

8. Other Pests and Disorders

Nematodes

There are many beneficial nematodes in agricultural soil, but when plant parasitic nematodes are present in high numbers, they can cause significant yield losses to horticultural crops. The extent of loss depends on the crop, nematode species and soil populations.

The most destructive and common plant parasitic nematodes in Ontario fruit crops are root-lesion (*Pratylenchus penetrans*) and northern root-knot (*Meloidogyne hapla*). The northern root-knot nematode is becoming more prevalent. The pin (*Paratylenchus* sp.) and dagger (*Xiphinema* sp.) nematodes occasionally cause yield losses to some fruit crops in isolated fields. The dagger nematode is mainly a virus vector on grape, raspberry and apple.

Generally, symptoms of nematode injury include:

- uneven plant growth
- poor plant establishment
- plants weakening over time
- poor root growth
- knots or galls on roots
- excessive branching of roots, hairy root symptoms

On strawberries:

- Root-lesion nematodes cause discolouration of the fine feeder roots and tiny brown scratch-like lesions on the young white roots. These lesions merge to form large brown areas. Root-lesion nematodes are involved in the black root rot complex and aggravate verticillium wilt of strawberries and other host plants. Severely infected plants appear stunted and unthrifty.
- Root-knot nematode feeding stimulates root cells to enlarge. Groups of enlarged cells look like small galls or beads (1 mm). As more and more nematodes establish feeding sites in the same region of the root, the groups of enlarged cells become one larger root-knot.

On raspberries:

- Root-lesion nematode feeding causes scratch-like lesions on roots, similar to the symptoms on strawberry roots. Severely infested plants have thinner and fewer canes per crown. Up to 25% of first-year canes may be killed by severe infestations of these nematodes.
- Dagger nematodes spread tomato ringspot virus, which causes crumbly berries, mottled leaves and cane dieback.

On tree fruits:

- Root-lesion nematodes can be a major cause of orchard replant failures, and are a significant factor in Apple Replant Disorder (ARD). They can cause a decline in vigour of existing peach and cherry orchards. These nematodes cause small brown lesions on the white lateral roots and kill the fine feeder roots. When lesions merge, the entire root system appears discoloured. Root lesions are frequently invaded by other pathogens which can cause root rot. Severely affected trees may lose all feeder roots. Young replant trees may die. Existing trees lack uniformity.

Thresholds

Nematode populations above economic thresholds can significantly reduce yields. The economic threshold for nematode populations refers to the population at planting. Planting a susceptible crop in soils with a population of nematodes near or above the economic threshold will result in crop losses over time. For economic thresholds, see Table 8–1. *Nematode Thresholds for Fruit Crops* on this page.

Table 8–1. Nematode Thresholds for Fruit Crops

Type of Nematode	Economic Threshold (nematodes/kg soil)
Root-lesion	1,000 (exception: 500 on strawberries)
Root-knot	1,000
Pin	5,000
Dagger	100
Bulb and stem	100

- Nematode problems are most often found in sandy-loam and sandy soils. Always sample these soils for nematode populations before planting fruit crops.
- Root-lesion and root-knot nematode problems are not usually found in clay or clay-loam soils. Sample these soils for nematodes before planting in replant sites or where susceptible crops have been recently grown.
- Sample clay or clay-loam soils for dagger nematode before planting on virus-susceptible grape, raspberry or tree fruit.

For more information, see OMAFRA Factsheet, *Sampling Soil and Roots for Plant Parasitic Nematodes*. Information on how to sample soil for nematodes and where to send the samples is found in Appendix G: *Diagnostic Services*, page 344.

