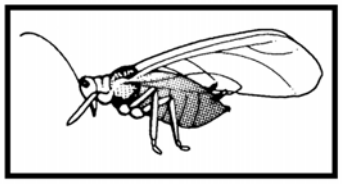
APPENDIX B:

INSECT FACTSHEETS

Ornamental Insects



Aphids (Various species) Homoptera: Aphididae

Key Characteristics

Look for "cornicles". They look like stubby "tailpipes". These point backward from the tip of the abdomen (see figure). Some aphid species produce a white "fluff" (waxy secretion). The aphids will be found under the fluff.

Host Plants

Rose, maple, willow, viburnum, apple, cherry, and other ornamentals

Damage

Aphids suck plant sap. This causes distorted leaves, buds, and branch tips. Aphid feeding can also cause leaves to drop. Aphids excrete honeydew when they feed. This sweet, sticky liquid drips onto the leaves and objects below. It leaves a sticky mess when it lands on cars and sidewalks. It also attracts yellow jacket wasps. Sooty molds often grow on the honeydew, and cause blackened streaks on leaves and tree trunks.

Biology and Life Cycle

Most species of aphids live in colonies. When they become crowded, winged aphids appear and fly off to start new colonies.

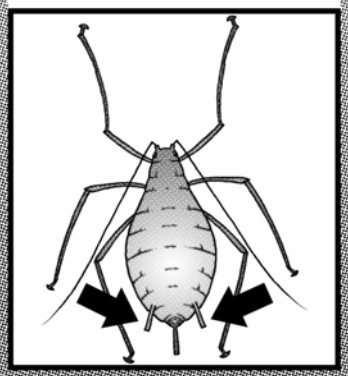
Most aphids spend winter as eggs laid on stems, branches, or other plant parts. In the spring, the eggs hatch into female aphids. These give birth to live aphids all season without mating or laying eggs. In the fall, these females give birth to "true" males and females. This last generation mates and lays eggs that over winter. In indoor gardens, aphids can reproduce all winter.

Most aphid species only attack a few closely related plants. For example, aphids found on roses may move to other roses. There is

Description

Adults and Nymphs

Aphids are 2-8 mm long, pear-shaped sucking insects with long antennae. Colours may be green, grey, pink, yellow, dark brown or black.



little risk of them moving onto other plants such as fruit or maple trees. Some species of aphids move between two host plants. For example, the bird cherry-oat aphid moves between wild cherry and young cereal grain plants. A few, such as green peach aphid, have a wide range of hosts.

Monitoring

Check plants frequently (e.g., weekly). Look for droplets of honeydew. These form shiny, and sticky patches. Look for distorted or curled leaves and branch tips. Use a 10X or 15X magnifying lens to look for aphid colonies. Look These are often found under the oldest leaves and on the newest foliage.

Aphids have many natural enemies. These may be predators or parasites. Look for all life stages of these enemies among aphids. References with pictures of aphid natural enemies are given at the end of the IPM chapter.

Counting Methods

Roses and other plants

Count the number of branch tips, leaves, or plants with aphids. Start checking the most susceptible plants in the spring, a few weeks before you would expect to see aphids. Check 5-10 leaves (or shoots or plants) every 1-2 weeks. Record the number with and without aphids. Do this each week and tally the counts. Inspect a number of plants in each area. Count aphid predators at the same time. This information can be used in setting thresholds. Keep records of when and where aphids first appear each year. This helps pinpoint the best time and place to start looking for them in the future.

Boulevard trees

Place cards under the foliage**.** Count the number of honeydew droplets falling on the cards during a given time period (e.g., a half hour, 2 hours, 4 hours). Special, water-sensitive cards used to monitor spray drift can be used. Cards made of acetate or dark construction paper will also work. Cards should be set out in midday. Attach cards to clipboards placed on the ground beneath the tree, or clipped to lower branches.

Injury and Treatment Thresholds

The following are examples of injury thresholds used by some landscape managers:

- For background plants, where falling honeydew is not a problem, the injury threshold is 20-40% of leaves with aphids.
- For roses, the injury threshold is 5-10% of branch tips infested.
- For other plants, the injury threshold is less than 1 aphid predator per 50 or more aphids. For example, if more than one life stage (egg, larva, or adult) of an aphid predator is seen among 50 aphids, there is no need to treat. These levels of natural predators are high enough to control the

problem. Aphid predators include lady beetles, aphid midges, syrphid flies, lacewings and parasitic wasps.

- If honeydew is the main problem caused by aphids, an injury threshold can be based on the number of honeydew drops falling on monitoring cards per hour. If the honeydew is falling on plants and sidewalks, the threshold number of drops can be higher than when honeydew is falling on parked cars.

Treatments

Physical Controls

Prune out infested foliage. Remove aphids by spraying plants with a strong stream of water. Knocking aphids off plants with water damages their mouthparts. Few will be able to go back to the plant and feed again. This works best if the treatment is repeated a few days apart. This catches any aphids that may have survived the first spray.

Biological Control

Many aphid biological controls occur naturally. Biological control species may be drawn to landscapes by flowers that provide pollen and nectar.

