatments are needed. Some species of beneficial insects help keep pest populations in check. A good-sized population of these can reduce the number of pests.

To identify insects and mites, use:

- Reference books and insect guides (given at the end of chapter 8)
- Local resources on the internet
- Agricultural colleges and universities
- Professional diagnostic services

Monitoring

Monitoring provides the information needed to make decisions on managing pests. It helps you to decide if treatments are needed. You can also decide where and when treatments are most likely to work. Monitoring programs can be based on the pest history of the site and weather conditions (e.g., growing degree days).

Monitoring for insects and mites is often done weekly when pests are expected. Keep written records of monitoring.

Insects can be monitored using the following:

- **Visual Inspections** use a hand lens or magnifying loupe to look at plant shoots, buds, leaves, bark and roots (if possible). Look for signs of insect damage such as curled, rolled or malformed leaves or shoots. Mite damage on leaves shows up as yellow and speckled areas and in some cases galls. Fine webbing may also be present. Look for sticky honeydew patches on leaves. Check for borer holes in tree trunks.

- **Indicator Plants** are landscape plants or turfgrass areas that indicate the presence of the pest. Careful observation over a number of years will reveal which plants in an area are most susceptible to attack by certain pests whether due to their age, variety or poor growing conditions. These plants can be used as an early warning system that a pest problem has emerged in the area. If these are checked first, and no pests are found, there is usually no need to check other plants. Using indicator plants requires careful observation and record keeping. The pest manager must know which plants to check first. This method is useful in checking for aphid attack in early spring.

- **Counting Methods** involve counting the number of insects found in a turf area, leaf samples or plant. This information can be compared to future counts. Some insects and mites can only be counted under a magnifying loupe or microscope. Insects in turf roots can be counted by removing a plug of turf or by folding back a measured section of sod. Count the insects in the soil among the roots.

- **Drenches (floatation method)** allow some turf insects (e.g., chinch bugs and leatherjackets) to be counted by driving them out of turf with an irritant drench of lemon-scented dish soap or mixed in water. Apply the drench with a watering can to a marked or measured area of turf, **OR** pour it into a large, bottomless tin can pushed 5 to 10 cm into the turf. After 15 minutes, larvae and adult sod insects will wiggle to the sod surface. These can be counted.

- **Pheromone Traps** are used to look for cutworms, leaf rollers, clearwing borers, and others. The trap has a pheromone lure that emits an odour that attracts the insects. Most traps use synthetic sex pheromones that simulate the odour given off by female insects to attract males. Each type of lure attracts only one species (or a few closely related species). The inside of the trap is coated with glue. Males are caught as they come to the trap. When using a pheromone trap, check it each week and count the number of males caught. The counts can be used to tell if the population of insects is reaching a peak. This allows you to time sprays, to have the most effect on young larvae shortly after hatching from eggs.

- **Sticky Traps** are yellow traps coated with glue. These are used in indoor plantscapes and greenhouses to catch whiteflies, flower thrips, fungus gnats, shore flies and other insects that are drawn by the bright yellow. Check the traps each week. Count the total number of insects and species caught. Bright blue traps can also be used for flower thrips. White traps can be used for tarnished plant bugs. Sticky traps also attract beneficial species. This makes them less suited for outdoor use.

- **Beating** involves sampling insects by shaking (shrubs) or beating the trunks of trees with a padded stick. The insects are knocked into a canvas tray held below. This method is used to count elm leaf beetles, leafhoppers, weevils, sawflies, and some species of caterpillars. It is also a good way to check for lady beetles, lacewings, and other beneficial insects. Mites on evergreens can be monitored by tapping foliage over a clipboard covered with a sheet of white paper.

Injury and Action Thresholds

It is difficult to set injury and action thresholds that work in all situations. Thresholds for insects and mites in the landscape can be defined using:

- Percentage of leaves damaged on a given plant
- Percentage of plants affected on a site
- Number of pests counted per leaf or shoot for landscape plants, or area for turf
- Number of pests counted against the number of beneficial insects present

For turf pests, the number of insects that can be tolerated (injury level) often depends on the health of the turf grass. Healthy turf quickly fills in thin or sparse areas caused by insect feeding. Poor turf can show damage from insect numbers that would have little or no effect on healthy turf.