Nematode management

Nematode management starts a year before planting a susceptible crop like fruit trees. Try to reduce nematode populations so that clean stock can establish well before the nematodes rebound to damaging levels. Young plants tolerate much less nematode feeding than established plants. Use a combination of the following methods to manage nematodes:

- Start new fields with transplants free from nematodes, and grown by an accredited plant propagator.
- Rotate susceptible crops with non-host crops for several years.
- Grow nematode-suppressing cover crops in the years prior to establishing fruit crops.
- Destroy residual crop roots.
- Plant resistant fruit cultivars where available.
- Control weeds, as they are good hosts of nematodes.
- Use soil fumigation before planting when nematode populations in soil reach or exceed thresholds (see Table 8–1. *Nematode Thresholds for Fruit Crops*, page 269).

Cover crops for nematode suppression

Cover crops may reduce populations of nematodes when properly managed in the year before planting. In Ontario, these nematode-suppressing cover crops have been successful:

- oilseed radish
- certain oriental mustard cultivars like Caliente, Cutlass or Forge
- specific sorghum × sudan-grass hybrids
- African marigold cultivars like Crackerjack or Creole
- Canadian Forage Pearl Millet 101

These cover crops can reduce plant parasitic nematode populations. Not all cultivars reduce nematode populations, so choose the right variety. One or more years of nematode-suppressing cover crops may be required to reduce nematodes below economic thresholds.

Cover crops suppress nematodes in different ways:

- Canadian Forage Pearl Millet 101 is a poor host and inhibits the ability of root lesion nematodes to reproduce in its root-system.
- Certain cultivars of African marigolds produce a root exudate that is toxic to nematodes in the soil.
- Nematode-suppressing cultivars of oilseed radish and certain oriental mustards produce glucosinolates and an enzyme in their leaves, stems and petioles. The enzyme converts the glucosinolates into isothiocyanates, which are toxic to nematodes when the cover crop is cut green and incorporated immediately into the soil.

Exclude cover crops such as clovers and buckwheat from berry and orchard rotations. These are excellent hosts for root-lesion nematodes. Wheat or barley are the best cereal crops to grow before planting. For more information, see Table 2–17. *Characteristics of Cover Crops*, page 25.

Other cultural practices to reduce nematodes

Nematode populations can build on many weed species. A good weed control program is essential the year before planting fruit crops. Plan an intensive weed management strategy for the cover crop where nematode-suppressing cover crops are grown.

Keep land fallow the year before planting to reduce nematode numbers. A disadvantage to fallow land is increased susceptibility to soil erosion.

In orchards, choose ground covers for planting between the rows that do not support nematodes, such as annual or perennial ryegrass, or creeping red fescue.

Soil fumigation

Pre-plant soil fumigation is the most effective method of controlling nematode problems. Fumigants can be broadcast over the whole field or applied only in bands where trees will be planted. Tree-row application, or the treatment of a 2–2.5 m strip centred on the row, is more economical, but requires good planning. However, broadcast fumigation will reduce the risk of re-contamination if non-fumigated soil is mixed into the fumigated strip.

For products, rates and other information on fumigants, refer to Table 8–2. *Products for Management of Nematodes and Other Soil-borne Pests*, on this page.

Application of fumigants before planting

Most fumigants are applied by shank injection using specialized application equipment. Some formulations of metam sodium can be applied to the soil surface and watered in. See the product label for application instructions.

- Fumigate when soil temperatures are above 4°C at 20 cm depth. Warmer temperatures (15°C and over) are preferred for more rapid fumigant dispersal in the soil. Fumigation in the early fall before planting is best for fruit crops which are planted in early spring when soils are still cool.
- Land preparation is critical for effective fumigant application. Fumigants cannot easily penetrate large clumps of soil and organic matter. Remove trash and old root systems. One week prior to fumigation, work the soil to a depth of 25–30 cm and obtain good seedbed tilth and moisture. Keep soil moist and if necessary irrigate the treated area during the week prior to fumigation. A light cultivation immediately before fumigation may be necessary if a soil crust has developed.
- Soil moisture in the top 15–20 cm must be at the level stipulated by the fumigant label prior to and during fumigation. If soil moisture is not sufficient, it must be adjusted before product application can occur.