Commercial biological control species can be bought from vendors. The aphid midge (*Aphidoletes aphidimyza*) is a common native species that can be used outdoors in roses, shrubs, and boulevard trees. Ladybeetles are also sold. The species most widely sold, *Hippodamia convergens*, often flies away when released. These are not suited for outdoor use, unless the release is carried out over a very large area. These can be released indoors, if vents are screened to keep beetles inside. For biological controls, the time to release predators is early spring. This should be done once aphid colonies are found. Check with biological control vendors for advice on release rates, timing, and handling methods.

Chemical Controls

Insecticides are rarely needed to control aphids. They are difficult to control with insecticides. Leaf coverage must be very thorough. Aphid populations quickly become resistant to pesticides that are used too often.

Avoid using residual insecticides, especially as foliar or broadcast sprays. These will have long-term effects on aphid predators. This can lead to more severe aphid infestations in the future. Non-residual insecticides for aphids include:

- Spot sprays of insecticidal soap, insecticidal soap with pyrethrins, or pyrethrins alone
- Horticultural oils applied as spot sprays on growing foliage
- Dormant oil sprays to aphids eggs over wintering on deciduous trees
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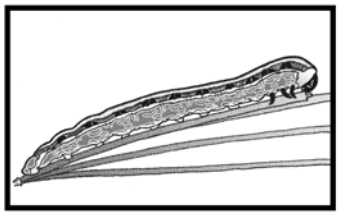
Check municipal and provincial permit or approval requirements before commercially applying insecticides to boulevard trees and other public use areas.

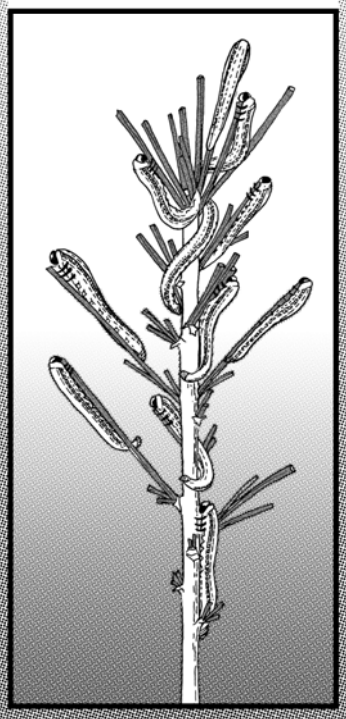
Ornamental Insects



Description

Adults
Adult sawflies are stout, wasp-like insects (2-3 cm long). They have two pairs of clear wings. Females have a saw-like appendage on the abdomen. This is used to insert eggs into foliage.

Larvae
Most sawfly larvae look like small caterpillars.



Sawflies (Various species) Hymenoptera: Tenthredinidae, Diprionidae

Key Characteristics

Both sawflies and caterpillars have prolegs. Prolegs help larvae move around and adhere to plant surfaces. Sawflies have 5 or more pairs of soft, fleshy, false legs or "prolegs" (see figures) on abdominal segments. Caterpillars have 2-5 pairs of prolegs. It is important to be able to tell the difference between sawfly larvae and caterpillars. There is an effective microbial pesticide for caterpillars *(Bacillus thuringiensis kurstaki*). However, this product has no effect on sawfly larvae.

Host Plants

Two main groups of sawflies cause problems in landscapes. "Conifer" sawflies attack conifers (e.g., pine, spruce, and larch). "Broadleaf" sawflies attack broadleaf plants (e.g., roses, alder, birch, willow, and pear).

Damage

Conifer sawfly: Conifer sawfly larvae often feed on needles or buds. Some mine into tips and shoots, causing dieback.

Broadleaf sawfly: Broadleaf sawfly larvae often start by chewing small holes between the veins of leaves. Larger larvae chew large irregular holes in leaves. Some broadleaf sawflies also start by mining in leaf tissue. This leaves discoloured, winding tunnels. The rose sawfly, or roseslug (*Endelomyia spp.*) skeletonizes the lower leaves of the rose.

Biology and Life Cycle

Sawflies have four life stages; egg, larva, pupa and adult. Depending on species, the larvae hatch from the late spring to early summer. The larva feed heavily for 30-40 days until they mature. Some species feed singly while others feed together in colonies.

Mature larva drop to the ground to pupate. Conifer sawflies overwinter just beneath the soil surface in cocoons. Most broadleaf sawflies spend winter as eggs in foliage or pupate in an earthen cell or leaf litter below the host plant.

Some sawfly species have more than one generation per year.

Prevention

Conifer sawflies attack stressed or weakened trees. For example, yellow headed spruce sawflies often attack young, isolated spruce trees. Those in wet conditions or on south slopes are at risk. Prevention includes:

- Choosing other trees that are better suited to the site, such as larch ("tamarack")
- Draining waterlogged sites
- Planting spruce among other trees, in groups

Make sure that conifers from nurseries are not infested. Pre-treat stock trees before planting in permanent sites.

Broadleaf sawflies also do the most damage to stressed trees and shrubs. Keeping plants healthy will help prevent sawfly damage.

