CROP PROTECTION GUIDE
FOR NURSERY AND LANDSCAPE PLANTS

2019

Publication 840

Ministry of Agriculture,
Food and Rural Affairs

Ontario

Discard old editions of this publication. Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the committee, at the time of printing, the pesticide products listed in this publication were:

- **federally registered**
- **classified by the Ministry of Environment, Conservation and Parks (MECP)**

The information in this publication is general information only. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

This publication lists a number of brand names of pesticides. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

The Pesticide Label

Consult each product label before you use a pesticide. The label provides specific information on how to use the product safely, hazards, restrictions on use, compatibility with other products, the effect of environmental conditions, etc.

The pesticide product label is a legal document. Follow all label directions.

Federal Registration of Pesticide Products

The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticide products for use in Canada based on following an evaluation of scientific data to ensure that the product has value, and the human health and environmental risks associated with its proposed use are acceptable.

1. **Full Registration**
   Pesticide registrations are normally granted for a period of 5 years, subject to renewal.
2. **Conditional Registration**
   Conditional registration may be granted for a specified, limited time period, where the registrant agrees to produce additional scientific or technical information.
3. **Emergency Registration**
   An emergency registration is a temporary, time-limited registration of no more than 1 year, approved to deal with serious pest outbreaks that have limited control options.

Maximum Residue Limits

The PMRA has established maximum residue limits (MRLs) for pesticides. Processors or retailers may demand more restrictive limits. Growers should seek the advice of their intended market to determine if more restrictive limitations apply. Keep accurate and up-to-date records on pesticide use in each crop.

Supplemental Labels

You MUST obtain a supplemental label and follow all the label directions when PMRA approves new uses for a registered pesticide that do not appear on the current label.

Examples of when you must use a supplemental label include:

- **Emergency Use Registration**
- **Minor Use Label Expansion**

You can obtain a copy of a supplemental label from the pesticide manufacturer or pesticide vendor, the grower association that sponsored the emergency registration or minor use, from OMAFRA or from PMRA's Pest Management Information Service.

For more information on the federal registration status, check the PMRA website at www.healthcanada.gc.ca/pmra or call 1-800-267-6315.

Regulation of Pesticides in Ontario

The MECP is responsible for regulating pesticide sale, use, transportation, storage and disposal in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09.

All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at Ontario.ca/e-laws or by calling ServiceOntario Publications toll-free number: 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MECP, the classification of pesticide products before they can be sold or used in Ontario. Once approved by the MECP, classified products are posted on the MECP website: ontario.ca/pesticides.

Certification and Licensing

Certified Farmers and Their Assistants

For information about certification for growers and training for assistants, check the Ontario Pesticide Education Program website: www.opep.ca or call 1-800-652-8573.

Commercial Applicators (Exterminators) and Their Assisting Technicians

For more information about exterminator licensing and technician training, visit:

- The Ontario Pesticide Training and Certification website at www.ontariopesticide.com or call 1-888-620-9999 or 519-674-1575
- The Pesticide Industry Council's Pesticide Technician Program website at www.horttrades.com/pesticide-technician or call 1-800-265-5656 or e-mail pic@hort-trades.com
- The Pesticide Industry Regulatory Council (PIRC) at www.oipma.ca.

Cette publication est aussi disponible en français.

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The information contained in this publication is supplied by Crop Specialists of OMAFRA's Agriculture Development Branch.

OMAFRA Publication 840, *Crop Protection Guide for Nursery and Landscape Plants 2019*, and Publication 841, *Guide to Nursery and Landscape Plant Production and IPM*, together replace OMAFRA Publication 383, *Nursery & Landscape Plant Production and IPM*.

OMAFRA Publication 840 contains information about pesticide products that have been registered as of December 31, 2018, on outdoor ornamentals. Any supplements to this publication will be posted at ontario.ca/crops.

OMAFRA Publication 840 is a companion to OMAFRA Publication 841, *Guide to Nursery and Landscape Plant Production and IPM*. Publication 841 contains more comprehensive information on pest management, nutrition and water quality and includes colour photos for many common pests.

Need technical or business information?

Contact the Agricultural Information Contact Centre at

1-877-424-1300
or
info.omafra@ontario.ca

If you are looking for nursery and landscape plant information on the Internet, check ontario.ca/crops.

It's one-stop shopping for factsheets, articles and photos about the production and maintenance of woody plants.

Supplements to this publication will be posted at ontario.ca/crops.

If you are looking for timely information on the production and maintenance of outdoor ornamentals, check out the Nursery and Landscape Blog at www.onnurserycrops.wordpress.com.

Subscribe by entering your e-mail address and selecting "Follow" to receive e-mail notifications of new posts.

Cover Images

FRONT COVER PHOTOS:

Top:	Various evergreen and deciduous plug-grown seedlings in fall
Bottom Left:	Field grown maple trees in summer
Bottom Centre:	Take It Easy™ shrub rose in summer
Bottom right:	Container grown cedar in summer

BACK COVER:

Top left:	Pot-in-pot production of honeylocust trees in fall
Top centre:	Close up of red oak leaves in fall with slight frost
Top right:	Polyhouse with young deciduous container-grown shrubs
Bottom:	Field grown junipers in winter

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1. Using Pesticides in Ontario

The information in this chapter is updated regularly. For up-to-date information, visit ontario.ca/usingpesticides. Some of the information in this generic chapter may not apply to all crops.

Read the label before use.

Product labels may change.

Review the Grower Pesticide Safety Course Manual. www.opep.ca/certification/grower-pesticide-safety-course/

Keep detailed spray records.

FEDERAL REGISTRATION OF PESTICIDES

Before a pesticide (pest control product) can be sold or used in Ontario, it must be registered under the federal *Pest Control Products Act* (PCP Act) and be classified under the provincial *Pesticides Act*. The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticides for use in Canada following an evaluation of scientific data to ensure that any human health and environmental risks associated with its proposed uses are acceptable, and that the products have value.

The PMRA re-evaluates registered pesticides to determine whether today's health and environmental protection standards are still met when the pesticide is used according to the label. The PMRA also assesses whether the pesticide still has value. Re-evaluations are initiated every 15 years. Outcomes of a re-evaluation can be:

- no change to the registration
- amendments to the label (e.g., changes to personal protective equipment requirements, restricted entry intervals, buffer zones)
- modifications to existing Maximum Residue Limits (MRLs)
- elimination or phasing-out of certain uses or formulations
- discontinuation of the registration

A special review of a registered pesticide can be initiated at any time by the PMRA if the PMRA has reason to believe its use may pose unacceptable risk to human health or the environment or the pesticide no longer has value. Special reviews focus on a specific concern (e.g., pollinator health).

The pesticide label is a legal document. Follow all label directions. Labels for all registered pesticides are under "Search Pesticide Labels" on the PMRA website at pr-rp.hc-sc.gc.ca/ls-re/index-eng.php. Ensure you have the most current label and are aware of any re-evaluation decisions. Emergency registrations are temporary registrations (one year or less) for pesticides needed by growers to manage a new invasive pest or pest outbreak. Know the expiration date for pesticides you are using under an emergency registration.

REGULATION OF PESTICIDES IN ONTARIO

The Ministry of the Environment, Conservation and Parks (MECP) is responsible for regulating the sale, use, transportation, storage and disposal of pesticides in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09. All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at ontario.ca/e-laws or by calling ServiceOntario at 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

Before a federally registered pesticide can be sold or used in Ontario, it must be classified under the provincial *Pesticides Act*. The Ontario pesticide classification system consists of 12 classes. Ontario's Pesticides Advisory Committee (OPAC) is responsible for assessing new pesticide products and recommending to the MECP the classification of these products. Pesticide products are classified on the basis of their toxicity, environmental and health hazard, persistence of the active ingredient or its metabolites, concentration, usage, federal class designation (e.g., domestic, commercial, restricted) and registration status. The provincial classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario. Once approved by the MECP, classified products are posted on the MECP website at ontario.ca/pesticides.

CERTIFICATION AND LICENSING

Certified Farmers and Their Assistants

Growers must be certified through the Grower Pesticide Safety Course in order to buy and use Class 2 and 3 pesticides on their farms. They do not require this certification to buy and use Class 4, 5, 6 or 7 pesticides, however, a grower needs to provide his/her Farm Business Registration Number or a signed "Farmer Self Declaration to Enable Purchase of a Class 4 Pesticide" form to the vendor when buying Class 4 pesticides. For information about certification for growers and training for assistants to growers, visit the Ontario Pesticide Education Program website at www.opep.ca or call 1-800-652-8573.

Class 12 Requirements for Growers

Starting on July 1, 2015, new requirements will be phased in for growers who plan to purchase or plant neonicotinoid-treated corn (silage or grain) or soybean seed in Ontario. For more information on the training and reporting requirements for growers, visit the MECP website at ontario.ca/pesticides, then click on "Neonicotinoid regulations."

Commercial Applicators (Exterminators) and Their Assisting Technicians

For more information about exterminator licensing and technician training, visit:

- the Ontario Pesticide Training and Certification website at www.ontariopesticide.com/ or call 1-888-620-9999 or 519-674-1575
- the Pesticide Industry Council's Pesticide Technician Program website at horttrades.com/pesticide-technician or call 1-800-265-5656 or e-mail pic@hort-trades.com
- the Pesticide Industry Regulatory Council (PIRC) at www.oipma.ca

Exception Uses Under the Cosmetic Pesticide Ban

Pesticides listed in this publication are meant for Exception Uses (e.g., agriculture) under the Cosmetic Pesticide Ban unless the active ingredient is listed under Class 11 pesticides in Ontario Regulation 63/09.

For information about requirements under the *Pesticides Act* and Regulation 63/09, for golf courses and other excepted uses for turfgrass, including mandatory golf course IPM accreditation, go to ontario.ca and search for:

- Pesticides and Golf Courses
- Specialty Turf and Specified Sports Fields

For more information about requirements in the *Pesticides Act* and Regulation 63/09 for the exception regarding the use of pesticides to maintain the health of trees, go to ontario.ca and search for:

- Tree Care Specialists

For more information about pesticide regulations, certification and licensing, see:

- Inside front cover of this publication
- Pest Management Regulatory Agency (PMRA) website: www.healthcanada.gc.ca/pmra
- PMRA Pest Management Information Service: 1-800-267-6315 or TTY 1-800-465-7735 (from within Canada) or 1-613-736-3799 (from outside Canada)
- Ontario Ministry of the Environment, Conservation and Parks (MECP) website: ontario.ca/pesticides
- Regional MECP Pesticides Specialist (See Appendix C. *Ministry of the Environment, Conservation and Parks — Regional Contact Information*, on page 188.)
- Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website: ontario.ca/omafra
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) website: www.opep.ca
- Ontario Pesticide Training & Certification website: www.ontariopesticide.com
- Pesticide Industry Council's Pesticide Technician Program website at www.horttrades.com/pesticide-technician
- IPM Council of Canada website: www.ontarioipm.com or www.ipmcouncilcanada.org
- Pesticide Industry Regulatory Council (PIRC) at www.oipma.ca

PESTICIDE APPLICATION INFORMATION

When you decide to use a pesticide, choose the most appropriate formulation and application method for your situation. Use only properly calibrated sprayer equipment. Choose less toxic and less volatile alternatives when possible. Take all possible precautions to prevent the exposure of people and non-target organisms to the pesticide. Read the most current pesticide label thoroughly before application. The label provides important information, such as:

- directions for use (e.g., rates of application, crops/ sites it can be used on, target pests, crop rotation restrictions, total number of applications, droplet size/nozzle type, application equipment, timing, appropriate weather conditions)
- required personal protective equipment (PPE)
- hazard symbols and warnings
- restricted entry intervals
- pre-harvest intervals
- buffer zones
- precautionary statements
- steps to be taken in case of an accident
- disposal

For more information on hazards, consult the Safety Data Sheet (SDS) or contact the manufacturer.

For more information on pesticide application, see:

- Sprayers 101 at www.sprayers101.ca
- OMAFRA Factsheet *Pesticide Drift from Ground Applications*
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos at www.opep.ca/resources/
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Clean-up and Responsibilities*

Restricted Entry Intervals

Restricted Entry Interval (REI) is the period of time after a pesticide has been applied that agricultural workers or anyone else must not do hand labour tasks in treated areas. The REI allows the pesticide residues and vapours to dissipate to safe levels for work to be done.

An REI can range from 0 hours to several days. A pesticide label may state different REIs that are specific to a crop and post-application task (e.g., scouting, harvesting). If the REI is not stated on a label for agricultural crops, use a 12-hr REI. For golf courses and residential turf applications, the spray solution must be dry before re-entry can occur.

Hand labour tasks involve substantial worker contact with treated surfaces such as plants, plant parts or soil. Examples of these activities include planting, harvesting, pruning, detasseling, thinning, weeding, scouting, topping, sucker removal, mowing, roguing and packing produce into containers in the field or greenhouse. You can only do these tasks after the REI has passed. Hand labour generally does not include operating, moving or repairing irrigation or water equipment, except for hand-set irrigation.

A Certified Farmer or Licensed Commercial Applicator (i.e., a holder of the appropriate Exterminator License, such as an Agriculture Exterminator Licence or a Greenhouse/Interior Plant Exterminator Licence) may need to re-enter a treated area to do short-term tasks before the end of the REI. In these cases, the Certified Farmer or Licensed Commercial Applicator may re-enter 4 hr after the application wearing a NIOSH-approved respirator and any other protective clothing (PC) and the personal protective equipment stated on the label for mixing and loading. This Certified Farmer or Licensed Commercial Applicator (exterminator) must not be in the treated area during the REI for more than a total of 1 hr in any 24-hr period.