Table 8–2. Products for Management of Nematodes and Other Soil-borne Pests

CAUTION: These products are very toxic. Read the label and follow instructions for handling and application. Always follow manufacturer's directions carefully for dosage and methods of use. The applicator must wear suitable protective clothing, etc. These requirements vary between products and can be found on the label.

Product	Active Ingredient	Ontario Class ¹	Pests Controlled ²			Fruit Crop Registrations	Rates (shank injection or surface applied)	Rates (sprinkler application)
			Nematodes	Soil-borne Diseases	Weeds			
Busan 1020	metam sodium 33%	4	yes	yes	yes	fruit crops	375–935 L/ha (shank injection)	700–935 L/ha
Busan 1180	metam potassium 54%	3	yes	yes	yes	fruit crops	231–576 L/ha (shank injection)	431–576 L/ha
Busan 1236	metam sodium 42%	4	yes	yes	yes	fruit crops	274–683 L/ha (shank injection)	511–683 L/ha
Chloropicrin 100	chloropicrin 99%	2	yes	yes	no	strawberries, raspberries	93 L/ha ³ (shank injection)	do not apply with sprinklers
Enfuse M 510	metam sodium 42%	4	yes	yes	yes	fruit crops	260 L/ha (surface applied)	do not apply with sprinklers
Pic Plus	chloropicrin 85.1%	2	yes ⁴	yes	no	strawberries, raspberries	108 L/ha ⁵ (shank injection)	do not apply with sprinklers
MustGrow	oriental mustard seed meal 100%	3	yes ⁶	yes ⁶	no	strawberries, raspberries, tree fruit, tree nuts	1121–2240 kg/ha (surface applied)	do not apply with sprinklers
Vapam HL	metam sodium 42%	4	yes	yes	yes	fruit crops	279–696 L/ha (shank injection)	350–670 L/ha

¹ See Table 11–8. *Pesticide Classification Schedules in Ontario: Classes 2, 3 and 4*, page 331.

² See label for exact registrations.

³ Use 140 L/ha Chloropicrin 100 for strawberry plant production (runner production).

⁴ Pic Plus is labelled for root-knot nematode but is not labelled for root-lesion nematode.

⁵ Use 162 L/ha PicPlus for strawberry plant production (runner production).

⁶ MustGrow provides suppression rather than control of nematodes and soil-borne diseases. For more information on MustGrow, see *Organic and Biopesticide Products*, page 279.

For best results, keep the soil surface moist during application and for 24 hours after application.

- Seal the soil surface immediately after injection of the fumigant. The best method for sealing the soil is covering it with tarps, however, rolling or cultipacking immediately behind the fumigant applicator can also be used. Some fumigants have specific requirements for sealing the soil—consult product labels to determine what is legally permissible for the fumigant and type of application. Light watering after application will further prevent the escape of fumigant from the soil.
- Leave soil undisturbed for at least 1 week after injection of the fumigant. Colder soils (below 15°C) require longer periods from injection to aeration.
- Work the soil and aerate for about a week before planting. For fall planting, work the soil and aerate for 2 weeks before planting. The time interval between fumigation and planting into fumigated soil depends upon the product used, the rate and the temperature following fumigation (consult product label).
- Use high-quality planting stock, preferably grown in fumigated soil. Nursery operators can provide information on how to manage nematodes.
- Always read the product label. All fumigant labels now contain detailed Good Agricultural Practices for soil conditions, sealing, application and re-entry. These are mandatory and must be followed for all fumigant applications.
- A Fumigation Management Plan (FMP) must be completed prior to the start of any fumigant application. This is an organized, written description of the steps involved to ensure a safe and effective fumigation. The specific requirements for the FMP will be listed on the product label.
- Mandatory Good Agricultural Practices are now required. This standardizes many practices already on existing labels and helps improve the safety and efficacy of soil fumigations. These practices will vary with the product and application method but will include identifying optimal weather conditions, proper soil preparation, requirements for soil moisture and temperature, methods for soil sealing and use of proper application depths.
- DO NOT apply these products when a temperature inversion is occurring or is predicted to occur within 48 hours after application is complete, as fumigant vapours may drift. For more information on how inversions affect drift of pest control products, see www.sprayers101.ca/spray-drift/surface-inversions/
- DO NOT apply these products if light wind conditions (less than 3 km/h) are forecast to persist for more than 18 consecutive hours from the time the application starts until 48 hours after the application is complete. Calm conditions could indicate a temperature inversion, which could lead to spray drift. See www.sprayers101.com for more information on temperature inversions.
- Any person involved in the use of fumigants is considered a fumigant handler. All fumigant handlers must hold an appropriate pesticide applicator certificate or license recognized by the provincial pesticide regulatory agency where the pesticide application is to occur.
- Entry into fumigant application blocks by any person (other than fumigant handlers, emergency personnel and local, provincial or federal officials performing inspection, sampling or other official duties) is PROHIBITED during the Application Block Period.
- The Application Block Period begins at the start of application and expires at least 5 days after the application is complete. The length of the period will depend on application criteria (e.g., tarped or non-tarped, etc.). The applicator must verbally warn workers of the application.
- Fumigant application signs must be posted on all entrances to the application block. Signs must be posted prior to the start of the application (but no earlier than 24 hours prior to application) and remain