Monitoring

Conifer Sawflies: Inspect needles in early spring. Look for signs of mining or tiny feeding larvae. From a distance, this may appear as a discolouration on the tips and shoots. Monitoring times for specific sawflies are as follows:

- In May, look for red pine sawfly on jack pine and red pine.
- In June, look for balsam fir sawfly, European spruce sawfly, and larch sawfly.
- In July, look for yellow headed spruce sawfly.

Broadleaf sawflies: Start looking for leaf mines in June. Look for early signs of skeletonizing. This starts as very small patches on leaves. When larvae are found, make sure they are sawfly larvae, and not caterpillars. To do this count the prolegs. Sawfly larvae have more than five pairs of prolegs on the abdominal segment, while caterpillars have two to five pairs.

To sample for sawflies:

- Shake or beat foliage over beating trays. Count the larvae that drop.
- Count the number of damaged tips (for conifers).
- Check trees that tend to show infestations first (indicator trees).

Injury and Treatment Thresholds

For some conifers, especially those growing in poor conditions, treatments may be needed as soon as damage is found. Others can withstand moderate populations without showing signs of damage.

A large number of sawflies may live on broadleaf trees without causing long-term damage. They may cause an unsightly appearance. If insecticides are needed, they should be applied when the first generation is present. Later generations cause little additional damage. If tree damage reaches an unacceptable level by late summer, treatments should be planned for the next spring.

Treatments

Physical Controls

Sawflies are relatively easy to knock from the foliage with a stick. They do not climb back up. Roseslug, pearslug, and other "broadleaf" sawflies can be washed from leaves with a strong stream of water. For smaller trees and shrubs, this method may be enough to minimize damage and protect natural enemies.

Remove lightly infested tips of conifers.

Biological Control

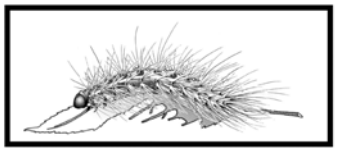
Sawflies have many natural enemies. These include parasitic wasps and birds. Sawflies are often controlled by predators in mixed landscape plantings. There are no commercially available biological control species for sawflies.

Chemical Control

Insecticides should not be used to control roseslug (rose sawfly). This can harm aphid predators and cause an aphid outbreak. Water sprays work best for roseslug.

For conifer sawflies, use low toxicity insecticides (e.g., insecticidal soap, spinosad, and azadiractin). Some products with carbaryl, methoxychlor, or permethrin may be used on some sawflies. These are more harmful to beneficial insects than low toxicity products.

Ornamental Insects



Description

Adults

Adult fall webworms are white moths with 5-6 cm wingspans. Their Fore-wings have fine black dots. The abdomen of the moth is yellow with black spots.

Larvae

The larvae are pale yellow, hairy caterpillars, up to 2.5 cm long. They have one broad black stripe on their backs with a yellow stripe on either side.

Fall Webworm (*Hyphantria cunea*) Lepidoptera: Arctiidae

Key Characteristics

Larvae spin, loose silken nests. They feed inside. Webworms are often confused with Eastern tent caterpillars. Tent caterpillars feed on trees in May and early June. Their nests are smaller and in the crotches of branches. Webworms feed later in the summer. Their nests are large, loose and spun over the ends of branches.

Host Plants

Fall webworm caterpillars feed on fruit trees and other deciduous trees and shrubs. These include speckled alder, Manitoba maple, cherry, apple, and elm along roadsides.

Damage

Defoliation causes little damage to the trees. Webs can be large and unsightly.

Biology and Life Cycle

Adults emerge from early July until early September. Eggs are laid soon after emergence. Each female adult lays from 400-500 eggs in one mass. They are often found under a leaf at the end of a branch. Eggs hatch in about two weeks. The young larvae, as a group, spin a loose tent of silk over the leaf. They feed for about six weeks. The tent gets bigger until it covers a whole branch, or the top of a tree. Webs are easy to see from late July to early September. At the end of the feeding period, larvae move from the nest to pupate and overwinter. Webworm pupae spend winter in leaf litter or under tree bark. There is one generation per year in Atlantic Canada.

Monitoring

Look for eggs on branches in mid-summer. They are laid in masses and covered with yellow hair. Later in the summer, look for small silken nests on the ends of branches.

Injury and Treatment Thresholds

Webworm feeding rarely affects the long-term health of deciduous trees. Treatments are only required to preserve the appearance of high value ornamental plants. Finding nests early allows them to be removed by pruning or by hand before damage appears. Control is not needed on roadside shrubs, farm windbreaks, or in waste areas. Appearance is not a concern in these cases.

Treatments

Physical Controls

It is often enough to remove nests. This can be done by pruning. Nests can be pulled out of foliage using a long stick with a few large nails driven into the tip.

Biological Controls

Naturally occurring natural enemies include:

- Parasitic wasps and flies
- Natural caterpillar diseases that attack webworms

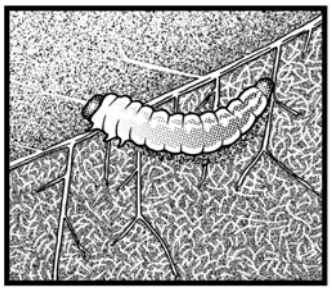
Populations can vary from year to year. Natural enemies control webworms in a 5-10 year cycle.