See Figure 1–1 for an example of a 24-hr REI on a pesticide label.

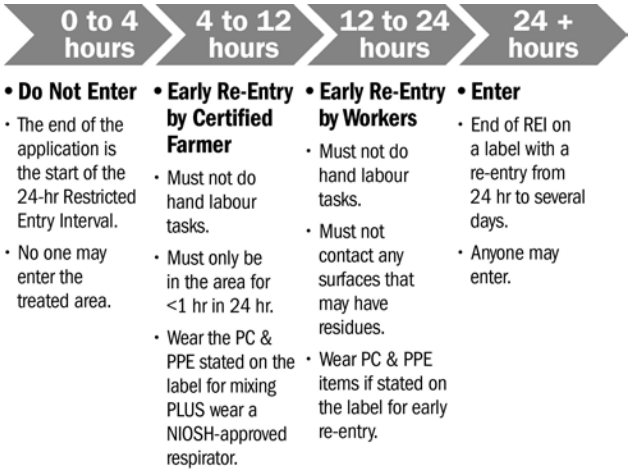

Figure 1–1. Example of a 24-hr REI on a pesticide label.

Certified Farmers and Licensed Commercial Applicators should plan pesticide applications around work tasks so that no one needs to re-enter treated areas before the restricted entry interval has passed.

Days to Harvest Intervals for Food Crops (Pre-harvest, Pre-grazing and Feeding Intervals)

These intervals state the minimum time that must pass between the last pesticide application and the harvesting of the crop or the grazing and cutting of the crop for livestock feed. If you harvest a crop before the pre-harvest interval (PHI) has passed, there may be pesticide residues in excess of the maximum residue limits (MRLs) set by PMRA.

"Up to the day of harvest" means the same as 0 days PHI; however, the REI may be more restrictive (e.g., a 12-hr restricted entry interval) and must be observed for harvesting that occurs on the day of pesticide application.

To avoid exceeding the maximum residue limits, always follow the directions on the label.

Buffer Zones

Buffer zones, or no-spray areas, are areas left untreated to protect an adjacent sensitive area, such as sensitive terrestrial and aquatic habitats. Generally, a buffer zone is the downwind distance separating the point of direct pesticide application from the nearest boundary of a sensitive habitat. For soil fumigation, a buffer zone is an area established around the perimeter of each application block.

Pesticide labels indicate the required buffer zone between the treatment area and adjacent sensitive area. Buffer zones vary depending on the method of application (e.g., aerial, field boom, air blast, nozzle type, the type of sensitive area and the crop sprayed).

Sensitive terrestrial habitats include hedgerows, grasslands, shelterbelts, windbreaks, forested areas and woodlots.

Sensitive freshwater habitats include lakes, rivers, streams, creeks, reservoirs, marshes, wetlands and ponds.

Health Canada's PMRA has an online spray drift calculator that may allow applicators to modify the buffer zones specified on the product label based on weather conditions, the category of the spray equipment and the droplet size. For more information, see the Buffer Zone Calculator at www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/drift-derive/calculator-calculatrice-eng.php.

Setback Distances for Water Bodies

It is an offence under the federal *Fisheries Act* to introduce into water any material that may be harmful to fish or fish habitat, and under the *Species at Risk Act*, to impact endangered or threatened fishes and fresh water mussels. To protect these waters, applicators must determine a suitable setback distance between the area to be protected and the area where pesticide treatments are planned (if the setback distance is not specified on the pesticide label). The protected area includes the water body as well as adjacent riparian (riverbank) areas that contribute to fish food and habitat.

PROTECT THE ENVIRONMENT

Protect Water Sources

According to the British Crop Protection Council (BCPC), 40%–70% of surface water pesticide contamination comes from mixing and filling areas.

Where possible, load or mix pesticides on impermeable surfaces located safely away from watercourses or environmentally sensitive areas. Collect drainage and run-off and dispose of it safely (*Your Guide to Using Pesticides,* BCPC 2007).

Clean your spray equipment away from wells, ponds, streams and ditches. Apply the diluted rinse water (usually at a ratio of 10:1) to the treatment area (crop), but do not exceed the pesticide rate recommended on the label.

Do not make a direct connection between any water supply (e.g., public supply, wells, watercourse or pond) and a spray tank. Use an anti-backflow device or intermediate system to prevent back-siphoning that could contaminate the water supply.

Immediately contain and clean up any spills to prevent contamination to water sources.

Check the pesticide label for specific instructions on protection of water sources.

For more information on protecting water sources, see ontario.ca/crops:

- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Cleanup and Responsibilities*
- OMAFRA Factsheet *Groundwater — An Important Rural Resource: Protecting the Quality of Groundwater Supplies*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13

Bee Poisoning

Honeybees, native bee species (e.g., bumble bees, squash bees) and other pollinating insects are important pollinators for many Ontario crops. Insecticides, some of which may negatively affect bees, require careful management to achieve both pollination and insect control. Growers and licensed commercial applicators can protect bees by following these suggestions:

- Time insecticide applications to minimize bee exposure (e.g., apply post bloom). Daytime treatments, when bees are foraging, are most hazardous. Insecticide applications in the evening are the safest, unless there is evidence of a strong temperature inversion or high humidity. Under normal circumstances, spraying after 8 PM allows the spray to dry before the bees are exposed to it the next day. Spraying during early morning is the next best time, when fewer bees are foraging, but pesticide residues may still be present. Spraying should be completed well before 7 AM. While honeybees and most other pollinating insects do not usually forage at temperatures below 13°C, bumblebees do. If you plan to spray in the morning, contact beekeepers who have bees within 5 km of your crop and spray site. The beekeepers may then have the option of taking any possible protective action.
- Do not apply insecticides while fruit trees are in bloom. The *Bees Act* makes it an offence to do so in Ontario. Do not spray any flowering crop on which bees are foraging.
- To prevent drift toward nearby hives, do not apply insecticides on windy days or when there is evidence of a strong temperature inversion.
- Bees and other pollinators may be poisoned by visiting flowering weeds, trees and cover crops that have come into contact with an insecticide via spray drift or drift of insecticide-contaminated dust during planting. Avoid spray drift to flowering weeds that are adjacent to or within the target field. Where possible, mow down flowering cover crops or flowering weeds in and bordering target fields prior to spraying to help safeguard the bees. Control dandelions and other flowering weeds within fields before spraying or planting seeds treated with an insecticide. Take measures to reduce movement of dust from insecticide seed treatments to flowering trees, weeds and

water sources that are in or adjacent to the target field. For more information on reducing dust movement, see PMRA's *Pollinator Protection and Responsible Use of Treated Seed — Best Management Practices* at www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/pollinator-protection-pollinisateurs/treated_seed-semences_traitees-eng.php.

- Systemic insecticides may also pose a high risk to bees and other insect pollinators. Bees can be exposed to insecticide residues in or on flowers, leaves, pollen, nectar and/or surface water. Do not apply insecticide or allow it to drift onto blooming crops or off-site habitat if bees are foraging in or adjacent to the treatment area.
- In crop settings where pesticide use is highly likely, beekeepers should remove honeybee colonies as soon as pollination and bloom are complete in the crop and before any insecticides are applied post bloom. In emergency situations, if the colonies cannot be removed in time, beekeepers can place burlap or cloth soaked in water at the entrance of the hive to disrupt the flight of the bees for up to 12 hr and provide more time for spray to dry. To help prevent overheating of the hive during this time, keep an opening of 2.5 cm on each side of the hive entrance so bees can still get out and ventilate the hive. Also, the water on the burlap or cloth will help cool the colony.
- Not all pesticides are equally toxic to bees. If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to bees. When there is a choice, choose a product formulation that is less hazardous to bees.
- Always read the most current pesticide label for guidance. Some pesticides cannot be used when bees are active in the crop.

Manage Drift

Pesticide drift is the aerial movement and unintentional deposit of pesticide outside the target area. Drift results in wasted product and may compromise crop protection and also may adversely affect nearby sensitive environmental areas, crops and wildlife. The following strategies can help reduce the risk of pesticide drift:

- Do not spray when wind direction is changeable, or wind speeds are high or gusty. These conditions increase the potential for off-target drift. While most pesticide labels indicate allowable wind speeds some do not.
- Regularly monitor wind conditions during spraying, preferably in the field with a handheld wind meter at nozzle height. Record the wind speed and direction. As conditions change, make adjustments to manage drift potential. Adjustments may include a Coarser droplet size, minimizing nozzle-to-target distance, slowing travel speed, changing nozzle technology, using a drift reducing spray additive or discontinuing spraying until conditions improve.
- Do not spray during periods of dead calm. Periods of dead calm may occur between late evening and early morning and can result in the Vapor or Fine spray droplets remaining aloft, like fog. Spray-filled air can move unpredictably over great distances several hours after the spray event is completed.

Temperature inversions create problems for spray applicators because pesticide spray can:

- remain suspended and active in the air above the target for long periods of time
- move with light breezes in changeable and unpredictable directions
- move down slopes and concentrate in low-lying regions

Field air temperatures are often very different from local or regional forecasts, so the most reliable method of detecting inversion conditions is to measure temperatures at, and several metres above, the ground. Commercial hand-held inversion detectors are now available. Spray applicators can also recognize a temperature inversion from environmental cues, such as when:

- there is a big drop from daytime to nighttime temperature
- wind dies down by early evening and night
- far away sounds can be heard clearly
- odours seem more intense
- daytime cumulus clouds collapse toward evening
- overnight cloud cover is 25% or less
- smoke or dust hangs in the air and/or moves laterally in a sheet

Temperature inversions start to form about 3 hr prior to sunset, become stronger as the sun sets and continue until sunrise when the surface warms and air mixing begins. **If you suspect there's an inversion, don't spray. Often, warnings for the risk of inversions are stated right on the product label.**

- Use the sprayer output specified on the pesticide label.
- Use a nozzle that will produce the droplet size specified on the pesticide label or delivers droplets appropriate for the job.
- Where practical, use air induction nozzles, which significantly reduce drift compared to conventional nozzles.
- Minimize the distance between nozzle and target as much as possible while still maintaining spray uniformity.
- Establish buffer zones for the protection of adjacent sensitive areas. Some pesticide labels will state buffer zone setbacks; follow these carefully.
- Use drift reduction technology, such as hoods, shrouds, screens or air curtains.
- If appropriate, use drift-reducing adjuvants in the spray tank. The intense agitation in airblast sprayers has been shown to reduce the effectiveness of drift-reducing adjuvants. Certain combinations of drift-reducing adjuvants and air-induction nozzles have been shown to increase the incidence of Fine droplets.
- When possible, use non-volatile pesticide formulations or products.

For more information about spray drift, see:

- Sprayers 101: www.sprayers101.ca
- OMAFRA website: ontario.ca/spraydrift
- OMAFRA Factsheet *Pesticide Drift from Ground Applications*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos *How to Manage Spray Drift* and *Spray Drift Reduction Through Air Induction*, available at https://youtu.be/LeO9aFoJ1qU

WASTE MANAGEMENT (CONTAINER DISPOSAL)

Empty Pesticide and Fertilizer Containers Up to 23 L

Never re-use empty pesticide containers.

The Ontario Empty Pesticide and Fertilizer Container Recycling Program, an industry-led program, is available free of charge to growers and commercial applicators. Through this program, you can return triple-rinsed or pressure-rinsed plastic pesticide and fertilizer containers up to 23 L to container collection depots located throughout the province. Remove the cap and booklet from the pesticide container before recycling. To locate the closest container collection depot, visit www.cleanfarms.ca, call your local dealer or contact CleanFARMS at 416-622-4460 (toll-free at 877-622-4460) or info@cleanfarms.ca.

Empty Pesticide Containers Greater Than 23 L

Growers and commercial applicators should return pesticide containers that are greater than 23 L in size to the point of sale or to the manufacturer for disposal. Contact your local dealer for details on disposal of these containers, or contact CleanFARMS at 416-622-4460 (toll-free at 877-622-4460) or info@cleanfarms.ca.

Empty Seed and Pesticide Bags

Growers can return their empty seed and pesticide bags to select retail locations. Contact your local dealer for details on disposal of these empty seed and pesticide bags, or contact CleanFARMS at 416-622-4460 (toll-free at 877-622-4460) or info@cleanfarms.ca.

Surplus Spray Mix

The best approach is to plan the spray job accurately to avoid creating a surplus.

When this is unavoidable, dispose of excess spray mix by spraying it on other crops that require an application of this pesticide. Before spraying, check the label to make sure the pesticide is registered for use on that other crop.

If you cannot find another allowable crop to spray, then dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix. The diluted solution can be safely applied to the original treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest or disposal of surplus spray mix.

Never re-spray the treated field with undiluted spray mix. Spraying an area twice at the same pesticide rate will double the labeled pesticide rate. This may cause illegal pesticide residues in the harvested crop or harmful residues in the soil that can cause crop damage.

Surplus Pesticide Disposal

Be sure to safely dispose of pesticides that you do not need or cannot use. Options for proper disposal include:

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original, unopened container.
- Hire a licensed waste hauler who is licensed under Part V of the *Environmental Protection Act* to carry hazardous wastes. Look in the Yellow Pages of your telephone directory under Liquid Waste Removal.
- CleanFARMS operates a free Obsolete Pesticide and Animal Health Product Collection Program throughout the province every three years. To locate the closest collection point and date, visit the CleanFARMS website (www.cleanfarms.ca), contact CleanFARMS at 416-622-4460 (toll free at 877-622-4460) or info@cleanfarms.ca or contact your local dealer for program details.
- Contact your municipality to see if any hazardous waste collection days are scheduled and verify whether quantities of agricultural pesticides will be accepted.