Fumigating single-tree sites before planting replacement trees

When trees are replanted within an existing orchard, nematodes and diseases can be controlled in the planting hole using Vapam or Busan before planting. Refer to the product label for application details, rates and safety precautions.

New requirements for fumigants

Health Canada's Pest Management Regulatory Agency (PMRA) has changed the label requirements for soil fumigant products containing chloropicrin, metam sodium and metam potassium. These requirements are intended to further limit user exposure and increase protection of workers, bystanders and the environment. The changes took effect in September 2014. Growers and applicators should ensure they have the most current version of product labels before applying any fumigant. Detailed instructions can be found on product labels, but requirements include:

posted for the duration of the Application Block Period. Signs must be removed within 3 days of the end of the Application Block Period.

- Only fumigant handlers with an appropriate pesticide applicator certificate or license recognized by the provincial regulatory agency may be in the application block from the start of the application until the Application Block Period expires, and in the buffer zone during the Buffer Zone Period.

Buffer Zones

- A buffer zone must be established for all fumigant applications. A buffer zone is an area around the perimeter of the fumigated area that extends equally in all directions. The size of the buffer zone area will depend on the product and application criteria.
- Only fumigant handlers with appropriate certification may enter the buffer zone during the Buffer Zone Period, the 48-hour period following application. All non-handlers, including field workers, residents and pedestrians must be excluded from the buffer zone during the Buffer Zone Period, except for transit (e.g. vehicular or bicycle traffic).
- The size of the buffer zone will vary with application method, rate and field size. Product labels will include tables to determine the required buffer zone distance.
- Buffer zones cannot include any residential area or occupied building, outdoor residential areas (e.g., lawns, gardens, play areas) or other areas that may be occupied during the 48-hour period following application.
- An emergency preparedness plan will be required when residences or businesses are located in close proximity to the outer edge of the buffer zone.

Nematode suppression after planting

Vydate will suppress nematodes after planting non-bearing apples (trees that will not bear fruit for 12 months) and raspberries. Vydate is less effective than pre-plant soil fumigation and does not control soil-borne disease. Refer to the product label for application methods, mixing instructions, rates and precautions.

- Vydate is highly toxic to bees. Do not apply during the pink or bloom period.
- Vydate is very toxic to humans. Follow application instructions closely.

Apples

Soil drench and foliar spray: Treat young whips and non-bearing fruit trees with 1 application of Vydate as a soil drench around the base of each tree when roots are actively growing and leaf growth begins in the spring. Follow this with a foliar application of Vydate. An alternative method is to only use **foliar applications:** Make 3 foliar applications on a 2–3-week schedule for a total of 3 applications. Do not allow spray to drift onto trees in bloom. Do not apply to trees under water stress or not actively growing.