The microbial pesticide, *Bacillus thuringiensis kurstaki* (BTK) can be used to control the caterpillars. It must be applied while larvae are small or just as larvae are starting to leave their nests to feed. Larvae feed inside the web most of the time. This protects them from most pesticides.

Chemical Controls

Insecticidal soap and growing season oil sprays can be applied using the same timing as for BTK described above. Malathion can also be used.

Ornamental Insects



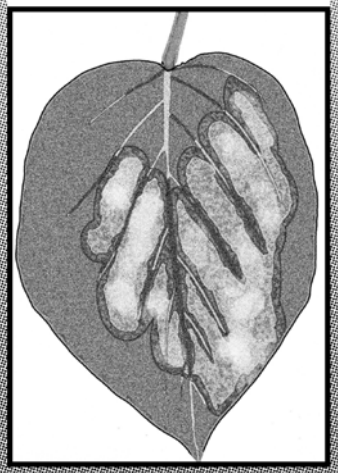
Description

Adults

Adult birch leaf miners are black four-winged sawflies, about 3 mm long.

Larvae

Larvae are tiny, flattened, pale green larvae.



Birch Leafminer (*Fenusa pusilla*) Hymenoptera: Tenthredinidae

Key Characteristics

Larvae are leaf miners. They feed between the upper and lower surface of leaves.

Host Plants

Wire birch, white birch, yellow birch, and European cut-leaf birch

Damage

Larval feeding causes brown blotches on leaves. Leaves may turn completely brown in severe cases.

Biology and Life Cycle

The birch leaf miner has three generations a year. Sometimes there is a partial fourth. It spends winter in a cocoon beneath the surface, at the base of an infested tree. Adults emerge in the spring when leaves come out (May 24th to June 15th). Each female lays 3 to 15 eggs in the tissue of a leaf. Eggs hatch in 6 - 10 days. Larvae feed inside the leaf for 10-15 days. They then emerge from the leaf and drop to the ground. The larvae spin cocoons and pupate in the soil. The next generation of adults emerge in about 20 days. There is overlap of generations. Mines may be present in leaves from May to September.

Prevention

Avoid planting birches in areas with a history of leafminer damage. Plant birches among other trees. Leafminer attacks are worse on open-grown birches.

Monitoring

Start soon after leaves unfold (late May and June). Check trees for the first sign of eggs. Eggs are laid in slits in the new leaves. The first symptoms of damage are gray areas in the leaf tissue around the eggs. Olive-green translucent blotches appear after eggs hatch. These become larger and the entire leaf may be destroyed in time. Mining begins near the mid-rib. It moves out toward the edges of the leaf.

Injury and Treatment Thresholds

Leafminers prefer young tender leaves that appear early in the season. As a result, the first generation causes the most damage. If insecticides are used, they should be targeted to the first generation in early spring. Late season insecticide applications are of little use. Later generations often attack younger leaves at the top of the tree and at the ends of the branches. The damage has been done for the season. Spraying will not improve tree appearance. If tree damage reaches an unacceptable level by late summer, treatments can be planned for the next spring.

Treatments

Biological Control

Predatory insects, parasitic wasps, and birds are natural enemies of leafminers. Minimize harm to beneficial species when choosing a control. This will help with future leafminer control.

Chemical Control

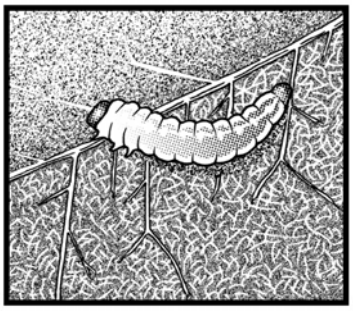
Larvae feed between the upper and lower leaf surfaces. They cannot be killed with ordinary contact and stomach poisons. These pesticides do not penetrate leaf surfaces.

- **Banding with Insecticide:** Trees can be banded with a systemic insecticide such as dimethoate. Paint the undiluted pesticide in a band around the tree trunk. Width should equal tree diameter, but not exceed 16cm. Paint just below the lowest branch. This should prevent serious injury for about five weeks. Trees should be treated when buds begin to open (April 25th to May 15th). If a systemic insecticide is used more than once a year, applications should be made at different places on the trunk. Do not treat stems less than 3cm in diameter.

- **Soil Drenching with Insecticides**: One soil drench treatment per year is enough to control leaf miner. This method may not work on newly transplanted birches. Their root systems are not well established to take up the product properly.

- **Spraying with Insecticide**: Spraying works best when applied 10-15 days after the eggs hatch. Look closely at the foliage for small pinpoint blisters on leaves. This period is roughly May 20th to June 10th. Repeat the application in seven days. Two repeat applications six weeks later may help (roughly July 10th and July 25th). This controls the second generation of sawflies.

Ornamental Insects



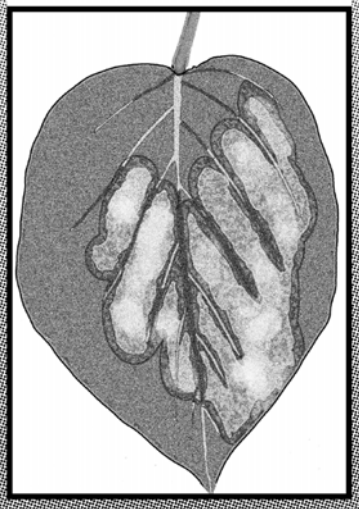
Description

Adult

The adult lilac is a brown moth, about 6 mm long.