Treatments

An IPM program often uses one or more treatment methods. Treatment can involve any combination of:

- Prevention or cultural methods (discussed above)
- Physical methods

- Mechanical methods
- Biological methods
- Chemical methods

Some treatments are more effective on immature stages (nymphs or larvae). Others are more effective against adults. Using a number of treatments that attack pests at different stages is more likely to succeed. For example, insecticides do not affect insect eggs and pupae. Many beneficial insects feed on insect eggs or pupae. Attracting beneficial insects and taking steps to protect them if insecticides are used can increase the success of an integrated pest management program.

Physical and Mechanical Control Methods

Physical control methods for pests on ornamentals include the following:

- Use strong sprays of water to control aphids, spider mites, and some sawflies, such as roseslug and pearslug (*Endelomyi* spp.).

- Remove infested leaves or branches by hand (e.g., pruning out webworm nests or removing scale infested branches).

- Use sticky tree bands to trap female winter moths when they climb trees to lay eggs in late fall. This should not be used during the growing season. It traps many beneficial species.

Biological Control

Promoting populations of native beneficial species is the most common way to use biological control in the landscape. Native species are free of charge; they just need to be protected. The best way to protect native beneficial insects and mites is to avoid using pesticides. If pesticides are to be used, avoid broad-spectrum pesticides and pesticides with a long residual activity.

Native beneficial insects are attracted to landscape plants for pollen and nectar. In many beneficial species, only the larvae are predators. The adults eat plant nectar. When females can feed on pollen and nectar, they are likely to stay in the area and lay eggs. These hatch into predatory or parasitic larvae that feed on pests. Many annual and perennial plants are good for attracting beneficial insects. Where possible, design a landscape planting to attract beneficial insects. This can be as simple as planting an edging of sweet alyssum around a bed of roses. This will attract predators of rose aphids.

PLANTS THAT ATTRACT BENEFICIAL INSECTS

Many ornamentals plants attract beneficial insects. These include plants in the:

- Carrot family (Apiaceae)
- Mustard family (Brassicaceae)
- Mint family (Lamiaceae)
- Aster family (Asteraceae)

Table 6-1: Plants that attract beneficial insects.

Plants that Attract Beneficial Insects	
Alyssum	**Phacelia**
Aster	**Potentilla**
Basket-of-gold (Aurinia saxatilis)	**Rudbeckia**
Beebalm (Monarda sp.)	**Salvia**
Calendula	**Schizanthus**
Candytuft (Iberis sp.)	**Shasta daisy**
Coreopsis	**Speedwell (Veronica sp.)**
Cosmos	**Sedum**
Feverfew (Chrysanthemum parthenium)	**Sweet alyssum (Lobular maritime)**
Golden marguerite (Anthemis tinctoria)	**Marigolds**
Thymes	**Verbena**
Goldenrod	**Yarrows (Achillea sp.)**
Lavenders	

USING COMMERCIAL NATURAL ENEMIES

Most beneficial species sold in Canada are intended for use in indoor plants and greenhouse vegetable crops. A few are useful in outdoor landscapes. There are restrictions on importing living organisms from the United States. Permits must be obtained from the Pest Management Regulatory Agency. A provincial permit may also be required. **Contact your provincial regulator to determine what additional permits are required prior to importing any species.** Examples of commercially available natural enemies include:

- **Aphid midge**, *Aphidoletes aphidimyza*: This is a native species. It is mass-produced to control indoor and outdoor aphids. These are used in roses, shrubs, and street trees outdoors. They are also used in nurseries and indoor plantscapes.

- **Insect parasitic nematodes** (several species are available): These are tiny parasitic worms that attack insects. They are mixed with water and applied as a soil drench. Parasitic nematodes control root weevil larvae, white grubs, and other soil insects. Each species of nematode is only effective against a certain species of insect.

- **Predatory mites**: A number of hardy native species *(Amblyseius spp.* and others) can be purchased. These control spider mites, European red mites, flower thrips, and cyclamen mites outdoors.

Most beneficial insect species for sale only attack a certain species of pest. Proper identification of pests is needed to avoid a wasted effort. Do some research before purchasing biological controls. Make sure that available species are the correct ones to control the pest problem. Talk to colleagues and experts with experience in biological controls. Contact vendors to find out availability and recommended release rates. Because biological controls are living, organisms and may perish, they must be handled carefully; most must be released as soon as they are received.