Do not re-enter treated fields for 24 hours after application.

Raspberries

Treat raspberry plants with 1 application of Vydate as a soil drench over roots in the fall before October 31. Do not apply Vydate to raspberries in the spring. Do not apply to raspberries more than once a year. Do not re-enter treated fields for 72 hours after application.

Deer Management

Deer are attracted to fruit crops, especially apples and strawberries, and browse at different times during the season. They can cause extensive damage, particularly in fields located near large populations. Controlling deer damage requires an integrated approach, which includes regulated hunting (with permit), scare devices, repellents and fencing (conventional or electric).

There are several different types of fences available which are excellent options for areas where deer densities are high and the likelihood of damage is great:

- Permanent woven wire fences provide a barrier that requires little maintenance but can be expensive to install.
- Mesh fencing is strong, long lasting, difficult to see, and easy to install.
- Electrical fences are easy to erect, repair and maintain. Temporary electrified fences are simple, inexpensive and useful.
- Permanent high tensile fences provide year-round protection from deer and are best suited to orchard crops, and may be the only solution where pressure is heavy.

For more information see Vertebrate Pest Management at ontario.ca, or OMAFRA Publication 310, *Integrated Pest Management for Apples*.

Table 8–3. Bait for Mouse and Vole Management

Product Name	Active Ingredient	Application Rates	Crop Registrations	Comments
Ramik Brown	diphacinone	<ul style="list-style-type: none"> • 22 kg/ha in two applications of 11 kg each 	orchards, Christmas tree plantations, newly reforested areas, shelter belts, and nurseries	Apply after all fruit is harvested. Applications can be made 20–40 days apart based on monitoring. DO NOT use in locations accessible to pets or livestock, or in sites that will be open to the public. DO NOT place bait in areas where there is a possibility of contaminating food or surfaces that come in direct contact with food.
Bartlett Waxed Mouse Bait	zinc phosphide	<ul style="list-style-type: none"> • 4.5–9 kg/ha depending on severity of infestation OR • place in bait stations, 15 g of bait per bait station 	orchards, Christmas tree plantations, newly reforested areas, etc.	Apply in early fall, or any time before a covering of snow. Distribute evenly but do not apply to bare ground, in heaps or piles, or where there is a hazard to wildlife or pets. Bait applied in sites that will be open to the public MUST be placed in tier 1 bait stations.
Rodent Bait or Rodent Pellets	zinc phosphide	<ul style="list-style-type: none"> • 4.5–9 kg/ha, depending on severity of infestation OR • place in bait stations 	orchards, nurseries, fruit and vegetable storage areas (in bait stations)	Best timing is after harvest before leaf-fall or lodging of the grass. Repeat at least once before snow is expected.

Deer removal permit program

A permit is required to shoot deer in defense of property. Contact the local Ministry of Natural Resources and Forestry (MNRF) office for an evaluation and action plan. Action depends on the severity of damage, the level of previous control attempts and a reasonable expectation of controlling the deer problem. The MNRF area supervisor or enforcement supervisor issues permits to farmers or their agents. Take these steps to request a permit:

- File a written report, reflecting the extent of damage, in percentage of crop loss, and associated dollar value. The evaluator must consider the damage to be economically significant.
- Demonstrate that you have made reasonable attempts to control deer by modified farm management practices. Show that you permit licensed deer hunters on the property during open season, if any. Document this information and keep it with the deer removal permit file.
- Ensure appropriate arrangements for the disposal of the carcass(es).

mice. Remove straw, trash, sod, etc. from around the base of the tree for at least 60 cm from the trunk.

- Encourage predation by cats, foxes and birds of prey, especially red-tailed hawks, kestrels and great horned owls, which all help to reduce mouse populations.