Larvae

Larvae are pale yellow caterpillars, 6 mm long.



Lilac Leafminer (*Caloptilia syringella*) Lepidoptera: Gracillariidae

Key Characteristics

Larvae mine and roll the leaves. Several may be found feeding on the same leaf.

Host Plants

Lilac, privet shrubs, or hedges

Damage

Feeding first shows up as small, discoloured spots. Mines later become large blotches. Leaf damage often causes complete browning of foliage. This can be confused with lilac blight or effects of poor growing conditions.

Biology and Life Cycle

Moths emerge from late May to early June and lay eggs on the underside of leaves. The eggs hatch in 7-10 days. Larvae burrow into the leaves causing small discoloured spots. Larvae come out of the leaves in about three weeks. They then roll up a portion of leaf and feed inside it. About 10 days later, they drop to the ground. Leaf miners pupate in the debris, just below the surface. About two weeks later (early August), a second generation of moths appears. The life cycle repeats. Feeding by the second generation goes on until about mid-September. Mature larvae drop to the ground. They spend winter as pupae in the soil beneath infested plants.

Prevention

If lilacs are repeatedly infested, consider replacing them with other plants.

Monitoring

Start soon after leaves unfold in late May and June. Check foliage for the first signs of egg laying. Tiny white eggs are laid in groups of 5-10 on the underside of the leaves. These are mainly found where leaf veins cross.

Injury and Treatment Thresholds

Leafminers prefer young tender leaves that appear early in the season. The first generation causes the most damage. Insecticides should target the first generation in early spring. Later generations often attack younger leaves at the top of the tree and at the ends of the branches. Late season insecticide applications are of little use. The damage has been done for the season. Spraying will not improve tree appearance. If tree damage reaches an unacceptable level by late summer, treatments can be planned for the next spring.

Treatment

Physical Controls

Remove and destroy infested leaves at the first sign of egg laying in late May. This may work on shrubs that are small enough to reach.

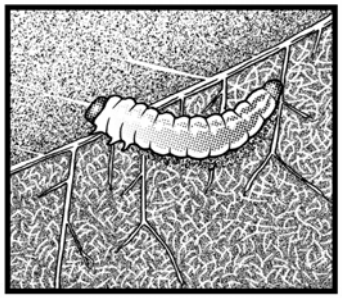
Chemical Control

Larvae are hard to kill. They feed in between the upper and lower leaf surfaces. Ordinary contact and stomach insecticides cannot reach them.

Systemic insecticides can be applied in a 7cm band around the stem. The band should be 30cm above the ground. This will control leaf miners for about four weeks. Two applications will be needed. The first is needed when leaves appear (around the last week in May). The second is needed during the last week in July.

Foliar insecticide sprays can be used before adults emerge. Apply spray right after the leaves flatten out (last week of May to first week in June). Repeat treatment for the second generation (during the last week in July). If spraying is delayed until blotches appear, control will be less effective.

Ornamental Insects



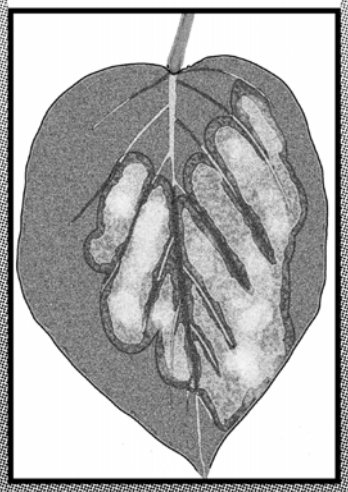
Description

Adults

Adult elm leafminers are small sawflies, 3 mm long.

Larvae

The larvae are pale white or green larvae, up to 2-3 mm long.



Elm Leafminer (*Fenusa ulmi*)
Hymenoptera: Tenthredinidae

Key Characteristics

Larvae mine leaves. They feed between the upper and lower surface of leaves.

Host Plants

Host Plants are mainly English and Scots elm and the Camperdown variety. White elm may be attacked.

Damage

Severe infestations turn trees completely brown. Severe leaf browning has been reported in Nova Scotia in the Annapolis Valley and in Halifax. In New Brunswick, cases have been recorded mostly in the Sackville, St. Andrews, and Baie Verte areas.

Biology and Life Cycle

Adults emerge from late May to early June when leaves are unfolding. Eggs are laid in the leaf tissue. They hatch about 10 days later and begin feeding in the leaf. Larvae mature by late June or early July. They drop to the ground and spin cocoons in the soil. Larvae spend winter in cocoons in the soil. There is only one generation per year.

Monitoring

Blotches in leaf tissue between veins are early symptoms of attack. These blotches turn brown. Some drop out and leave holes in the leaves.