Types of Insecticides and Miticides

Insecticides are pesticides with active ingredients that are used to kill, attract, repel, or alter the growth of insects. Active ingredients can be natural or synthetic. Miticides attack mites. Insecticides and miticides are often classified by the way they work, their residual effect, and selectivity. The following are classes of insecticides and miticides:

- **Contact Insecticides and Miticides** must contact the pest to work. They can be applied to pests or to surfaces that pests are likely to touch. Some contact insecticides (e.g., malathion and methoxychlor) have a **residual effect**. These can kill insects (including beneficial species) for a number of weeks after application. Others (e.g., pyrethrins) break down within a few days.

- **Stomach Poisons** must be swallowed by the pest to be effective. They are often applied to the plant where the pest is feeding.

- **Systemic Insecticides and Miticides** are a special group of stomach poisons. They are often applied to the host plant and move inside the plant tissue through sap. Target pests are killed when they suck poisoned sap or eat poisoned plant parts. Dimethoate is the only systemic insecticide used in landscapes. It is both a systemic and contact pesticide.

- **Suffocating Insecticides and Miticides** are mainly horticultural oils. They clog the breathing systems of insects and mites. They can also disrupt egg membranes and keep them from hatching. Dormant oils are used for scale and other insect pests when trees are dormant during winter. Summer, or growing season oils can be used on some landscape plants while they are in leaf.

- **Fumigants** work as gases. In soil fumigation, they are applied to soil and move through air spaces between soil particles. Insects and mites breathe poisonous fumes and are killed. Fumigants are not used in landscapes. Landscape use is limited to treating infested soils in nursery production of ornamentals. **A separate class of pesticide applicator certificate is required to apply fumigants.**

- **Insect Growth Regulators (IGRs)** are natural or synthetic insect hormones. IGRs disrupt normal moulting and growth. These hormones disrupt development at crucial times in the life cycle. The pest dies before reaching the adult stage and does not reproduce. Kinoprene is an IGR for use on certain greenhouse ornamentals to control aphids and whiteflies. Tebufenozide is another IGR used to control the caterpillar stage of moths (e.g., codling moth, leafrollers, winter moth, and others).

- **Silica Dusts or Gels** kill crawling pests by causing them to dry up. Contact insecticides are sometimes mixed with these powders. Silica pesticides are not often recommended for use in landscapes. As they also kill beneficial insects. Silicon dioxide (diatomaceous earth) is the active ingredient in a number of silica dust pesticides used for crawling insect pests. They are often used in buildings for structural pest control.

- **Sticky Glues and Pastes** are spread on surfaces or traps to capture insects. Colours (bright yellow, white, or bright blue) or chemical attractants are used to draw the insects to the traps. Sticky pastes are used as barriers to capture crawling pests. Sticky bands on tree trunks are used to capture female winter moths. They cannot fly and must climb tree trunks in late fall to lay eggs. Tree bands can be used to catch ants that protect aphid colonies on trees and shrubs. However, in general, they are not often advised for outdoor trees during the growing season because they also capture many beneficial insects.

- **Microbial Insecticides** contain microorganisms (tiny organisms). Most are insect diseases. Microbials are often sprayed on plants that are being eaten by larval insects. Once the microbes are eaten by the insect, they cause it to become ill. *Bacillus thuringiensis (BT)* is the most widely used microbial insecticide. The bacteria produce a toxin in the insect's stomach that prevents food from being absorbed into its body. The insect stops feeding immediately. After several days, it dies from starvation. Microbials are selective. The disease effect is often limited to a few species of related insects. For example, *BT* strains that affect caterpillars (*Bacillus thuringiensis kurstaki*) do not harm birds or beneficial insects that feed on caterpillars. *Bacillus thuringiensis israelensis* is used for certain fly larvae. It is mainly used on ornamentals for fungus gnat larvae control in greenhouse production. *Bacillus thuringiensis tenebrionis* affects certain beetle larvae (e.g., elm leaf beetle).

When choosing insecticides to use in IPM, the following should be considered:

- **Residual effectiveness** is the length of time that an insecticide remains effective after being applied. Some insecticides do not have a residual effect (e.g., insecticidal soaps or horticultural oils). Others have a short residual period of a few hours (e.g., pyrethrins). Some insecticides have a residual period of a number of weeks. Pesticides with short, or no residual effects are best suited for use in an IPM program. They have the least impact on natural enemies of pests. When a monitoring program is used, applications of insecticides can be correctly timed. Long residual effects are not needed.