Use a guard around the trunk of all newly planted trees. A number of commercial tree guards are available from agricultural and forestry suppliers. Two of the most common are spiral plastic and galvanized wire mesh. Ensure tree guards are 45 cm high, and bury the bottom of the guard in the soil 5 cm deep, or preferably, in a mound of fine crushed stone or sharp cinders.

- Remove and inspect tree guards regularly. Check tree guards each fall to ensure they are mouse-proof and free of trash.
- Ensure tree guards do not interfere with root development as the tree grows.
- Trees will outgrow spiral guards left in place too long, which can interfere with bark development. Remove guards before this occurs.

Mouse and Vole Management

Mice and voles can cause widespread damage in orchards that provide attractive shelter, especially in new plantings.

- Use a wide weed-free strip in the tree row or under individual trees, coupled with regular close mowing (8–15 cm) of orchard ground cover to help discourage

Bait for mouse and vole management

Removing dropped fruit from the orchard may help to reduce rodent populations. However, in orchards with high mice and vole pressure, the use of baits may be necessary to reduce populations.

Bait stations help control mice longer than broadcast treatment. Bait stations also help prevent non-target mammals from feeding on the bait. Set up bait stations

at a rate of approximately 25 stations/ha, in locations not accessible to children, pets or livestock.

To ensure safe use of this product, tamper-resistant bait stations must have the following characteristics:

- constructed of high-strength materials and resistant to destruction by children and non-target animals
- entrance designed to ensure children and non-target animals cannot reach the bait
- internal structure that prevents bait from being shaken loose
- access panel that fastens securely and locks (e.g., metal screw or padlock)
- capable of being securely fastened to a surface (e.g., nailed down)
- clearly labelled: WARNING – POISON

Broadcast bait should be applied over the floor of the orchard before the grass falls and the ground is covered with snow. Apply bait on bright days with no rain expected for several days. If further mouse activity is detected, repeat the treatment when rain is not expected.

See Table 8–3. *Bait for Mouse and Vole Management*, page 274, for several commercial bait formulations that are available for orchard use. Consult the label before application and obey all safety instructions.

- Baits are poisonous to humans, domestic animals and wildlife.
- Store the bait away from children, irresponsible persons and animals.
- Wear chemical-resistant gloves and wash hands after handling poison baits.
- Use bait during dormant season, only after harvest and all dropped fruit has been picked up.
- Avoid inhalation of dust or fumes.
- Destroy empty containers safely.
- Keep children, pets and domestic animals away from treated areas.
- Where possible, remove mouse bodies and bury or dispose of them in a safe manner.

Rabbit Management

Wrapping young trees

To protect young trees from rabbits, wrap burlap around the top and the trunk of the tree (above the mouse guard). Tie the wrapped tree securely to a strong stake or steel fencepost to prevent snow and ice from breaking the tree. Mouse guards generally do not give protection against rabbits when the snow is deep.

Repellents

Rabbits do not like to feed on the trunks of young trees if the trees have been treated with thiram. Products such as Skoot, and other commercial mixtures containing thiram, can be painted directly onto the tree trunks by hand or diluted with water for backpack sprayer application. Be sure to treat the tree as high as rabbits can reach when they stand on deep snow.

For more information about the application of paint with thiram, refer to *Control of Southwest Injury on Fruit Trees*, page 277.

Repairing damage by mice and rabbits

Carry out regular inspections throughout the winter to check for injury. Mice often feed just below the surface of the snow or in the litter. If a tree has been wholly or partially girdled, cover the wound with a grafting compound or wound dressing promptly or before it dries out.

The process for repairing fruit trees damaged by mice and rabbits is described in OMAFRA Factsheet, *Repair Grafting*. Before the buds swell in the early spring, secure scions that are long enough to bridge the wound. Store scions in damp sand or sawdust in a cool place, preferably in refrigerated conditions. Avoid storing scions with apple fruit to avoid ethylene damage. If the wound extends for more than one quarter of the circumference of the trunk, use scions to connect the healthy tissue by bridge grafting. Graft when the bark slips readily from the wood, usually about bloom. This technique is not practical on trees with a diameter less than 10 cm. Instead, replace small trees.