STORING PESTICIDES

Ontario's *Pesticides Act* and Regulation 63/09 provide details on storage requirements for pesticide storage facilities. As shown in Table 8–1, the storage requirements that must be followed are dependent on which classes of pesticides you store.

Table 1–1. Requirements for Pesticide Storage Facilities

	Pesticide Classes		
Storage requirements	**Class 2**	**Class 3**	**Class 4, 5, 6 & 7**
No contact with food or drink	**YES**	**YES**	**YES**
Not an impairment to health and safety	**YES**	**YES**	**YES**
Clean and orderly	**YES**	**YES**	**YES**
Warning sign G posted*	**YES**	**YES**	**YES**
Emergency telephone numbers posted**	**YES**	**YES**	**YES**
Vented to outside	**YES**	**YES**	NO
Limited access (locked)	**YES**	**YES**	NO
No floor drain	**YES**	**YES**	NO
Respiratory protection and protective clothing kept readily available	**YES**	**YES**	NO
Area used primarily for pesticides	**YES**	NO	NO

Note: Sufficient precautions are needed in your storage area to prevent the pesticide from entering the natural environment. Ensure your floor drain does not enter the natural environment.
* See ontario.ca for requirements for warning sign G (Search for sample warning signs for pesticide use). These signs can be purchased from your pesticide dealer/vendor.
** Emergency contact numbers must include telephone numbers for the local fire department, hospital and poison control centre. The number for the MECP Spills Action Centre (1-800-268-6060) should also be readily available.

For more information about storing pesticides, see:

- OMAFRA Factsheet *Farm Pesticide Storage Facility*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) *Grower Pesticide Safety Course Manual*, available at www.opep.ca. Select "Learning."

PESTICIDE SPILLS

If a pesticide spill causes, or is likely to cause, an adverse effect that is greater than that which would result from the proper use of the pesticide, you must notify the Ministry of the Environment, Conservation and Parks Spills Action Centre at 1-800-268-6060 (24 hr a day, 7 days a week) and your municipality.

A spill is defined as a discharge of pollutant that is abnormal in quality or quantity, from or out of a structure, vehicle or other container into the environment. An incident such as an overturned pesticide sprayer that results in the loss of the spray solution to the environment is an example of a spill. A pesticide container that ruptures and leaks its contents is another example of a spill. The discharge or spraying of a pesticide in an unapproved area is also considered a spill.

Before you begin to clean up a spill of any nature, remember to protect yourself against pesticide exposure. Wear the proper protective clothing and personal protective equipment. If the spill occurs inside an enclosed area (e.g., a pesticide storage area or a vehicle during transport), ventilate the area first. Once you have protected yourself and removed other persons or animals from the spill site, take additional measures to stop the spill at the source and prevent it from spreading and/or contaminating watercourses. Specific precautions, emergency contact information and first aid procedures may be found on the label.

For minor spills, it may be possible to rectify the problem:

- **For a liquid spill** — Cover the spill with a thick layer of absorbent material such as kitty litter, vermiculite or dry soil. Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.
- **For a dust, granular or powder spill** — Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.

For major spills, it is essential to stop the spill from spreading.

The clean-up guidelines above may not be appropriate for all spill situations. Once you have contained the spill, follow directions from the manufacturer and regulatory authorities on cleaning the contaminated area.

Some of the information contained in this chapter is not authoritative. It is derived from the *Pesticides Act,* Ontario Regulation 63/09 and the federal *Pest Control Products Act, Fisheries Act* and *Species at Risk Act* and is for informational purposes only. Efforts have been made to make it as accurate as possible, but in the event of a conflict, inconsistency or error, the requirements set out in the referenced legislation take precedence. For specific legal details, please visit ontario.ca/laws (for Ontario legislation) and www.laws.justice.gc.ca (for federal legislation) and consult your lawyer if you have questions about your legal obligations.

For information on preventing spills, see:

- OMAFRA Factsheet *Ways to Avoid Pesticide Spills*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) *Grower Pesticide Safety Course Manual,* available at www.opep.ca. Select “Learning.”

For pesticide poisonings and pesticide injuries, call:

Poison Information Centre: 1-800-268-9017

(TTY) 1-877-750-2233

For more information, see Emergency and First Aid Procedures for Pesticide Poisoning on inside back cover.

2. Crop Protection: Insects, Mites and Diseases

USING PESTICIDES

Classification of Pesticides for Sale and Use in Ontario

The *Cosmetic Pesticides Ban Act, 2008,* and Ontario Regulation 63/09 came into effect in 2009 from the Ministry of Environment, Conservation and Parks (MECP). Under this act, pesticides cannot be used for cosmetic purposes on lawns, vegetable and ornamental gardens, patios, driveways, cemeteries, or in parks and schoolyards. In these areas, biopesticides and alternatives to pesticides can be used. Pesticides can be used for some excepted uses such as agriculture, which includes nursery production. Pesticides are now classified for sale and use under 12 different classes. For more information on the legislation, see ontario.ca/pesticides.

Toxicity Information

The "relative toxicity" of a pesticide is expressed in the LD_{50} value. The higher the LD_{50} value of a pesticide, the less toxic the product is to humans. LD_{50} is the number of milligrams of a pesticide per kilogram of body weight that will kill 50% of the tested subjects. LD_{50} is commonly measured as the Acute Oral LD_{50}, which means the chemicals are ingested through the mouth or nose. In addition, toxicity values for penetration through the skin (Dermal LD_{50}) can usually be found on the material safety data sheet (MSDS) and are available from the manufacturer.

Prevent Bee Poisoning

Honeybees, as well as other bees and insects, are important pollinators of crops. Many crops also offer bees important sources of nectar for honey production. For more information on the prevention of bee poisoning, see *Bee Poisoning* on page 5. Most organophosphate and carbamate insecticides are highly toxic to bees. Examples of insecticides used in greenhouse and outdoor ornamental crop production that are toxic to bees are listed in *Table 2–1, Relative Toxicity of Pesticides to Honeybees.*

Read each pesticide label for specific precautions regarding bees.

Table 2–1. Relative Toxicity of Pesticides to Honeybees

For more detailed information on the toxicity of specific pesticides to honeybees, see the pesticide label.

Trade Name	Active Ingredient
Group 1 — Highly toxic. **Severe losses may be expected if the following materials are used when bees are present at treatment time or within a few days thereafter.**	
AceCap 97	acephate
Actara, Flagship 25 WG	thiamethoxam
Admire 240	imidacloprid
Ambush 50 EC	permethrin
Avid 1.9% EC	abamectin
Cygon 480	dimethoate
DeltaGard	deltamethrin
Diazinon	diazinon
Dursban, Lorsban	chlorpyrifos
Dyno-Mite	pyridaben
Ima-jet	imidacloprid
Imidan 50 WP	phosmet
Lagon 480	dimethoate
Lorsban 4 E	chlorpyrifos
Malathion	malathion
Orthene 75 SP	acephate
Pounce 384 EC	permethrin
Pyrate 480 EC	chlorpyrifos
Silencer 120EC	lambda-cyhalothrin
Sevin	carbaryl
Success	spinosad
Group 2 — Moderately toxic. **These can be used around bees if dosage, timing and method of application are correct, but do not apply them directly on bees, in the field or at the colonies.**	
Floramite SC	bifenazate
Horticultural oil	mineral oil
Landscape Oil	mineral oil
Maestro 80 DF	captan
Purespray Green Spray Oil	mineral oil
Supra Captan 80 WDG	captan
Tristar 70 WSP	acetamiprid

Table 2–1. Relative Toxicity of Pesticides to Honeybees

For more detailed information on the toxicity of specific pesticides to honeybees, see the pesticide label.

Trade Name	Active Ingredient
Group 3 — Pesticides relatively non-toxic to bees.	
Acelepryn	chlorantraniliprole
Actinovate SP	*Streptomyces lydicus*
Aliette T&O	fosetyl AL
Apollo SC	clofentezine
BioProtec CAF	*Bacillus thuringiensis*
Bravo 500	chlorothalonil
Confirm 240 F	tebufenozide
Daconil 2787	chlorothalonil
Decree 50 WDG	fenhexamid
Dipel 2X DF	*Bacillus thuringiensis*
Elevate 50WDG	fenhexamid
Folpan 50 WP, Folpan 80 WDG	folpet
Forbid 240 SC	spiromesifen
Funginex DC	triforine
Insecticidal soap	potassium salts of fatty acids
Kontos, Movento	spirotetramat
Lorsban NT	chlorpyrifos
MilStop	potassium bicarbonate
Nova 40 W	myclobutanil
Pristine WG	boscalid + pyraclostrobin
Rhapsody ASO	*Bacillus subtilis*
Rovral 50 WP	iprodione
Senator 70 WP	thiophanate-methyl
Serenade	*Bacillus subtilis*
Shuttle 15 SC	acequinocyl
Subdue Maxx	metalaxyl
TreeAzin	azadirachtin

CHEMICAL FAMILIES

Most agricultural chemicals belong to a chemical "family" which is a group of substances that share important characteristics. To prevent pests from becoming resistant to a particular product, rotate between pesticides from different chemical families.

Table 2–2. Insecticides and Fungicides Used to Protect Ornamentals, lists pesticide products in alphabetical order. This reference table can be used to help make decisions (e.g., pesticide resistance management) about pesticide applications by providing information on toxicity, chemical family and classification.

Table 2–2. Insecticides and Fungicides Used to Protect Ornamentals (as of January 1, 2019)

LEGEND: I = insecticide; F = fungicide and/or bactericide; R = rodenticide; A = acaricide (miticide); M = molluscicide; – = no information

Product Name	Type	Common Name	Oral LD_{50} (mg a.i./kg)	Chemical Family	Group*	Ontario Classification
AceCap 97	I	acephate	1,030	organophosphate	1B	3
Acelepryn	I	chlorantraniliprole	> 5,000	diamide	28	2
Acrobat 50 WP	F	dimethomorph	2,939	cinnamic acid amides	40	3
Actara 25WG	I	thiamethoxam	> 5,000	neonicotinoid	4A	3
Aliette	F	fosetyl-AL	2,860	phosphonate	33	3
Altus	I	flupyradifurone	>2,000	butenolides	4D	3
Apollo SC	A	clofentezine	> 5,000	mite growth inhibitor	10A	3
Aprovia Top 195 EC	F	benzovindiflupyr, difenoconazole	550	pyrazole-carboxamides, triazole	3, 7	3
Arbotect 20-S	I	thiabendazole	> 5,000	benzimidazole	B1	4
Banner MAXX	F	*propiconazole*	4,340	triazole	3	3
Beleaf 50SG	I	*flonicamid*	> 2,000	chordotonal organ modulators	29	4
BioProtec	I	*Bacillus thuringiensis*	> 15,000	biological	11A	3
BlightBan A506 XXXX	F	*Pseudomonas fluorescens* (strain A506) non-toxic biological	> 5,000	biological	–	4
BlightBan C9-1	F	Pantoea agglomerans (strain C9-1)	non-toxic	biological	–	4
Bloomtime Biological	F	Pantoea agglomerans (strain E325)	non-toxic	biological	–	4
Captan 50-WP	F	captan	> 5,050	phthalimide	M4	3
Citation 75WP	I	cyromazine	4,460	moulting disruptor	17	3
Closer	I	sulfoxaflor	>5000	sulfoximines	4C	3
Compass 50WG	F	trifloxystrobin	> 5,050	strobilurin	11	3
Confirm 240F	I	tebufenozide	> 5,000	diacylhydrazines	18	3
Copper	F	copper sulphate	481	inorganic	M1	3
Copper Spray	F	copper oxychloride	1,600	inorganic	M1	3
Daconil 2787	F	chlorothalonil	4,200	chloronitrile	M5	4
Deadline M-PS	M	metaldehyde	> 5,000	–	–	4
Decree	F	fenhexamid	> 2,000	anilide	17	3
Delegate	I	spinetoram	>5,000	spinosyns	5	3
Dipel	I	Bacillus thuringiensis	> 5,000	biological	11	3, 4
Dithane	F	mancozeb	> 5,000	dithiocarbamate	M3	4
Dragnet FT	I	permethrin	998	synthetic pyrethroid	3A	4
Dursban T	I	chlorpyrifos	135	organophosphate	1B	3
Dutch Trig	F	Verticillium albo-atrum strain WCS850	–	biological	–	4
Dygall	F	Agrobacterium radiobacter strain K84	–	biological	–	3
Dyno-Mite	A, I	pyridaben	1,930	METI acaricides and insecticides	21A	4
Endeavor 50 WG	I	pymetrozine	> 5,000	pyridine azomethine	9B	3
Equal 65WP	F	dodine	1,456	guanidines	U12	4
Ferbam 76 WDG	F	*ferbam*	> 5,000	dithiocarbamate	M3	4
Flagship 25WG	I	thiamethoxam	> 5,000	neonicotinoid	4A	3
Flint	F	trifloxystrobin	>3,000	strobilurin	11	3
Floramite SC	A	bifenazate	> 5,000	bifenazate	20D	4

* Pesticide Group classifies the compound according to mode of action. This system helps the user rotate among pesticides with different modes of action in order to reduce the risk of resistance to a specific pesticide product.