Injury and Treatment Thresholds

Leafminers prefer young tender leaves that appear early in the season. The first generation causes the most damage. Insecticides should target the first generation in early spring. Later generations often attack younger leaves at the top of the tree and at the ends of the branches. Late season insecticide applications are of little use. The damage has been done for the season. Spraying will not improve tree appearance. If tree damage reaches an unacceptable level by late summer, treatments can be planned for the next spring.

Treatments

Physical Controls

Remove and destroy infested leaves at the first sign of egg laying in late May. This may work on shrubs that are small enough to reach.

Chemical Control

Larvae are hard to kill. They feed between the upper and lower leaf surfaces. Ordinary contact and stomach insecticides cannot reach them.

Systemic insecticides can be applied in a 7cm band around the stem. The band should be 30cm above the ground. This will control leaf miners for about four weeks. Two applications will be needed. The first is needed when leaves appear (around the last week in May). The second is needed during the last week in July.

Foliar insecticide sprays can be used before adults emerge. Apply spray right after the leaves flatten out (last week of May to first week in June). Repeat treatment for the second generation (during the last week in July). If spraying is delayed until blotches appear, control will be less effective.

Turf Insects

Description

Adults

Adult antler moths are reddish-brown moths with a 2-3cm wingspan. They have a central mark on each forewing that looks like an antler.

Larvae

The larvae are dark brown cutworms, 3-4 cm long. They have brown heads, wrinkled skin, and yellow-white lines down the sides and back.

Antler Moth (*Cerapteryx graminis)*
Lepidoptera: Noctuidae

Key Characteristics

Unlike other cutworms, antler moth larvae are active during the day. They can be found feeding or moving in groups.

Host Plants

Larvae feed on roots, shoots, and leaves of grasses. Native to Europe, the antler moth was accidentally introduced to Newfoundland. It was first recorded in Mount Pearl in 1966. By 2002 it had spread across the Avalon Peninsula and as far as Port Rexton. It only occurs on the island part of Newfoundland and Labrador. **The Antler moth has not been reported in other parts of Atlantic Canada.**

Damage

High numbers can cause large dead areas in turf.

Biology and Life Cycle

Antler moths overwinter as eggs. These hatch in late April or May. Larvae feed on grasses until they reach full size. Large groups of larvae sometimes move across lawns, sidewalks, and driveways. Adults fly from June to September. Antler moths fly during the day and night. They are drawn to lights at night.

Antler moths spin cocoons from early July to early August. After about ten days, moths emerge from cocoons. After mating, each female lays 250-500 eggs. Egg survival is favored by a cool humid fall, followed by a cold snowy winter.

Prevention

Healthy turf will heal more quickly from attack than stressed turf. Over-seeding may be required to repair badly damaged areas. This will prevent weeds from growing in the damaged areas.

Monitoring

Unlike other cutworm larvae, they are active during the day. They tend to stay in groups. In naturalized areas, they can be found under rocks.
Larvae are easy to see due to their size and behavior. If damage appears in midsummer, but no larvae are found, it can mean they have left the area to spin cocoons. It can also mean that the damage was caused by something else.

Injury and Treatment Thresholds

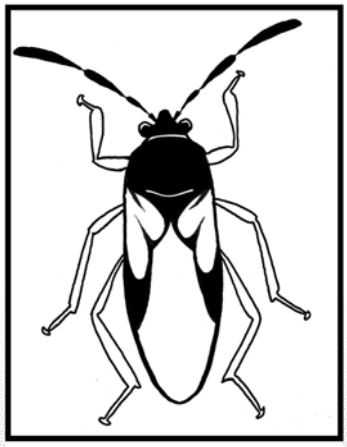
Insecticides should be used when larvae are feeding (in early summer). Antler moth feeding can seriously damage lawn turf in Newfoundland. Treatments may be needed to preserve the appearance of lawns.

Treatments

Chemical Control

Contact insecticides (e.g., insecticidal soap and pyrethrins) may control larvae. Carbaryl and permethrin are more toxic controls. Chlorpyrifos, an insecticide once used on lawns, can no longer be used on residential lawns.

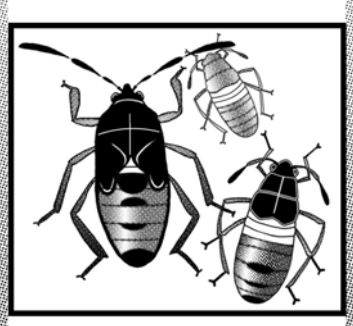
Turf Insects



Description

Adults

Adult Cinch bugs are oval insects, about 4 mm long. They are dark, with white wings folded flat across the back.



Nymphs

When they hatch, nymphs are tiny and bright red, with a white band across the back. Their colour darkens as they grow and pass through five moults. The last nymphal stage before adult stage is almost black.

Hairy Chinch Bug (*Blissus leucopterus hirtus*) Heteroptera: Lygaeidae

Key Characteristics

They are quick-moving insects with small eyes. Their main predator is the big-eyed bug. It is similar in shape and size, but has large, prominent eyes.

Host Plants

Both adults and nymphs damage turfgrass. They pierce and suck sap from leaves and crown. Their saliva contains a toxin that is injected into the plant as they feed. This often kills the plant.

Damage

Chinch bug damage closely resembles drought stress. The damage first appears as yellow patches in the lawn. These continue to expand. Turf later dies and turns brown. Lawns not watered in the summer may not show damage until rains start in fall. Chinch bug damage is most common on warm open areas and dry slopes.