Bird Management

Every year birds destroy large quantities of fruit in Ontario. Sweet cherries, grapes, blueberries and saskatoon berries are the crops most subject to attack, but other fruit crops may also be damaged. The amount of loss due to birds depends on the cultivar, the time of season, location in the province, proximity to bush

and hydro lines, and availability of other food sources. Losses range from relatively minor to total crop loss. Actual losses are difficult to measure, since fruit that has disappeared is hard to account for. Pecking and puncturing damage are often as great as actual losses from fruit consumed and can cause secondary problems with rot.

Managing bird damage

Fruit becomes attractive to birds as it begins to turn colour. Birds are very selective and quickly learn where to find the most tasty, ripe fruit. Start controls early, 10–30 days prior to colouring of the fruit, depending upon the cultivar. An integrated approach using several control methods is necessary for effective and long-lasting control.

Regardless of the bird control method used, follow all local, provincial and federal laws. For more information on bird control, see OMAFRA Factsheet, *Bird Control on Grape and Tender Fruit Farms*.

Location

Where you plant commercial fruit crops can be an important factor in bird control. Fruit crops planted near wooded areas or hydro lines are particularly susceptible to damage, because birds nearby find shelter, perching locations and nest sites.

Physical protection

The only completely effective control method is to cover the crops with netting. This method may be economically feasible for some higher valued cultivars of grapes, cherries and highbush blueberries. However, nets are not the answer in every situation since they can be costly to purchase and install, as well as difficult to work with. There is considerable interest by growers to find simpler, cost-effective netting systems for fruit crops.

Shooting

Normally, shooting does not significantly reduce bird populations, but it does frighten them out of the orchard. Laws protect robins and northern orioles, but special permits may be obtained to kill them if you can show they are causing damage.

For a permit, contact the permit office, Canadian Wildlife Service, Environment Canada, at 905-336-4464.

Pyrotechnic pistol cartridges are also available with delayed explosions and/or sustained whistles that disorient and frighten birds.

Propane-fired bird scaring cannons

Cannons are one of the most commonly used bird scaring devices. Loud, unexpected gunshot-like sounds, produced at random intervals, cause birds to flee. Move the cannons periodically to different locations in the orchard or vineyard. Birds quickly adjust their feeding habits if cannons are in the same location throughout the harvest season.

A major drawback of these devices is the disruption to neighbours. Growers must recognize this and adjust usage to minimize discomfort to neighbours. Most neighbours are sympathetic to the need for crop protection, but may complain if the equipment is not used properly.

- Fire cannons only during bird forage periods in daylight hours, generally accepted as 30 minutes before sunrise and 30 minutes after sunset. Check the local newspaper or radio for sunrise and sunset times in your area. Operation outside these times is not considered a normal farm practice.
- Place cannons as far away from neighbours as possible and at least 125 m away from their houses.
- Operate cannons on the Frequency 2 setting, meaning the firing sequence occurs randomly during a 4–8-minute span.
- Do not place cannons closer than 125 m apart, unless the area of the crop being protected is less than 4 ha, in which case place them no closer than 100 m apart.
- Make sure cannons are level so they fire in all directions uniformly.
- Monitor the equipment regularly to ensure it functions properly.

For more information on bird scaring cannons, see OMAFRA Factsheet, *Using Propane-Fired Cannons to Keep Birds Away from Vineyards*.

Electronic sound devices

This equipment emits electronic or other types of sounds that imitate distress or predator calls of different bird species. The sound produced, although loud, is usually less objectionable to neighbours than propane-fired cannons.

- Operate electronic sound devices only during daylight hours.
- Move the equipment periodically for maximum effectiveness.

Chemical controls

Currently, there are no chemicals registered for use in Ontario to control birds in fruit crops. It is illegal to use unregistered chemicals.