Table 2–2. Insecticides and Fungicides Used to Protect Ornamentals (as of January 1, 2019)

LEGEND: I = insecticide; F = fungicide and/or bactericide; R = rodenticide; A = acaricide (miticide); M = molluscicide; – = no information

Product Name	Type	Common Name	Oral LD_{50} (mg a.i./kg)	Chemical Family	Group*	Ontario Classification
Folpan	F	folpet	> 5,000	phthalimide	M4	1, 4
Foray	I	*Bacillus thuringiensis*	> 5,000	biological	11A	3, 4
Forbid	I	spiromesifen	> 2,000	lipid biosynthesis inhibitor	23	3
Funginex	F	triforine	3,487	piperazine	3	3
Ground Force	R	chlorophacinone	>5000	anticoagulant	–	4
Guardsman Copper Oxychloride	F	copper oxychloride	1,700	inorganic	M1	3
Heritage MAXX	F	azoxystrobin	1,714	strobilurin	11	3
Heterohabditis bacteriophora	I	*Heterohabditis bacteriophora (H.b.)*	non-toxic	biological	–	–
Heterohabditis megidis	I	*Heterohabditis megidis (H.m.)*	non-toxic	biological	–	–
Ima-jet	I	Imidacloprid	> 1,600	neonicotinoid	4A	3
Imidan 50 WP	I	phosmet	300	organophosphate	1B	3, 4
Insecticidal soap	I	potassium salts of fatty acids	> 5,000	insecticidal soap and botanical	–	4
Inspire Super	F	difenoconazole, cyprodinil	5,000	triazole, anilino pyrimidines	3, 9	3
Intercept 60 WP	I	imidacloprid	1,858	neonicotinoid	4A	4
Kanemite 15 SC	I	acequinocyl	> 5,000	naphthaquinone derivative	20B	3
Kasumin	F	kasugamycin	> 5,000	hexopyranosyl antibiotic	24	3
Kontos	I	spirotetramat	> 2,000	tetramic acid	23	4
Lagon 480 E	I	dimethoate	425	organophosphate	1B	3
Landscape Oil	I	mineral oil	> 15,000	horticultural oil	–	4
Lannate	I	methomyl	23	carbamate	1A	2
Lorsban	I	chlorpyrifos	300	organophosphate	1B	3, 4
Maestro 80 DF	F	captan	5,000	phthalimide	M4	3
Mako	I	cypermethrin	760	pyrethroid	3A	3
Malathion	I	malathion	1,400	organophosphate	1B	4
Medallion	F	fludioxonil	> 5,000	phenylpyrrole	12	2
Met 52	I	*Metarhizium anisopliae* strain F52	> 2,000	biological	–	4
Micora	F	mandipropamid	>5000	cinnamic acid amide	40	3
MilStop	F	potassium bicarbonate	2,700	inorganic	–	4
Mimic 240 LV	I	tebufenozide	> 5,000	insect growth regulator	18	3
Movento 240SC	I	spirotetramat	> 2,000	tetramic acid	23	4
Nova	F	myclobutanil	> 2,500	triazole	3	3
Opal Insecticidal Soap	I	potassium salts of fatty acids	> 5,000	insecticidal soap and botanical	–	4
Orthene	I	acephate	1,494	organophosphate	1B	3
Phostrol	F	phosphorous acid and salts	> 5,000	phosphonates	33	4
Palladium	F	cyprodinil	> 5,000	anilino-pyrimidine	9	2
		fludioxonil		phenylpyrrole	12	
Polyram	F	metiram	> 5,000	dithiocarbamate	M3	4
Pounce	I	permethrin	3,129	pyrethroid	3A	4

* Pesticide Group classifies the compound according to mode of action. This system helps the user rotate among pesticides with different modes of action in order to reduce the risk of resistance to a specific pesticide product.

Table 2–2. Insecticides and Fungicides Used to Protect Ornamentals (as of January 1, 2019)

LEGEND: I = insecticide; F = fungicide and/or bactericide; R = rodenticide; A = acaricide (miticide); M = molluscicide; – = no information

Product Name	Type	Common Name	Oral LD_{50} (mg a.i./kg)	Chemical Family	Group*	Ontario Classification
Presidio	F	fluopicolide	> 2,000	pyridinylmethyl-benzamides	43	2
Previcur	F	propamocarb	2,000	carbamate	28	3
Pristine WG	F	boscalid	> 1,490	pyridine carboxamide	7	2
		pyraclostrobin		methoxy carbamate	11	
Purespray Green Spray Oil	I	mineral oil	> 5,000	horticultural oil	–	6
Pyganic	I	pyrethrin	>2,000	pyrethrins	3A	3
Pyrate	I	chlorpyrifos	409	organophosphate	1B	3
Ramik Brown, Ramik Green	R	diaphacinone	> 7	anticoagulant	–	4
Ratak+	R	brodifacoum	0.27	anticoagulant	–	4
Regalia Maxx	F	*Reynoutria sachalinensis*	> 5,000	biological	–	3
Rhapsody	F, B	*Bacillus subtilis* *Bacillus subtilis* QST 713	> 5,000	biological	44	4
Rimon 10EC	I	Novaluron	3914	benzoylureas	15	3
Ripcord 400 EC	I	cypermethrin	760	pyrethroid	3A	3
Rodent Bait, Rodent Pellets	R	zinc phosphide	910	phosphide	–	3
Rootshield	F	Trichoderma harzianum	–	biological	–	3, 4
Rovral	F	iprodione	> 2,000	dicarboximide	2	3
Rozol	R	chlorophacinone	–	anticoagulant	–	1, 4, 6
Sanmite	A, I	pyridaben	1,930	METI acaricides and insecticides	21A	4
Senator 70 WP	F	thiophanate-methyl	7,500	benzimidazole	1	4
Serenade Max	F	*Bacillus subtilis*	–	biological	44	4
Shuttle 15 SC	M	acequinocyl	> 5,000	naphthaquinone derivative	20B	3
Silencer 120 EC	F	lambda-cyhalothrin	98	pyrethroid	3A	3
Sluggo	M	ferric phosphate	> 5,000	mineral	–	4, 6
Streptomycin	F	streptomycin sulphate	>5000	glucopyranosyl antibiotic	25	4
Subdue MAXX	F	metalaxyl-M and S-isomer	2,965	acylalanines	4	3
Success	I	spinosad	> 2,000	spinosyn	5	4
Sulphur (various)	F	*sulphur*	> 5,000	inorganic	M2	4
Supra Captan 80 WDG	F	captan	5,000	phthalimide	M4	4
Thiram	F	thiram	1,800	dithiocarbamate	M3	1, 3
Thuricide	I	*Bacillus thuringiensis*	> 15,000	biological	11	3, 4
Tivano	F, B	citric acid, lactic acid	none known	biological	–	4
Torrent	F	cyazofamid	> 5,000	cyano-imidazole	21	4
TreeAzin	I	azadirachtin	> 2,000	uncertain	UN	4
Tristar 70 WSP	I	acetamiprid	1,064	neonicotinoid	4	3
Trounce	I	potassium salts of fatty acid and pyrethrin	> 5,000	insecticidal soap and botanical	3A	4
Truban	F	etridiazole	1,077	thiadiazole	14	4
Vectobac	I	*Bacillus thuringiensis subsp. israelensis*	> 5,000	biological	11	3, 4
Vendex	A	fenbutatin oxide	> 5,000	organotin	12	1, 4
Waxed Mouse Bait	R	zinc phosphide	45	phosphide	24A	3

* Pesticide Group classifies the compound according to mode of action. This system helps the user rotate among pesticides with different modes of action in order to reduce the risk of resistance to a specific pesticide product.

A COMPENDIUM OF PESTS AND DISEASES WITH RECOMMENDED MANAGEMENT PRACTICES — AS OF JANUARY 1, 2019

Common pests and diseases found on nursery crops are listed below. The list is organized according to the host plant genus. The pesticide products listed appear alphabetically within the tables and the order in which products appear does not constitute a preference ranking.

If no product is listed in the compendium, either a pesticide application would not be effective, or there is no product registered at the time of printing for this publication. The "Notes" column contains information on pest biology and monitoring and additional remarks about the use of registered pesticides.

See *Table 2–2. Insecticides and Fungicides Used to Protect Ornamentals,* on page 13–15, for a list of pesticides registered on outdoor ornamentals and their chemical properties, such as toxicity.

***ABIES* — FIR**			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *ABIES*			
Balsam gall midge (*Paradiplosis tumifex*)	Movento 240SC	585 mL/ha	A pest of Christmas trees in Eastern Canada. Balsam gall midge damage appears on current-year needles as early as late June and persists until fall. The larvae initiate the formation of galls, which appear as swollen growths at the base of the needles; several galls can be seen on a single needle. Each gall contains a larva, which feeds on the internal tissue of the needle. Galled needles turn yellow and dry out, causing them to drop prematurely in the fall. Repeated severe infestations can cause tree growth loss but does not result in mortality. The appearance of the adults in May coincides with the development of fir buds. The female lays her eggs between the tight needles of the opening buds. Each newly hatched larva crawls to the base of a needle, where it settles and begins to feed, initiating the growth of gall tissue, which ultimately completely encloses the larva, thus forming the gall. The larva leaves the gall in the fall and drops to the ground where it overwinters. First application of Movento should be timed for egg hatch stage when adult emergence has peaked. This normally occurs after bud break when needles start flaring. Maximum number of applications: 2. Interval between applications: 7 days.
Balsam twig aphid (*Mindarus abietinus*)	Admire 240	250 mL/ha	The eggs overwinter on bark and hatch into first-generation nymphs ("stem mothers") in early spring when bud caps begin to loosen, but before new growth emerges. Second-generation nymphs feed on newly developing needles, causing the needles to become distorted and discoloured. Monitor for stem mothers by tapping twigs on a dark surface and look for tiny, off-white aphids. Treat when stem mothers first hatch (about 180–250 GDD Base 10°C) which coincides with bud swell. Second-generation nymphs are more difficult to manage due to their protective, waxy covering.
	Closer	200 mL/ 1,000 L water	
	Endeavor 50 WG	193 g/ha in 275 L water	
	Malathion 500 EC	1.4-3 L/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
Cutworms (various species)	Confirm 240 F	0.5 L/ha	Cutworms are moth larvae (caterpillars) that hide in shallow soil burrows during the day and crawl up plant stems to harvest plant parts at night. Injury appears as chewed or girdled stems on woody species (and clipped stems on herbaceous plants). Larvae are greyish-brown in colour, often with black spots along their sides and stripes along their body. They have three pairs of true legs, four pairs of fleshy prolegs and one pair of "claspers" at the end of their abdomen. They can be up to 3 cm long. Late instar larvae overwinter and pupate in spring. Use insecticides to reduce cutworm populations at the first sign of feeding injury. Treat plants with insecticides in the evening since the larvae feed at night. Applications of Confirm should be made with a high-volume spray and sprayed to run-off (for greenhouse use). Applications of Pounce should be made under warm, moist conditions when larvae are small.
	Pounce	45–90 mL/ha	

ABIES — FIR			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *ABIES* (cont'd)			
Spruce budworm (*Choristoneura fumiferana*)	Dragnet	160 mL/ 1,000 L water	Larvae have a black head and brownish body with four light spots on the back of each segment. This pest is a widespread, important defoliator of balsam fir and spruce. Tiny overwintering larvae begin to feed as buds break and continue feeding until late spring. Larvae can often be found feeding inside emerging shoots from suspiciously persistent bud caps. There is 1 generation per year. Apply Mimic to control early instar larvae; allow 3–7 days for larval mortality. A second application may be required. Apply a general coverage spray for broad-spectrum insecticides in mid-May to reduce larval populations.
	Foray 48 B	1.6–2.4 L/ha	
	Malathion 85 E	2.93 L/ 1,000 L water	
	Mimic 240 LV	290 mL/ha	
	Pounce	45–90 mL/ha	
Spruce spider mite (*Oligonychus ununguis*)	Cygon 480 E	1.25 L/ 1,000 L water	Overwintered eggs hatch in early May, when *Amelanchier laevis* and *Magnolia* x *soulangiana* are in full bloom. Mites prefer older needles as feeding sites. To monitor for mites, use a hand lens to check the undersides of twigs and needles for tiny reddish eggs or brown mites with black backs. Shake a branch over a white sheet of paper and look for crawling specks. Apply miticides when mites first appear. Kanemite is effective against mobile life stages but may also reduce egg viability. Use horticultural oil as a dormant treatment in early spring to target eggs and newly hatched nymphs. Do not use horticultural oil (including Landscape Oil) on white pine. Horticultural oil (including Landscape Oil) can be used when plants are dormant. Landscape Oil can be used in summer when leaves are fully expanded and hardened off. See product label. Permanent discolouration of foliage will occur to blue cultivars of both *Juniperus* and *Picea*. To prevent foliar discolouration on blue Colorado spruce, use only wettable powders and avoid horticultural oil. If populations are still significant, make 2 applications of other miticides at 10-day intervals when mites exist in spring. Many predatory mites co-exist with pest mite populations. To conserve predatory mites, try miticides that are less toxic to these beneficials, such as Vendex and Floramite.
	Floramite SC	625 mL/ 1,000 L water	
	horticultural oil	20 L/ 1,000 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	see label	
	Lagon 480	1.25 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375–500 mL/ 1,000 L water	
	Vendex 50 W	50–100 g/ 100 L water	
Tarnished plant bug (*Lygus lineolaris*)	Actara 25 WG, Flagship 25 WG	210–280 g/ha	These are small (5-mm) yellowish-brown insects. Adults have wings that are folded in an X pattern. Tarnished plant bugs feed by inserting their mouthparts inside leaf tissue and sucking out the contents, leaving the lower and upper epidermis behind. The resulting injury appears as small, clear "windows" on leaf tissue of broad-leaved plants. On conifers, feeding often causes terminal growth to yellow and become distorted and bushy. Treat in spring and early summer to manage populations of this insect.
	Ripcord 400 EC	172 mL/ha	
White grubs: European chafer (*Rhizotrogus majalis*) June beetle (*Phyllophaga* sp.)	**Larval management:**		These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including *Cornus* sp.). Before planting, cultivate infested fields to expose grubs to natural predators. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering. Apply Acelepryn any time that larvae are present or during the mating period/egg-laying period to egg-hatch.
	Acelepryn	5.6–8.8 mL/ 100 m^2	
	Lorsban 4E (rescue treatment for shipping)	4.5 L/ 1,000 L water	
	Intercept 60 WP	467 g/ha	
	Adult management:		
	Imidan 50 WP	1.25 kg/ 1,000 L water	