Biology and Life Cycle

Adult chinch bugs spend winter in sheltered areas (under trees and shrubs) and in long grass. When it warms in the spring, they become active and start laying eggs (May and June). Females lay 200-300 eggs. They are laid in small groups in the crowns of the grass plants inside the base of the leaf sheaf. This is inside the base of the leaf sheath above the crown. Eggs take over a month to hatch. Nymphs develop into adults in July and August. They spend winter as adults. In the Atlantic region, there is likely only one generation per year. There have been scattered reports of a second generation in the most southern areas.

Nymphs seem to prefer sunny and dry areas of lawns especially where the soil is compacted. Wet conditions and high soil moisture may control early nymphal stages. Chinch bug feeding occurs throughout the season, but it may not become visible until late summer. Dry conditions and drought stress increase damage.

Prevention

Grow vigorous, healthy turf, in well-aerated soils. Prevent drought stress. Chinch bug damage can be more severe in drought stressed turf. Research is being carried out to determine which turfgrass species and cultivars resist chinch bug damage.

Manage thatch to ensure that it does not become too thick. Some researchers believe that thick thatch can promote chinch bugs. A recent Quebec study did not find this link. Excess thatch does make it hard to find and manage chinch bugs.

Turfgrass mixtures containing grasses that are infected by beneficial endophytic fungi can help turf resist damage. These fungi are toxic to leaf and crown feeding insects. They can help control chinch bugs.

Monitoring

- **Quadrat Method**: A sampling technique for chinch bugs was developed at Laval University. It has showed promise for use in Atlantic Canada. Place a 0.1m^2 frame on the turf and count all insects seen in the quadrat for one minute. This test should be done weekly from late June to late July. Use three quadrat counts per 100m^2 of lawn.

- **Flotation Method**: Remove both ends of a tin can. Push it 5cm into the turf. Pour soapy water into the can. All stages of chinch bugs float and can be counted after 10-15 minutes.

Injury and Treatment Thresholds

Chinch bugs only cause noticeable damage on some lawns. Their presence does not always require treatment.

Injury thresholds are being developed and refined for Atlantic Canada. The following are examples of injury thresholds. Stressed turf can be damaged by lower numbers of chinch bugs. Consult university or agricultural extension experts for more recent research.

- **Using the flotation method,** damage has been found to occur at 35 chinch bugs (all stages) per square foot.

- **Using the quadrat method,** damage occurs when an average of 10 or more chinch bugs are counted per quadrat.

Treatments

Cultural Control

Cultural Controls improve turf health. Proper watering helps it recover quickly and show less damage from chinch bugs.

Biological Control

Native predators (e.g., big-eyed bugs) attack chinch bugs. These insects occur naturally and are not commercially available. The fungus (*Beauveria bassiana*) is being studied for development as a biological control.

Chemical Control

Chinch bug damage is usually very patchy. Insecticide spot treatments are only required in areas where counts exceed injury thresholds. Spot treating infested or damaged areas in otherwise healthy turf provides good control. Avoid application to the whole turf area. This helps preserve naturally occurring predators.

Insecticides have less effect in dry conditions. Control may be improved by irrigating to moisten soil before and after application. Some pesticides containing carbaryl are used to control chinch bugs.

Pesticide treatments work best when applied to the insect in the 3rd instar stage. Most of the eggs will have hatched by this time. Few nymphs will be at later stages that are harder to control with pesticides. Treatments applied too early or too late will give poor control. These will also reduce populations of beneficial insects that attack chinch bugs.

Turf Insects

White Grubs (*Phyllophaga* spp.) Coleoptera: Scarabaeidae

Description

Adult

Adult june beetles are blocky, shiny reddish brown insects, up to 2cm long. They are found in May or June.

Larvae

Full-grown larvae may be up to 1.2cm long. They are white to gray, with a brown head and 6 distinct legs.

Key Characteristic

Larvae usually curl into a "C" shape when disturbed. They are found in the root zone of plants.

Host Plants

Plant roots, particularly turf.

Damage

Healthy turf may not show damage, even when pest numbers are high. Occasionally, damage can be severe, resulting in brown dead sections. White grubs do not destroy the crown of the turf plant. Turf with light grub damage will often recover.

In some cases, skunks, raccoons, and birds cause the only damage that can be seen. They tear out turf to get at large grubs. Control programs can focus on managing these animals (live trapping, startle devices, screening, etc.).

Biology and Life Cycle

In Atlantic Canada, only one type of white grub, the May/June beetle has been found damaging turf. White grubs take 3 years to develop from an egg into a mature beetle. Adult beetles emerge from the soil in late spring and mate. Eggs are laid beneath the soil surface. When larvae hatch, they feed on rotting organic matter during summer. They burrow into the soil for winter. In the second summer, they feed on plant roots. They spend the next winter deeper in the soil. In the early spring, they again rise to the root zone to feed. In May or June of the third summer, they pupate and stay in the soil until spring. They then emerge as adults.

Prevention

Spreading manure on turf in summer attracts adults to lay eggs. If this practice is planned, wait until later in the summer **or** compost the manure and apply as a top dressing early in spring.