Visual deterrents

These include: aluminum foil hung in trees, model hawks and other birds of prey, strips of yellow plastic hung across vineyards, vibrating plastic strips, scarecrows, mirrors, kites and scare-eye balloons. Most visual deterrents move with the wind, produce noise and make reflections. Other visual deterrents on trial in Ontario include the use of lasers to disperse birds and robotic scaring devices activated by bird movement.

Falconry

Trained falcons and hawks provide successful bird control. Experienced falconers are needed to fly the birds. Availability, cost and time are major drawbacks of this approach for fruit growers.

Control of Southwest Injury on Fruit Trees

Southwest injury, or winter sunscald, occurs in the winter and is especially severe when cold still nights follow cold sunny days. This phenomenon can occur in apple, peach, pear, cherry, plum, apricot and tree nut orchards. The damage is usually confined to the south and southwest sides of the trunks and main scaffold branches. On sunny days these tissues become considerably warmer than the surrounding air and at night they cool rapidly. Under these conditions, freezing of the bark and underlying tissues may occur. This injury usually affects large portions of the bark tissue that become brown and eventually slough off as healing occurs beneath.

In stone fruit orchards, these injuries provide ideal sites for infection by peach canker or other canker diseases. The combined effect of southwest injury and peach canker greatly reduces the productive life of affected trees. Recent increases in apple tree cankers may also be linked to problems with southwest injury in the winter.

Paint the trunk, crotches and lower parts of main scaffold branches thoroughly with exterior white latex paint to minimize southwest injury. The white paint reduces the damage by reflecting direct sunlight from the exposed tissue. This helps to reduce rapid warming on sunny days when air temperatures are below freezing.

- Avoid oil-based or latex paints that contain any oil. These products contain toxic materials that may injure or kill fruit trees.
- October is the best time to apply the paint. For best results, paint trees on days when the temperature is above 10°C and when the paint or spray will dry rapidly.
- Apply the paint by brush or spray. If you choose spray, dilute the paint with 1–2 L of water/4.5 L of paint, depending on the thickness of the paint and the air pressure available.
- On young trees, paint the whole trunk. Only the south and southwest sides of older trees require paint. The whiter the bark after you paint, the greater the protection. Better quality paints are more durable.
- On young trees, injury from rodents may be a greater problem than southwest injury. To obtain protection from both problems, use commercially available products which reflect sunlight and repel rodents (e.g., Skoot). Avoid contact with eyes, skin and clothing with products containing thiram.
- Do not use the thiram-latex mixture if you plan to use a fall Bordeaux spray program. The thiram reacts with the Bordeaux spray, changing the colour of the paint from white to brown and reducing its effectiveness as a heat reflector. The Bordeaux spray does not affect trees painted with latex only and can be used when thiram is excluded from the mixture.

Heat Stress and Sunburn on Apple and Pear Trees

Surround WP is highly refined kaolin clay. Applied to the tree canopy, it forms a microscopic particle film that protects both leaves and fruit from high UV light and heat, which can slow the photosynthetic rate in a tree canopy.

The benefits of using Surround on young apple and pear trees during their establishment include:

- greater net accumulation of carbon from photosynthesis
- enhanced fruit bud initiation
- increased trunk diameter
- increased shoot growth

In established orchards, trees treated with Surround have healthier foliage through to leaf drop. Plant dormancy is not affected. Fruit finish and marketable yield are improved on several cultivars.

To prevent heat stress, make 2 applications of Surround, 7 days apart, using 50 kg/ha. Begin spraying before heat stress is likely to occur. Continue applications at 7–14-day intervals at a reduced rate of 25 kg/ha to maintain even coverage.

Precautions when using Surround:

- Do not mix Surround with spreaders, stickers or anti-foaming agents.
- Do not spray when bees are active.
- In orchards treated with Surround, monitor fruit maturity carefully and use starch iodine tests in the last 2 weeks of crop development.

For information on using Surround to suppress crop pests, see *Organic and Biopesticide Products*, page 279.