ABIES — FIR

Pest	Product	Rate	Notes
DISEASES AFFECTING *ABIES*			
Botrytis	Rovral WDG	1.5–2 kg/ 1,100 L water	During very humid conditions (e.g., storage), a fuzzy, grey growth may develop on succulent plant parts. Treat twigs and buds in spring before leaves develop. Treat conifer seedlings at the onset of botrytis. Remove all fading and diseased plant parts promptly, especially when wet weather is predicted. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Damping off, root rot and stem rot (*Phytophthora, Pythium*)	Heritage Maxx	0.4 L/ 1,000 L water	Stem rot and root rot cause rapid dieback and mortality and are often characterized by reddish-brown discolouration of the cambium. Subdue MAXX can be used as a drench or a pre-incorporated treatment for media to help protect conifer seedlings and transplants from *Pythium* and *Phytophthora*. Subdue MAXX can be used on conifer seedbeds, plugs and 2-0 transplants only. See product label.
	Presidio	60–119 mL/ 380 L water	
	Previcur	see label	
	Subdue MAXX	1.2 L/ha in 200 L water (drench)	
	Torrent 400SC	see label	
Needlecast (various fungi)	Banner MAXX	350 mL/ 1,000 L water	This is principally a nursery disease. It is caused by several fungi with 2-yr life cycles. Symptoms develop early in the second season. Infected needles turn brown and drop. Badly infected plants have only current season needles. Spray after new growth begins and again 10 days later.
	Copper Spray	4 kg/ 1,000 L water	
	Daconil 2787 F	2.4–4.8 L/ 100–1,000 L water	

ACER — MAPLE

Pest	Product	Rate	Notes
INSECTS AFFECTING *ACER*			
Aphids (various)	Altus	500–750 mL/ha	Treat when aphids first appear and repeat as required. Check leaves for honeydew and sooty mould. Aphids have many natural predators (e.g., ladybugs, hover flies, lacewings), so monitor for beneficial insects before making pesticide applications. Orthene may damage sugar maple leaves. * Do not apply Kontos insecticide during bloom as this product is toxic to bee brood.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	insecticidal soap	see label	
	*Kontos	see label	
	Malathion 500 EC	1.4–3L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Asian long-horned beetle (*Anoplophora glabripennis*)	Ima-jet	see label	Asian long-horned beetle is a serious pest of deciduous trees; it bores into stems and trunks and weakens trees, leading to dieback and mortality. Make Ima-jet applications when the pest has been detected in your area (or within 24 km) and trees still appear healthy. This cerambycid borer is mostly found on maple species, especially *Acer negundo*, Manitoba maple. For trees that may be visited by pollinators, applications of Ima-jet must be made post-bloom, as this product is toxic to bees and bee brood.

ACER — MAPLE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *ACER* (cont'd)			
Cottony maple scale (*Pulvinaria innumerabilis*)	horticultural oil	20 L/ 1,000 L water	The mature female scale with white egg sac resembles a partially popped corn kernel. This scale infests maple, linden, elm, beech, oak, and other trees and shrubs. It is found only on twigs. Use horticultural oil as an early-spring dormant treatment. Do not use horticultural oil on sugar or Japanese maples. Nymphs are active in late June/early July, about when *Philadelphus* and *Tilia cordata* are in bloom. Direct insecticidal spray to the lower leaf surface. Repeat application 10 days later. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	
Forest tent caterpillar (*Malacosoma disstria*)	Dipel WP	125–250 g/ 400 L water	Forest tent caterpillar larvae are hairy with a series of keyhole-shaped white spots along their backs. Larvae are present early in the season. Larvae feed in colonies. Forest tent caterpillar larvae do not form a tent on their host. Larvae may completely defoliate broadleaf trees, particularly poplars. Treat foliage in mid-to-late May to reduce populations of larvae. Orthene may damage sugar maple leaves.
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	1.0–1.6 L/ha	
	Orthene 75 SP	see label	
	Pounce	90 mL/ha	
	Pyrate 480 EC	500 mL/ 1,000 L water	
	Thuricide	see label	
Greenstriped mapleworm (*Dryocampa rubicunda*)	There is no product registered at the time of this publication.		Larvae have a cherry-red head and yellowish body with seven dark lines running the entire body length. Preferred hosts are maple, oak and box elder. Insecticidal applications are usually not required. Eggs hatch over an extended period. If necessary, spray insecticides when larvae are present (from mid-June to late July).
Gypsy moth (*Lymantria dispar*)	AceCap 97	773 mg/ cartridge 1 cartridge/ 10.16 cm	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. AceCap 97 applications must be made post-bloom as this product is toxic to bees and bee brood. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dipel	see label	
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	

ACER — MAPLE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *ACER* (cont'd)			
Leafhopper (several species)	Actara 25 WG, Flagship 25 WG	105 g/ha	Leafhoppers are tiny, yellowish-green to pale-coloured insects that jump quickly when disturbed. Wingless nymphs will often "side step" quickly to hide from potential predators. Leafhoppers have piercing-sucking mouthparts that cause yellowish flecks on the leaf surface. Check regularly for infestation of nursery crops when neighbouring farms are cutting alfalfa or hay. Hang yellow sticky traps in the canopy to monitor for leafhoppers. Check by disturbing plants or looking at the leaf bottoms for leafhopper nymphs or molted skins. Injury appears as leaf distortion with blackened leaf margins. Older leaves will appear bronze coloured or stippled. Treat as required.
	Altus	500–750 mL/ha	
	Tristar 70 WSP	5 solupaks	
Lecanium or European fruit lecanium (*Lecanium corni*)	horticultural oil	20 L/ 1,000 L water	When adults are mature in late spring/summer, they appear as a large, reddish-brown, spherical scale usually found on the underside of twigs. This scale infests many deciduous trees and shrubs. Use horticultural oil as an early-spring dormant treatment to reduce populations of overwintering nymphs. To suppress crawlers, spray insecticides when the *Sambucus canadensis* begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	
	Trounce	50 L/ 1,000 L water	
Maple bladder gall mite (*Vasates quadripedes*) Maple spindle gall mite (*Vasates aceriscrumena*) Crimson erineum mite (*Eriophyes regulus*)	horticultural oil	20 L/ 1,000 L water	Maple bladder gall mite causes globular, wart-like galls on the upper surface of silver and red maple leaves. Heavy infestations may completely deform leaves but seldom injure trees seriously. Maple spindle gall mite produces slender fusiform galls 5 mm long on the upper surface of sugar and silver maple leaves. There are several generations per year. Crimson erineum mite causes red granular, velvety patches on both sides of sugar, silver and red maple leaves. Use horticultural oil as an early-spring dormant treatment. Do not use oil on sugar maple or Japanese maples. Apply Malathion in the spring when the temperature is 2°C or higher. Do not use Malathion on Crimson King maple.
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
Maple petiole borer (*Caulocampis acericaulis*)	There is no product registered at the time of this publication.		The larvae bore inside leaf stems (petioles), causing petioles to turn black, shrivel and break near the blade, causing leaf drop. Collecting and destroying fallen leaves will not reduce the population of this pest. Larvae remain in petioles that are still attached to the tree, where they complete their life cycle. The adult is a tiny, amber-coloured sawfly that emerges as leaves are starting to emerge. Management with insecticides is usually not necessary.
Maple spider mite (*Oligonychus aceris*)	horticultural oil	20 L/ 1,000 L water	These tiny mites look very similar to spruce spider mite: brown bodies and legs with black backs. Mites overwinter as reddish-brown eggs close to bud scars on the previous year's growth. Eggs hatch in spring, and mite numbers can build up by early summer. Mites feed on the undersides of leaves, causing stippling and bronzing. Maple spider mites are most common on silver-red hybrids.
Maple trumpet skeletonizer (*Epinotia aceriella*)	There is no product registered at the time of this publication.		This pest is normally a minor problem. It attacks sugar, red and silver maples. It spins a long trumpet-like tube of silk and frass on the underside of a leaf, which folds around it. The maple trumpet skeletonizer feeds from within this tube, skeletonizing the part of the leaf covered by the web. This causes the leaf to crumple. This pest may also attack hawthorn and beech. Larvae exist from late July to September. Where necessary, apply control to bottom leaf surfaces from mid-July to mid-August.

ACER — MAPLE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *ACER* (cont'd)			
Sugar maple borer (*Glycobius speciosus*)	There is no product registered at the time of this publication.		This borer is usually a landscape problem, especially on stressed trees. It is a robust, black, long-horned beetle with five yellow bands on the wing covers. The fleshy white larva cuts deep channels in the wood. Cracked, swollen areas resembling cankers indicate infestation. The borer has a 2-year life cycle. Females cut a slit into the bark and lay eggs in late July and into August. Keep trees healthy in order to help them withstand infestations.
Western flower thrips (*Frankliniella occidentalis*)	Success	50 mL/ 1,000 L water	Western flower thrips can feed openly on new leaves or from inside terminal vegetative buds and flower buds. They have piercing-sucking mouthparts that suck out plant juices of immature leaves and flowers, resulting in major distortion and colour flecking when flowers and foliage emerge. Injury may be confused with that of leafhoppers. Do not make more than 3 applications of Success 480 SC per year.
Whitemarked tussock moth (*Orgyia leucostigma*)	Dragnet	160 mL/ 1,000 L water	The caterpillars are large (up to 3 cm long), with a multi-coloured body marked by 2 tufts of black hairs behind the head and white hairs along the sides of the abdomen. Caterpillars are found throughout the growing season on many species of deciduous and evergreen trees. Apply Mimic to control early instar larvae; allow 3–7 days for larval mortality. A second application of Mimic may be required.
	Mimic 240 LV	290 mL/ha	
DISEASES AFFECTING *ACER*			
Anthracnose (*Gloeosporium apocrytum*)	Banner MAXX	28 mL/ 100 L water	Leaves are infected as they emerge in the spring. This disease causes irregular brown lesions, often in between veins. Leaves may be distorted. Collect and destroy fallen leaves in autumn, as they are a source of inoculum the following spring. Often, the second flush of growth will cover up this disease. Where disease pressure is high, protect newly emerging leaves with fungicides before leaf wetness periods.
	Heritage Maxx	0.8–1.6 L/1000 L water	
Tar spot (*Rhytisma acerinum*)	Banner MAXX	28 mL/ 100 L water	Emerged leaves are infected in spring during cool, wet weather. This disease causes irregular, black, tar-like spots on Norway and sugar maple by late summer. The tar spot fungus overwinters on fallen leaves. Apply fungicides before rain events to protect foliage during leaf emergence (during and after bloom). Compass 50 WG gives suppression of tar spot and can only be applied once per season. Banner MAXX can be applied up to 4 times per season. Collect fallen leaves in late summer and autumn and destroy. Removing fallen leaves from all infected neighbourhood trees may help reduce disease incidence the following year.
	Compass 50 WG	14–21 g/ 100 L water	
Verticillium wilt (*Verticillium dahliae*)	There is no product registered at the time of this publication.		This is a soil pathogen that enters trees via roots and travels systemically to the crown, resulting in crown wilt and dieback. Infection causes the sapwood to darken into a greenish black. This disease is often followed by frost cracks and associated cankers. Prune wilted branches back to healthy wood. Thin the remainder of the crown. Fertilize and water to promote vigour, especially root growth. Organic amendments to soil may help decrease soil *Verticillium* populations and improve tree growth.
PHYSIOLOGICAL DISORDERS AFFECTING *ACER*			
Leaf scorch	A pesticide application would not be effective.		Physiological leaf scorch is a common symptom of desiccation on broadleaf decidous urban or roadside trees during hot, dry summers. Look for brown, dry leaf margins and areas in between leaf veins. It is often misdiagnosed as a foliar disease. Supplemental irrigation can help reduce stress on symptomatic trees.

AESCULUS — HORSECHESTNUT

Pest	Product	Rate	Notes
DISEASES AFFECTING *AESCULUS*			
Anthracnose (*Glomerella cingulata*)	Daconil 2787 F	2.5 L/ 1,000 L water	Protect leaves with fungicides during cool, wet springs. Encourage good air circulation through the canopy. Do not crowd plants.
Leaf blotch (*Guignardia aesculi*) (*Botryosphaeria aesculi*)	Daconil 2787 F	2.5 L/ 1,000 L water	Symptoms include large, blotchy, reddish-brown lesions surrounded by a yellow halo. Lesions appear on leaves by mid-summer. Leaves often curl and distort. A tree may show symptoms of leaf blotch, scorch and anthracnose. Protect leaves with fungicides during cool, wet springs. Encourage good air circulation through the canopy. Do not crowd plants.
PHYSIOLOGICAL DISORDERS AFFECTING *AESCULUS*			
Leaf scorch (physiological)	Application of a pesticide will not be effective on this disorder.		Physiological leaf scorch is a common symptom of desiccation on broadleaf decidous urban or roadside trees during hot, dry summers. Look for brown, dry leaf margins and areas in between leaf veins. Leaf scorch is easily confused with the fungal disease anthracnose (see above). Supplemental irrigation can help reduce stress on symptomatic trees.