Monitoring

Cutting a square foot section of turf will show the number of larvae feeding on plant roots. Cut turf along three sides. Fold back the sod to expose the roots. The larvae are large and easy to count among plant roots. After counting, the section of sod can be replaced with little damage to turf.

Injury and Treatment Thresholds

Larvae cause the most damage during the second summer. At this time, they are feeding on plant roots. Little work on thresholds has been done. A small study from Maryland suggests that 5-7 larvae per square foot can damage turf stressed by drought.

Treatments

Physical Controls

Soil aeration may kill a number of larvae in the root zone.

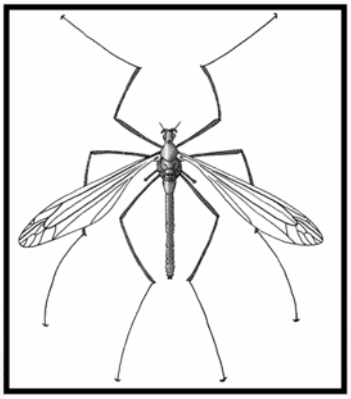
Biological Controls

Natural predators attack eggs and young larvae. Some insect parasite nematode species may attack white grubs. These have not been commercially available. Species that attack root weevil larvae or other pests may not affect white grubs. The fungus *Beauveria bassiana* is being studied for use as a biological control.

Chemical Controls

Some products with carbaryl can control white grubs. Diazinon and chlorpyrifos were used for white grubs in the past. These products are no longer registered for use in or around homes.

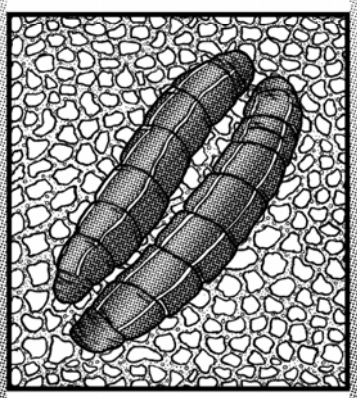
Turf Insects



Description

Adults

Adult crane flies are large, light brown flies up to 2. 5cm long. They look like giant mosquitoes. They have long, fragile legs.



Larvae

Crane fly larvae, called leatherjackets, are dull gray, legless maggots. They measure up to 3cm long when full grown.

Leatherjackets / European Crane Fly (*Tipula paludosa*) Diptera: Tipulidae

Key Characteristics

Maggots and pupae are large. They are gray and leathery. The large size of adults and their poor flying makes them easy to see among flying insects.

Host Plants

Larvae feed on roots and crowns of turf and pasture grasses.

Damage

In severe cases, feeding causes ragged, brown patches in turf (in the spring). The symptoms od a moderate infestation of crane flies are not distinctive. They can easily be confused with damage from other sources such as drought, excessive wear or fertility problems. Severe infestations resulting in turf death are rare in Atlantic Canada.

Biology and Life Cycle

Female crane flies lay eggs in turf from August to September. Larvae feed among roots for 1-2 months in the fall. They cause little damage because of their small size. The larvae spend winter in the soil. Many are killed by natural enemies and winter weather. Survivors begin feeding in early spring. They grow to full size by mid-June.

Larvae stop feeding for a few weeks and pupate in early July. Adults emerge from August to September.

Prevention

Damage is usually noticeable on stressed or highly managed turf (e.g., golf greens). Maintaining good healthy turf helps prevent damage from leatherjackets.

Monitoring

The following are ways to monitor for leatherjackets in turf:

- In early spring, find a $1m^2$ area of turf showing damage. Drench it with soapy water (lemon scented dish soap works best) , or water with a small amount of pyrethrins insecticide. Count the leatherjackets that wiggle to the surface. After counting, rinse the treated area with water to avoid damage to grass plants.

- In spring or fall, pull back sections of sod (e.g., cut one square foot on three sides). Pick through the soil and roots to count larvae and pupae. Replace the sod sections.

- Cut sections of damaged sod. Soak in a saturated solution of salt water. Count the larvae that float to the top. This method will damage the sample sod.

- Larvae can sometimes be seen feeding on the surface of close cut turf in the early morning.

Injury and Treatment Thresholds

Injury levels for leatherjackets used by turf managers are given below:

- For high profile, high maintenance sites, injury threshold occurs at 20-25 larvae per m^2 in spring.

- For intermediate sites, injury threshold occurs at 50-100 larvae per m^2 in spring.

- For natural or low care sites, injury threshold occurs at over 100 larvae/m^2 in spring or 300 larvae per m^2 in fall. The higher level in the fall is allowed because many larvae die over winter.

Required treatments should be timed from April to early June. These affect larvae when they are feeding on roots.

Treatments

Biological Control

Reduce the use of insecticides to protect species of mites, ants, beetles, and other predators. These feed on crane fly eggs and larvae. Insect parasitic nematodes may become available to control leatherjackets. It is not clear how well these work in Canada. Always follow label guidelines for release rates and timing.

Chemical Control

Some products with carbaryl control leatherjackets. Diazinon, once used for leatherjackets, is no longer registered for use on turf in residential areas.