- **Selectivity** is the tendency of an insecticide to only control certain insects or mites. They do not harm a broad range of insects, mites, or non-target organisms. For example, the microbial pesticide *BTK* only affects certain caterpillars. **Non-selective** insecticides affect a wide range of insects or mites, including beneficial species. They can also harm non-target organisms. Extra caution should be taken to limit the use of these insecticides. Ensure that they are only used when and where monitoring shows they are needed.

Factors Affecting Insecticide and Miticide Efficacy

The effectiveness of insecticides and miticides is affected by a number of factors including:

- **Timing of application:** Some life stages of insects and mites are not affected by pesticides. For example, many pesticides have little effect on insect eggs or pupae. In most cases, the younger the larval stage, the easier it is to control with contact and stomach poisons. Some pesticides work best on the adult stage.

- **Weather conditions:** Temperature, humidity and rain can interfere with some pesticides. High temperatures can quickly break down some chemicals. Frost can impair the effect of sprays such as horticultural oils. Rain can wash sprays from plants before pests come into contact with them.

- **Resistance:** Some species (mainly farm crops) have developed resistance to some pesticides or pesticidefamilies. Refer to the **Applicator Core Manual** for more information on resistance.

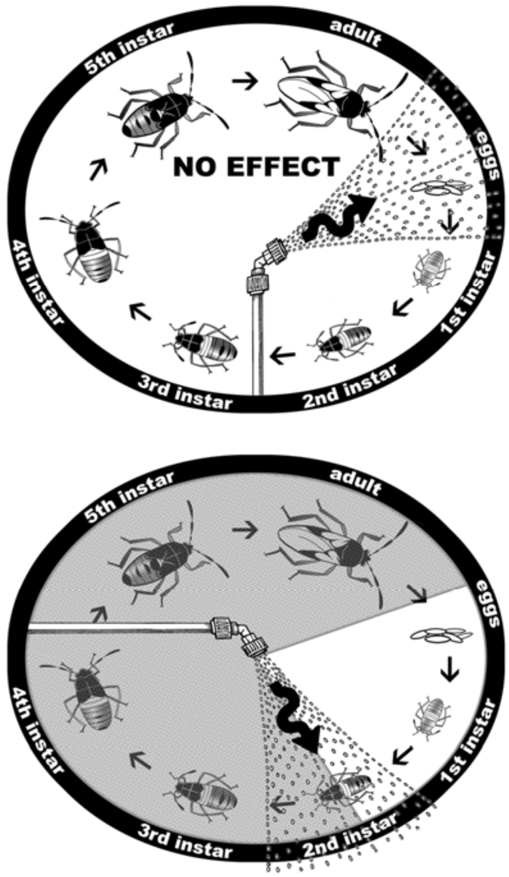

Figure 6-5: If pesticides are applied at the wrong stage of a pest's life cycle, they will not control the pest. Each pest has an optimum time/stage in their lifecycle where pesticide treatment is most effective.

Evaluation

At the end of each season review all aspects of the IPM program, consider the results obtained and identify any changes that can be made to improve the program's effectiveness. Before the next season starts, determine if there are new products and tools that could be used in the program.

Slugs and Snails (Molluscs)

Slugs and snails are molluscs. They have soft-bodies and move using a single "foot." They have a distinct head with two pairs of tentacles. Snails have shells, while slugs do not. Molluscs are common landscape pests in wet and humid areas of the region. To use IPM, you must first establish that slugs are causing a problem. They are often identified by their damage, because they are active at night. To plan proper control, it is important to know their biology. The following section provides information on mollusc biology and available treatments.

Life Cycle of Slugs and Snails

Snails and slugs have three stages in their life cycle. They begin life as round or oval translucent eggs. These eggs are often laid in jelly-like masses. The eggs hatch to produce immature nymphs. The nymphs mature into the adult stage. It may take a number of months to years for slugs to mature.

Managing Slugs and Snails

Land slugs and snails are mainly active at night, on cool cloudy days, or right after rain. During the day they hide in moist areas under objects or debris on the soil surface. Slugs and snails are somewhat territorial. They return to the same hiding place nightly. Molluscs leave slime trails as they travel. Slime protects molluscs from injury. Slime trails can be used to determine the cause of damage to plants. When conditions are dry, molluscs tend to avoid dusty, dry, and sharp materials. These materials can be used to protect plants when conditions are dry. They will not protect plants in wet conditions.