AMELANCHIER — SERVICEBERRY

Pest	Product	Rate	Notes
INSECTS AFFECTING *AMELANCHIER*			
Western flower thrips (*Frankliniella occidentalis*)	Success	50 mL/ 1,000 L water	Western flower thrips can feed openly on new leaves or from inside terminal vegetative buds and flower buds. They have piercing-sucking mouthparts that suck out plant juices of immature leaves and flowers, resulting in major distortion and colour flecking when flowers and foliage emerge. Injury may be confused with that of leafhoppers. Do not make more than 3 applications of Success per year.
DISEASES AFFECTING *AMELANCHIER*			
Gymnosporangium rusts	Nova 40 W	250–340 g/ 1,000 L water	Spores from *Juniperus* hosts can infect rosaceous plants (*Malus*, *Crataegus*, *Amelanchier*, etc.).
	Pristine WG	1–1.6 kg/ha	Treat when sporulation begins on the alternate host (*Juniperus*), in early-to-mid-spring when foliage is emerging and still tender. Repeat fungicidal application every 10–14 days if needed. Rotate registered fungicides with other chemical families to avoid resistance.
Powdery mildew	Heritage Maxx	0.4–1.6 L/ 1,000 L water	Fungal infection appears as white, powdery growth on the upper leaf surface.
	Nova 40 W	113 g/ 1,000 L water	Use Nova 40 W at the first sign of powdery mildew to manage this disease on Saskatoonberry. Use Nova 40 W no more than 3 times per season.
	Palladium WG	100 g/ 100 L water	

BETULA — BIRCH

Pest	Product	Rate	Notes
INSECTS AFFECTING *BETULA*			
Aphids (*Calaphis betulaecolens*), (*Euceraphis punctipennis*), (*Hamamelistes spinosus*)	Altus	500–750 mL/ha	*Calaphis betulaecolens*, a large green aphid, feeds only on birch. *Euceraphis punctipennis*, a black-and-green aphid, leaves a cottony-white wax on birch and alder. *Hamamelistes spinosus* feeds on birch and on *Hamamelis* (witch hazel). Feeding nymphs cause corrugated swellings between veins on leaves. Treat when adults first appear and repeat as required. Check the underside of leaves for honeydew and sooty mould. Many natural predators feed on aphids (e.g., ladybugs, hoverflies, lacewings).
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	Cygon 480 E	625 mL/ 1,000 L water	
	insecticidal soap	see label	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Birch leafminer (*Fenusa pusilla* and many other species)	AceCap 97	773 mg/ cartridge 1 cartridge/ 10.16 cm	Larval mines look like a brown blotch sometimes covering half or more of each leaf. Foliage of heavily infested trees looks scorched. There are 2 generations of leafminer per year; the second flush of growth is also attacked. The adult is a small black sawfly that emerges from the soil when the first leaves are half grown. First mines appear when *Spiraea* x *vanhouttei* blooms. When mines appear, use any listed control in mid-May and about 6 weeks later (when the second flush of leaves is attacked). AceCap 97 and Treeazin applications must be made post-bloom as these products are toxic to bees and/or bee brood.
	Cygon 480 E	500 mL/ 1,000 L water	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Lagon 480	500 mL/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Treeazin	see label	
Birch skeletonizer (*Bucculatrix canadensisella*)	There is no product registered at the time of this publication.		This pest is generally not a significant problem. Small yellowish-green larvae attack birches and some alders. Larvae feed on the bottom of leaves from mid-to-late summer. Collect and destroy fallen leaves to remove overwintering pupae. Thoroughly spray the underside of leaves about mid-August.
Bronze birch borer (*Agrilus anxius*)	Pyrate 480 EC	500 mL/ 1,000 L water	This beetle attacks injured and weakened birch trees. The elongated white larvae make long, winding tunnels just under the bark. Tunnels show up as spiral ridges around the branches and trunk. Larvae develop over 2 years and emerge as adults from June to August, through a D-shaped hole. The adult is a slender, olive-bronze beetle. Remove and destroy weakened and dying branches before mid-May. Good tree health reduces infestation risks. Birch roots do not compete well with lawn grasses. Deeply water the root zone several times during the growing season. Manage birch leafminers to reduce stress. Apply Pyrate as a direct spray at the trunk and branches.
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs but prefer basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	

BUXUS — BOXWOOD

Pest	Product	Rate	Notes
INSECTS AFFECTING *BUXUS*			
Boxwood leafminers (*Monarthropalpus buxi, M. flavus*)	Citation 75WP	188 g/ha	Larvae overwinter in leaves and pupate in spring. The adult is a gnat-like fly that lays eggs into newly emerged foliage in spring. Newly hatched larvae mine new leaves in spring and throughout the summer. Treat newly emerged foliage when adult midges appear to reduce successful egg hatch and larval development. Citation is used as a foliar spray to target larvae. Citation interferes with the moulting process, resulting in failure of larvae to complete their life cycle.
	Cygon 480 E	1 L/ 1,000 L water	
	Lagon 480	1 L/ 1,000 L water	
	Malathion	see label	
Boxwood psyllid (*Psylla buxi*)	insecticidal soap	see label	Tiny, orange eggs overwinter in bud scales and are difficult to detect. Overwintering eggs hatch as buds begin to break in spring. Young nymphs are light green and develop a white, woolly protective mass as they get older. Nymphs feed on developing leaves. Leaves become cupped, enclosing the nymphs. Treat young psyllids after egg hatch, as leaves are emerging.
DISEASES AFFECTING *BUXUS*			
Cylindrocladium Blight *(Cylindrocladium buxicola)*	Daconil 2787	2.5 L/ 1,000 L water	Look for small, black, rod-shaped, discontinuous cankers along older stems. Shoot dieback and browning will occur on cankered stems. Most of the twig dieback will occur on the lower stems, resulting in significant leaf drop. Under high humidity (propagation, plastic bag) white fuzzy masses of spores may be observed on infected stems and leaves. Protect healthy tissues with fungicide applications where warm, humid conditions persist and there is a risk of Cylindrocladium infection. Disease spread has been linked to the movement of infected plants, cuttings, and boxwood debris (especially fallen leaves). Another significant way this disease spreads is through contaminated tools and worker footwear/clothing. Sanitation and scouting are imperative to preventing the Introduction of Cylindrocladium blight. Dip tools for 10 seconds in ≥70% isopropyl alcohol, 10% sodium hypochlorite or 0.5-1.5% quarternary ammonium. To date, this disease is not established in Ontario but has only been detected on import of infested stock, which was subsequently destroyed. Fungicides are registered for growers to use on incoming nursery stock from potentially infested areas outside of Ontario.
	Compass 50WG	150 g/ 1,000 L water	
	Medallion	1.2 L/ 1,000 L water	

CARAGANA — PEA SHRUB

Pest	Product	Rate	Notes
INSECTS AFFECTING *CARAGANA*			
Volutella blight and canker *(Volutella buxi)*	Daconil 2787	see label	Outer stem tissue becomes purplish-black between nodes, stems usually turn brown and die from the canker to the tip of the shoot. Under high humidity (propagation, plastic bag), orange-pink fungal fruiting bodies will form on cankered stems. This blight can be a problem in propagation areas where cuttings are being taken from infested, older stock plants. Always inspect cuttings and rooting beds for signs of canker and dieback. Remove and destroy infested cuttings immediately as a sanitation measure. Higher temperatures and well-drained media will accelerate rooting and decrease incidence of this disease in propagation (e.g., summer propagation). Remove and destroy infected leaves and stems in established plants (container, field).

CARAGANA — PEA SHRUB

Pest	Product	Rate	Notes
INSECTS AFFECTING *CARAGANA* (cont'd)			
Leafhopper (several species)	Actara 25 WG, Flagship 25 WG	105 g/ha	Leafhoppers are tiny, yellowish-green to pale-coloured insects that jump quickly when disturbed. Wingless nymphs will often "side step" quickly to hide from potential predators. Leafhoppers have piercing-sucking mouthparts that cause yellowish flecks on the leaf surface. Check regularly for infestation of nursery crops when neighbouring farms are cutting alfalfa or hay. Hang yellow sticky traps in the canopy to monitor for leafhoppers. Check by disturbing plants or looking at the leaf bottoms for leafhopper nymphs or molted skins. Treat as required.
	Altus	500–750 mL/ha	
	Tristar 70 WSP	5 solupaks	
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	

CARYA — HICKORY

Pest	Product	Rate	Notes
INSECTS AFFECTING *CARYA*			
Hickory gall adelgid (*Phylloxera caryaecaulis*)	Malathion 500 EC	1.25 L/ 1,000 L water	This pest produces nearly round galls on hickory twigs and leaf stems. Galls are about 16 mm in diameter. Girdled twigs die and break at the location of a gall. Overwintering eggs hatch as buds break. Apply insecticides at that time. Treatment is ineffective once galls appear. Infestations will not kill the tree.
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
Walnut caterpillar (*Datana integerrima*)	Malathion 500 EC	2.5 L/ 1,000 L water	Larvae are black with long grey hairs. This caterpillar feeds on walnut and hickory. Caterpillar colonies descend tree trunks and molt, leaving a conspicuous clump of grey cast skins on the trunk. Adult moths lay eggs in early July, and larvae feed until the end of August. Spray when larvae first appear, usually in July. Spray or remove larvae clustering on trunk.

CHAENOMELES — QUINCE

Disease	Product	Rate	Notes
DISEASES AFFECTING *CHAENOMELES*			
Fire blight (*Erwinia amylovora*)	Kasumin 2L	5 L/ 1,000 L water (see label)	Fire blight infects succulent vegetative growth. Dead, dry leaves persist on infected branches. Spray bactericidal products at early bloom, full bloom and petal fall when the weather is warm and humid and fire blight is a recurring problem. Avoid excessive pruning and nitrogen fertilization in spring. During dormancy, prune out infected branches about 30 cm below the cankered area when the tree is dry.
	Serenade Max	2–3 kg/ha	

CLEMATIS — CLEMATIS

Pest	Product	Rate	Notes
INSECTS AFFECTING *CLEMATIS*			
Two-spotted spider mite (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	
Western flower thrips (*Frankliniella occidentalis*)	Success	50 mL/ 1,000 L water	Western flower thrips can feed openly on new leaves or from inside terminal vegetative buds and flower buds. They have piercing-sucking mouthparts that suck out plant juices of immature leaves and flowers, resulting in major distortion and colour flecking when flowers and foliage do emerge. Injury may be confused with that of leafhoppers. Do not make more than 3 applications of Success per year.

CORNUS — DOGWOOD

Pest	Product	Rate	Notes
INSECTS AFFECTING *CORNUS*			
Aphids (various)	Altus	500–750 mL/ha	Aphids appear as new growth emerges in the spring. Repeated applications of insecticidal soap will be required to reduce aphid populations. *Do not apply Kontos insecticide during bloom, as this product is toxic to bee brood.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	insecticidal soap	see label	
	*Kontos	see label	
	Trounce	50 L/ 1,000 L water	
White grubs: European chafer (*Rhizotrogus majalis*) June beetle (*Phyllophaga* sp.)	**Larval management:**		These beetle larvae are referred to as “white grubs.” The larvae chew fibrous roots and girdle underground stems of many woody ornamentals (including *Cornus* sp.). To expose grubs to natural predators, cultivate infested fields before planting. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application. Avoid overwatering. Apply Acelepryn any time that larvae are present or during the mating period/egg-laying period to egg-hatch.
	Acelepryn	5.6–8.8 mL/ 100 m^2	
	Lorsaban NT	4.5 L/ 1,000 L water (rescue treatment for shipping	
	Intercept 60 WP	467 g/ha	
	Adult management:		
	Imidan 50 WP	1.25 kg/ 1,000 L water	

CORNUS — DOGWOOD

Pest	Product	Rate	Notes
DISEASES AFFECTING *CORNUS*			
Anthracnose (*Glomerella cingulata*), (*Colletotrichum gloeosporioides*)	Banner MAXX	28 mL/ 100 L water	Leaves develop brown lesions in spring, often between veins. Leaves may become deformed and fall off. This fungus infects leaves as they are emerging in the spring. Where disease pressure is high, protect newly emerging leaves with fungicides before leaf wetness periods in spring.
	Heritage Maxx	0.8-1.6 L/ 1,000 L water	
	Palladium WG	150–300mL/ 1,000 L water	
	Nova 40 W	340 g/ 1,000 L water	
Leaf spot	Daconil 2787 F	2.5 L/ 1,000 L water	This disease is caused by several different fungi. Avoid overhead irrigation late in the day or at night. Do not crowd plants. Maintain adequate sunlight and good air circulation. Protect new leaves with fungicides at the first sign of disease.
	Nova 40 W	340 g/ 1,000 L water	
Powdery mildew	Heritage Maxx	0.4–1.6 L/ 1,000 L water	This disease appears as a white, powdery fungal growth on the tops of leaves. MilStop will help suppress powdery mildew when applied preventively.
	MilStop	2.8–6.5 kg/ 100 L water	
	Palladium WG	100 g/ 1,000 L water	
Twig blight	There is no product registered at the time of this publication.		This disease is caused by several different fungi. Cankers appear at the base of dead twigs. Prune infected twigs and branches back to healthy wood. Improve cultural conditions by watering during dry conditions. Do not crowd plants. Maintain adequate sunlight and good air circulation.

CORYLUS — CORKSCREW HAZEL, FILBERT

Disease	Product	Rate	Notes
DISEASES AFFECTING *CORYLUS*			
Eastern filbert blight (*Anisogramma anomala*)	Copper Spray	3–9 kg/ 1,000 L water	Filbert blight causes branch dieback and small, crescent-shaped, black cankers on killed stems. Prune out cankered branches when the plant is dormant and dry. Protect new growth with fungicides from bud swell to leaf emergence.
	Flint	140–280 g/ha	

COTONEASTER — COTONEASTER

Disease	Product	Rate	Notes
DISEASES AFFECTING *COTONEASTER*			
Phytophthora root rot	Presidio	60–119 mL/ 380 L water	Infected roots become water-soaked and turn brown. Infected stems and leaves turn brown and die. Diseased leaves often persist on stems. Quite often the cambium turns from green to reddish-brown. This disease is often associated with overwatering or low aeration porosity of the media.
	Previcur	see label	
	Torrent 400SC	see label	

CRATAEGUS — HAWTHORN			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *CRATAEGUS*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are soft-bodied insects that suck plant sap. They can be found on soft, succulent plant tissue. Feeding causes distorted growth, honeydew and sooty mould. Apply insecticides to reduce populations. Do not make more than 3 applications of Endeavor per year. Do not apply more than 3 kg of Endeavor/ha/yr.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Eastern tent caterpillar (*Malacosoma americanum*)	Dipel 132 ES	0.5–1.0 L/ha	This caterpillar has one white stripe down its back. Colonies feed early in the season. Silken tents appear in the forks of branches, mainly of apple, cherry and hawthorn trees. Prune and destroy overwintering egg masses. These are silver in colour, about 1–2 cm long in a raised band circling a twig. They hatch when buds break in the spring. Treat then or at the first sign of webs. In light infestations, remove and destroy the tents (which contain larvae).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	1.0–1.6 L/ha	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 WP	see label	
	Pounce	90 mL/ 1,000 L water	
	Success	25 mL/ 1,000 L water	
	Thuricide	see label	
Hawthorn leafminer (*Profensua canadensis*)	Malathion 500 EC	1.4–3 L/ 1,000 L water	This leafminer forms a blotch mine covering half or more of each leaf. Foliage of heavily infested trees looks scorched. The adult is a small, black sawfly that emerges from the soil as the first leaves start to emerge and blossoms begin to open. Adults are active as the leaves begin to unfold. Treat foliage as it emerges in the spring to reduce larval populations.
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	
Western flower thrips (*Frankliniella occidentalis*)	Success	50 mL/ 1,000 L water	Western flower thrips can feed openly on new leaves or from inside terminal vegetative buds and flower buds. They have piercing-sucking mouthparts that suck out plant juices of immature leaves and flowers, resulting in major distortion and colour flecking when flowers and foliage emerge. Injury may be confused with that caused by leafhoppers. Do not make more than 3 applications of Success 480 SC per year.

CRATAEGUS — HAWTHORN

Pest	Product	Rate	Notes
DISEASES AFFECTING *CRATAEGUS*			
Fire blight (*Erwinia amylovora*)	Copper Spray	1.25 kg/ 1,000 L water	Fire blight affects succulent vegetative growth. Dead, dry leaves persist on infected branches.
	Serenade Max	2–3 kg/ha	Spray bactericidal products at early bloom, full bloom and petal fall when weather is warm and humid and fire blight is a recurring problem. Avoid excessive pruning and nitrogen fertilization in spring. During dormancy, prune out infected branches about 30 cm below the cankered area when the tree is dry.
Hawthorn rust (*Gymnosporangium globosum*) Quince rust (*G. clavipes*)	Daconil 2787 F	2.5 L/ 1,000 L water	Symptoms appear as orange spots on leaf surfaces in late spring. In the case of *G. globosum*, finger-like structures appear on leaf undersides by mid-to-late summer. Infections of *G. clavipes* also appear on fruit and stems. Apply fungicide before bloom, when the fungus is sporulating on the alternate hosts (juniper). Remove alternate juniper hosts and/or separate alternate hosts as far away as possible from *Rosaceous* hosts (*Malus*, *Crataegus*, etc.).
	Nova 40 W	340 g/ 1,000 L water	
Leaf blight (*Diplocarpon* sp.)	Dithane DG, M-45, 80 WP	2.75–3.5 kg/ 1,000 L water	Symptoms appear as small brown spots on leaves in mid-summer. Spray fungicides in spring to help protect leaves as they emerge. Do not crowd plants. Maintain adequate sunlight and good air circulation. Avoid summer pruning, which encourages susceptible soft growth.
	Manzate DF	2.75–3.5 kg/ 1,000 L water	
Leaf spot (*Fabraea* sp.)	Daconil 2787 F	2.5 L/ 1,000 L water	Leaf spot appears as slightly depressed, angular, reddish-brown spots that join together. By mid-summer, dead areas have dark, raised bumps (fruiting structures). Collect and destroy fallen leaves. Spray protectant fungicides as flower buds open. Repeat applications if spots develop. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Powdery mildew	Compass 50 WG	140–210 g/ 1,000 L water	This fungus appears as a white, powdery growth on the tops of leaves. Apply fungicides at the first sign of disease to reduce disease spread.
	Heritage Maxx	0.4–1.6 L/ 1,000 L water	
	Palladium WG	100 g/ 100 L water	

EUONYMUS — EUONYMUS

Pest	Product	Rate	Notes
INSECTS AFFECTING *EUONYMUS*			
Black vine weevil, Taxus weevil (*Otiorhynchus sulcatus*)	Demand CS	360 mL/ 1,000 L water	Larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larval control is difficult. Adults are black snout beetles that hide in soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack arborvitae, hemlock, azaleas, yews and rhododendrons. In container production, they are also significant pests of several hosts, including herbaceous perennials. The beetles have fused wing covers and cannot fly. To control adults, treat the foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied in late summer/early autumn and in mid-spring to suppress larval populations. See the product label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25WG	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Met 52	see label	
	Silencer 120 EC	300 mL/ 1000 L water	

EUONYMUS — EUONYMUS

Pest	Product	Rate	Notes
INSECTS AFFECTING *EUONYMUS* (cont'd)			
Euonymus scale (*Unaspis euonymi*)	Cygon 480 E	2 L/ 1,000 L water	This greyish, pear-shaped scale also affects bittersweet (*Celastrus*) and *Pachysandra*. It produces 2 generations a year; the second generation appears about 6 weeks after the first. Examine plants during the dormant season, prune out highly infested regions and use dormant oil. Apply insecticides as nymphs emerge. *Catalpa speciosa* are beginning to bloom at this time; *Kolkwitzia* and *Philadelphus* are also blooming. Repeat the treatment after 7 days. Landscape Oil (horticultural oil) can be used when plants are dormant or in the summer when foliage is fully expanded and hardened off. See product label for rates and tolerant plants. Kontos insecticide can be used as a drench application. *Do not apply Kontos during bloom, as this product is toxic to bee brood.
	horticultural oil	20 L/ 1,000 L water	
	*Kontos	7 mL product/ 100L of growing media	
	Lagon 480 E	2 L/ 1,000 L water	
	Orthene 75 SP	see label	
Euonymus webworm (*Yponomeuta cagnagella*)	Dragnet	230 mL/ 1,000 L water	The larva is a pale yellow caterpillar with black spots along each side. Larvae feed on leaves in localized, webbed colonies. Severe defoliation can occur during June. Monitor deciduous euonymus for webbed colonies in May and June. Where possible, prune colonies out and destroy them.
	Pounce	90 mL/ 1,000 L water	
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application/season of Apollo SC. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times/season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	
DISEASES AFFECTING *EUONYMUS*			
Anthracnose (*Glomerella cingulata, Colletotrichum gloeosporioides*)	Daconil 2787	2.5 L/ 1,000 L water	Symptoms appear as a leaf spot and stem blight that is most prevalent on container-grown euonymus. Leaf spots are small, circular and dark brown with light brown centres about 0.5–3 mm in diameter. Infected foliage often drops (although extreme temperatures and humidity will also cause leaf drop). Stem lesions appear as brown-to-grey, raised, oval, scabby cankers that lead to dieback of stem and leaves above the canker. Variegated cultivars of *Euonymus fortunei* are the most susceptible to anthracnose. This fungus is a weak pathogen, and infection is usually facilitated by mechanical wounds (e.g., pruning) or low-temperature injury and freezing damage. This fungus infects and grows best during leaf wetness periods (June, July) with high temperatures and high humidity. To protect new growth, spray at bud break and through leaf emergence, especially during high temperatures and humidity. Maintain good air circulation. To limit leaf wetness periods, irrigate susceptible cultivars during mid-morning only. Prune out dead and dying twigs, especially in fall.
	Heritage Maxx	0.8–1.6 L/ 1,000 L water	
	Palladium WG	150–300mL/ 1,000 L water	

EUONYMUS — EUONYMUS

Pest	Product	Rate	Notes
DISEASES AFFECTING *EUONYMUS* (cont'd)			
Crown gall (*Agrobacterium tumefaciens*)	Dygall	160 g/ 50 L water	This gall appears as large, abnormal growths on stems and roots. Susceptible plants (*Euonymus*, *Rosa*, *Salix*) must be treated before disease exposure or final field placement. Wounding (e.g., pruning) and damaging plants facilitate entry and infection by this pathogen. Remove and destroy infected plants and soil. This is a soil-borne bacteria. Avoid growing susceptible plants at sites with a history of this disease.

FAGUS — BEECH

Pest	Product	Rate	Notes
INSECTS AFFECTING *FAGUS*			
Aphids (various) Beech blight aphid (*Fagiphagus imbricator*, *Grylloprociphilus imbricator*) Woolly beech leaf aphid (*Phyllaphis fagi*)	Altus	500–750 mL/ha	Conspicuous white, cottony threads cover beech blight aphids and woolly beech leaf aphids. Beech blight aphid appears on twigs and small branches. The woolly beech leaf aphid feeds on leaf undersides. While unsightly, woolly beech aphids cause little tree damage unless very high populations exist. Treat aphids when they first appear, and repeat as needed. Excessive fertilization or pruning can cause undesirable succulent growth levels that attract these aphids.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Cankerworm (*Alsophila pometaria*), (*Paleacrita vernata*)	Dipel 132 ES	1.6–2.4 L/ha	Green and dark-grey inchworms (loopers, geometrids) can be found feeding on leaf undersides and edges in spring. Unchecked, cankerworm can cause significant defoliation to deciduous trees. Treat with insecticides when larvae are small.
	Orthene 75 SP	see label	
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	

FORSYTHIA — FORSYTHIA

Pest	Product	Rate	Notes
DISEASES AFFECTING *FORSYTHIA*			
Bacterial blight (*Pseudomonas syringae*)	Clean Crop Copper Spray	6 kg/ 1,000 L water	Young shoots or leaves turn black between early spring and early summer, especially during wet, cool weather. Apply copper spray once in October and again in January. In addition, during warm, humid blight conditions in April and May, apply 1 g/L of active ingredient (2 g 50% wettable powder). Repeat at 7–10-day intervals. Avoid overhead irrigation late in the day. Do not crowd plants. Maintain adequate sunlight and good air circulation. Excessive fertilization or pruning can cause undesirable succulent growth levels and reduce natural resistance to disease.