An IPM approach for dealing with molluscs is described next:

Prevention

Change the conditions that allow molluscs to thrive. Remove objects and refuse from the surface of the soil. These serve as hiding places for slugs and snails. Thick organic mulches and weeds provide slug habitat. They should be removed from perennial beds and borders in the spring when conditions are wet. Irrigate landscape beds in the morning. This will allow the soil surface to dry out before evening when slugs are active.

Identification and Monitoring

Signs of mollusc damage include ragged holes in leaves and slime trails. Molluscs can be seen feeding on plants at night using a flashlight. This helps you to see the extent and location of the problem.

Treatments

Physical Control

- **Copper strips** repel molluscs. Strips can be wrapped around trunks of woody plants or used as edging on nursery beds. Slug barrier tapes can be bought in stores.

- **Baited traps** attract and drown slugs in fermenting liquid. Baits include beer or yeast dissolved in water. Baits can be set out in homemade or purchased traps that are set in the soil. The trap lip is set flush with the soil surface.

- **Hand picking** can help control molluscs if done on a regular basis. During the day, slugs can be found under boards or other objects and destroyed. If performed daily, this can deplete the local slug population. Slugs are territorial. It takes time for slugs to move in from elsewhere.

Chemical Control (Molluscicides)

Molluscicides are pesticides that kill, attract, repel, or alter the growth of slugs and snails. Common molluscicides attract slugs to feed on bait pellets that contain pesticide. There are two active ingredient registered for use in Canada:

- **Metaldehyde**: Metaldehyde is the oldest and most widely used molluscicide. It attracts and poisons slugs. Liquid and bait formulations are available. In bait form, it can be quite attractive to dogs and can result in poisoning. It poses a risk to children, pets and wildlife if eaten.

- **Ferric (iron) phosphate**: Ferric phosphate is a newer molluscicide. It comes in bait pellets. Ferric phosphate is quickly replacing pesticides with metaldehyde. It is not as attractive or poisonous to non-target organisms. The bait is eaten by molluscs. It disrupts slime making. This causes the molluscs to dry up and die.

In Review

There are many species of insects and mites. Only a few species cause damage to plants. Insects and mites damage plants by feeding or by laying eggs in plant tissue. Insects have three main body sections: head, thorax, and abdomen. Most adult insects have three pairs of legs and two pairs of wings. Mites, which are closely related to spiders, have a combined head and thorax section and an abdomen. Adult mites have four pairs of legs and are wingless. Insects and mites change as they grow through a process called metamorphosis. To manage insects and mites using IPM, ensure the pest is correctly identified and consider:

- **The biology of the pest**
- **Its natural enemies**
- **The host plant**
- **The environmental conditions that favor development**
- **The available treatments (biological, physical, and chemical) The risk to humans and animals**

Treatment can involve any combination of:

- **Prevention or cultural methods**
- **Physical methods**
- **Mechanical methods**
- **Biological methods**
- **Chemical methods**

There are many different types of insecticides that can be used to control pest insects. When choosing insecticides to use in an IPM program, consider the residual activity and selectivity of the pesticide.

Common Landscape Insect Pests In Atlantic Canada

Knowing an insect's biology will help you find the best way to monitor its development and decide if control is needed. To plan effective IPM program applicators need to know the following:

- The insect's lifecycle
- When the insect can be found in your area
- What part of the plant it feeds on or damages
- Where it hides when it is not feeding

The pests listed in Appendix B are the ones that are most frequently encountered by landscape managers in Atlantic Canada.

The information in Appendix B has been provided in fact sheet form to assist pesticide applicators to communicate with their clients and users of the facilities that they manage. These fact sheets can be reproduced and distributed to your clients. This section includes information on the following pests:

- Aphids
- Sawflies
- Fall webworm
- Birch leafminer
- Lilac leafminer
- Elm leafminer
- Antler moth
- Hairy chinch bug
- White grubs
- Leatherjackets/European crane fly

Self-test Questions

Answers are located in Appendix A of this manual.

Self test questions for chapters 5, 6, 7, and 8 can be found at the end of chapter 8.