FRAXINUS — ASH

Pest	Product	Rate	Notes
INSECTS AFFECTING *FRAXINUS*			
Ash flower gall mite (*Eriophyes fraxiniflora*)	horticultural oil	20 L/ 1,000 L water	This mite becomes active as male ash flower buds break in the spring. It feeds on the unfolding tissues, causing them to form irregular gall clusters of 12 mm diameter. Use horticultural oil as a dormant treatment. Use Malathion when the first blossoms begin to emerge. Landscape Oil (horticultural oil) can be used when the plant is dormant or in the summer when leaves are fully expanded and hardened off. See product label for rates and tolerant plants.
	Malathion	see label	
Ash-lilac borer (*Podosesia syringae*)	Pyrate 480 EC	500 mL/ 1,000 L water	Adults are dark brown, wasp-like moths, present from late May to late July (during *Syringa vulgaris* bloom). Larvae bore into trunks near the base. Lilac, mountain ash and privet are also hosts. Cut and destroy infested wood before May. Stressed trees are more susceptible to borers. Remove badly infested trees. Use pheromone traps to monitor adult activity. Treat trunk and large branches, especially around wounds, with insecticides when the *Syringa vulgaris* is in bloom. Repeat twice at 10-day intervals. Begin applications about 10 days after peak catch numbers.
Ash plant bug (*Tropidosteptes amoenus*)	There is no product registered at the time of this publication.		This plant bug feeds on *Fraxinus americana* and *F. pennsylvanica*. Young nymphs feed on leaf bottoms, causing leaf stippling. To monitor for plant bugs, tap a branch over a sheet of white paper or a tapping tray. Treat with insecticides when nymphs appear.
Emerald ash borer (*Agrilus planipennis*)	AceCap 97	773 mg/ cartridge 1 cartridge/ 10.16 cm	This exotic insect was first found in Essex County, Ontario, in 2002. Larvae bore into the phloem, making serpentine tunnels just under the bark. Small (8–14 mm), metallic-green, adult beetles emerge through tiny D-shaped holes in the bark from spring to summer. The larval tunnels in the cambium kill off sections of the tree, leading to dieback, epicormic (adventitious) branching at the base, and tree mortality. This borer is most commonly found on *Fraxinus pennsylvanica*. This is a regulated pest of quarantine significance to the Canadian Food Inspection Agency. It is difficult to detect infestations of emerald ash borer. Injectible insecticides are registered to combat this pest. However, trees with vascular damage due to boring larvae may not translocate insecticide as well as un-infested trees, so the efficacy may be lower. AceCap 97, Ima-jet and TreeAzin applications must be made post-bloom as these products are toxic to bees and bee brood.
	Ima-jet	see label	
	TreeAzin	see label	
Fall webworm (*Hyphantria cunea*)	Dipel	see label	Large webs appear in August over branch ends of ash, box-elder, flowering crab and many shade trees. The very hairy caterpillar is pale yellowish green. Chemical control is rarely needed. Remove webs and caterpillars by hand and destroy.
	Dragnet	230 mL/ 1,000 L water	
	Orthene 75 SP	see label	
	Pounce	90 mL/ 1,000 L water	

FRAXINUS — ASH

Pest	Product	Rate	Notes
INSECTS AFFECTING *FRAXINUS* (cont'd)			
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	
Lecanium or European fruit lecanium (*Lecanium corni*)	horticultural oil	20 L/ 1,000 L water	When adults are mature in late spring/summer, they appear as a large, reddish-brown, spherical scale usually found on the underside of twigs. This scale insect infests many deciduous trees and shrubs. Use horticultural oil as an early-spring dormant treatment to reduce populations of overwintering nymphs. To suppress crawlers, spray insecticides when the *Sambucus canadensis* begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
	insecticidal soap	see label	
	Malathion 500 EC	2.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	
	Trounce	50 L/ 1,000 L water	
Leopard moth (*Zeuzera pyrina*)	There is no product registered at the time of this publication.		The larval stage of leopard moth bores into the branch tips and eventually into the heartwood of trees (as larvae grow larger), weakening the tree and causing dieback and tree mortality. Look for bore holes in branch tips and large bore holes with sawdust at the base of the trunk. Larvae are large (up to 50 mm) and cream-coloured with black spots. Control is difficult once the borer has become established in a tree. Remove infested trees and destroy. Insert a piece of flexible wire in and upwards via the bore hole to destroy larvae. Leopard moths are rarely found in large numbers.
Oystershell scale (*Lepidosaphes ulmi*)	insecticidal soap	see label	This scale insect attacks over 125 forest, shade, fruit and ornamental tree species. In heavy infestations, greyish scales completely encrust twigs and stems. This can cause branch and tree mortality. Mature females are 3 mm long and rounded at the rear, resembling oyster shells. Eggs overwinter under dead female shells, rendering them completely resistant to pesticides applied in fall or early spring. Use insecticides when crawlers are present in late May. Apply again 10 days later, about the time *Spiraea* x *vanhouttei* is blooming. Ensure good coverage of trunk, branches and leaf bottoms. Landscape Oil (horticultural oil) can be used in the summer when leaves are fully expanded and hardened off. See product label for rates and tolerant plants.
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	

FRAXINUS — ASH

Pest	Product	Rate	Notes
INSECTS AFFECTING *FRAXINUS* (cont'd)			
Sycamore lacebug (*Corythucha ciliata*)	Malathion 500 EC	1.25 L/ 1,000 L water	Lacebugs are flat, rectangular insects, 4–6 mm long with broad, transparent, lace-like wing covers. Adults and nymphs feed on the underside of leaves. Leaves become pale and mottled, with white splotches. Lower leaf surfaces develop black and brownish dots. Heavily infested leaves may turn entirely brown and fall off. Most lacebug species produce 2 generations per year. Lacebugs usually occur on a single host, but sycamore lacebug can also be found on elm, hickory, linden, oak and walnut. Apply insecticides to leaf undersides when insects first appear.
	Orthene 75 SP	see label	
DISEASES AFFECTING *FRAXINUS*			
Anthracnose (*Gloeosporium aridum*)	Dithane DG, M-45, 80 WP	2.75–3.5 kg/ 1,000 L water	Symptoms appear as leaf spots, marginal leaf browning and leaf deformation. Defoliation may occur in late spring and early summer. Apply treatments at 10–14-day intervals, beginning before bud burst and continuing while wet weather persists in spring. Collect and destroy fallen leaves. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Manzate 200 DF	2.75–3.50 kg/ 1,000 L water	
	Heritage Maxx	0.8–1.6 L/ 1000 L water	
	Palladium WG	150–300mL/ 1,000 L water	
Leaf spot (*Mycosphaerella* sp.)	Daconil 2787 F	2.5 L/ 1,000 L water	Brown spots with yellowish borders appear by late summer. Apply fungicides at bud break. Collect and destroy fallen leaves to help reduce disease pressure. Do not crowd plants. Maintain adequate sunlight and good air circulation.

GLEDITSIA — HONEYLOCUST

Pest	Product	Rate	Notes
INSECTS AFFECTING *GLEDITSIA*			
Cottony maple scale (*Pulvinaria innumerabilis*)	horticultural oil	20 L/ 1,000 L water	Mature female scale insects with white egg sacs resemble a partially popped corn kernel. This insect infests maple, linden, elm, beech, oak, and other trees and shrubs. It is found only on twigs. Use horticultural oil as an early-spring dormant treatment. Do not use horticultural oil on sugar or Japanese maples. Nymphs are active in late June/early July, about when *Philadelphus* and *Tilia cordata* bloom. Direct the insecticidal spray to the lower leaf surface. Repeat the application 10 days later. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	
Honeylocust plant bug (*Diaphnocoris chlorionis*)	insecticidal soap	see label	Plant bugs become active as new leaves begin to emerge. Plant bug feeding causes leaf yellowing, stippling, stunting and deforming early in the season. Shoot dieback may occur. To monitor for plant bugs, tap a branch over a sheet of paper or a tapping tray or use a sweep net. Apply insecticides when nymphs are active and numerous.
Honeylocust podgall midge (*Dasyneura gleditchiae*)	There is no product registered at the time of this publication.		The adult is a small insect similar to a fruit fly. It lays eggs on new leaflets, and larvae feed on the inner surface. This causes leaves to curl into a pod-like structure. There are several generations a year.

GLEDITSIA — HONEYLOCUST

Pest	Product	Rate	Notes
INSECTS AFFECTING *GLEDITSIA* (cont'd)			
Honeylocust spider mite (*Eotetranychus multidigituli*)	horticultural oil	see label	Adults overwinter on bark. Mites are light orange and very difficult to see with the naked eye. Feeding causes stippling, bronzing and discoloured foliage. Heavy infestation may cause defoliation. Treat when mites appear and again in 10 days. Repeat the procedure as needed. Landscape Oil (horticultural oil) can be used in the summer when leaves are fully expanded and hardened off. See product label for rates and tolerant plants.
	Orthene 75 SP	see label	
Leafhopper (*Macropsis fumipennis*)	Actara 25 WG, Flagship 25 WG	105 g/ha	Symptoms of leafhoppers include leaf spotting and stippling and blackening of leaf margins. Leafhoppers become active as new leaves begin to develop. Treat leaf bottoms when leafhoppers are active (about mid-June), and repeat as needed. To monitor for leafhoppers, tap a branch over a sheet of paper or a tapping tray or use a sweep net.
	Altus	500–750 mL/ha	
	Orthene 75 SP	see label	
	Pyrate 480 EC	1 L/ 1,000 L water	
	Tristar 70 WSP	5 solupaks	
Leafrollers (various)	Dipel	see label	Leafrollers are caterpillars that feed while hidden in folded or rolled leaves. Fruit tree and redbanded leafrollers primarily affect fruit trees but also attack many shade trees and ornamentals. Apply insecticide to foliage soon after leaves unfold in early June.
Lecanium or European fruit lecanium (*Lecanium corni*)	horticultural oil	20 L/ 1,000 L water	When adults are mature in late spring/summer, they appear as a large, reddish-brown, spherical scale usually found on the underside of twigs. This scale insect infests many deciduous trees and shrubs. Use horticultural oil as an early-spring dormant treatment to reduce populations of overwintering nymphs. To suppress crawlers, spray insecticides when the *Sambucus canadensis* begins blooming.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	
	Trounce	50 L/ 1,000 L water	

HEDERA — IVY

Pest	Product	Rate	Notes
INSECTS AFFECTING *HEDERA*			
Aphids (various)	Altus	500–750 mL/ha	Aphids become numerous as new growth emerges in the spring. Repeated applications of insecticidal soap will help smother aphids.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	insecticidal soap	see label	

HEDERA — IVY

Pest	Product	Rate	Notes
INSECTS AFFECTING *HEDERA* (cont'd)			
Black vine weevil, Taxus weevil (*Otiorhynchus sulcatus*)	Demand CS	360 mL/1,000 L water	Larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larvae control is difficult. Adults are black snout beetles that hide in soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack arborvitae, euonymus, hemlock, azaleas, yew and rhododendrons. They are a significant pest in container production. The beetles have fused wing covers and cannot fly. To control adults, treat foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied in late summer/early autumn and in mid-spring to suppress larval populations. See product label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25 G	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Met 52	see label	
	Silencer 120 EC	300 mL/ 1000 L water	
Two-spotted spider mite (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 1,000 L water	
	Vendex 50 W	50–100 g/ 100 L water	

HEMEROCALLIS — DAYLILY

Pest	Product	Rate	Notes
INSECTS AFFECTING *HEMEROCALLIS*			
Western flower thrips (*Frankliniella occidentalis*)	Success	50 mL/ 1,000 L water	Western flower thrips can feed openly on new leaves or from inside terminal vegetative buds and flower buds. They have piercing-sucking mouthparts that suck out plant juices of immature leaves and flowers, resulting in major distortion and colour flecking when flowers and foliage emerge. Injury may be confused with that of leafhoppers. Do not make more than 3 applications of Success per year.
DISEASES AFFECTING *HEMEROCALLIS*			
Daylily rust (*Puccinia hemerocallidis*)	Heritage Maxx	0.8–1.6 L/ 1,000 L water	Daylily rust appears as orange, raised pustules in late summer and autumn. Yellow zones often encircle the pustules and leaves may be killed, especially on very susceptible cultivars. Orange, dusty spores arise from the pustules and spread by wind and rain to infect other plant foliage. See the OMAFRA Factsheet *Daylily Rust*, at ontario.ca/crops. Heritage fungicide is for use on daylilies to prevent the infection of daylily rust whenever spores may be present (usually starting in September in Ontario). Apply every 14–28 days. Do not make more than 2 applications per season.
Rhizoctonia stem blight (*Rhizoctonia* sp.)	Compass 50 WG	3.8 g/ 100 L water	Apply Compass as a drench at the time of propagation to help protect *Hemerocallis* from rhizoctonia stem blight.
	Heritage Maxx	0.4 L/ 1,000 L water	
	Medallion	300–600 mL/ 1,000 L water	
	Palladium WG	150–300mL/ 1,000 L water	

HERBACEOUS PERENNIALS — VARIOUS

Pest	Product	Rate	Notes
INSECTS AFFECTING HERBACEOUS PERENNIALS			
Aphids (various)	Altus	500–750 mL/ ha	Various species of aphids feed on herbaceous ornamentals. Aphids are small, soft-bodied insects that have piercing-sucking mouthparts to suck plant sap. Feeding causes distortion and stunting of foliage. *Do not apply Kontos insecticide during bloom as this product is toxic to bee brood. See Kontos label for host sensitivity.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	*Kontos	see label	
	Tristar 70 WSP	3 solupaks	

HERBACEOUS PERENNIALS — VARIOUS

Pest	Product	Rate	Notes
INSECTS AFFECTING HERBACEOUS PERENNIALS (cont'd)			
Black vine weevil, Taxus weevil (*Otiorhynchus sulcatus*)	Demand CS	360 mL/ 1,000 L water	Larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larvae control is difficult. Adults are black snout beetles that hide in soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack arborvitae, euonymus, hemlock, azaleas, yew and rhododendrons. They are a significant pest in container production. The beetles have fused wing covers and cannot fly. To control adults, treat foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied to suppress larval populations in late summer/early autumn and in mid-spring. See product label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25WG	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Met 52	see label	
	Silencer 120 EC	300 mL/ 1000 L water	
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	
Western flower thrips (*Frankliniella occidentalis*)	Success	50 mL/ 1,000 L water	Western flower thrips can feed openly on new leaves or from inside terminal vegetative buds and flower buds. They have piercing-sucking mouthparts that suck out plant juices of immature leaves and flowers, resulting in major distortion and colour flecking when flowers and foliage do emerge. Injury may be confused with that of leafhoppers. Do not make more than 3 applications of Success per year.

HERBACEOUS PERENNIALS — VARIOUS

Pest	Product	Rate	Notes
DISEASES AFFECTING HERBACEOUS PERENNIALS			
Botrytis flower blight (*Botrytis cinerea*)	Captan 50 W	2 kg/ 1,000 L water	Botrytis blight appears as a grey, fuzzy mould on succulent plant tissues (e.g., flowers). Apply fungicides when disease first appears, and repeat at 7–10-day intervals.
	Compass 50 WG	7.5–30 g/ 100 L water	
	Daconil 2787	2.5 L/ 1,000 L water	
	Rhapsody	1.0–2.0 L/ 100 L water	
	Rovral WP	10 g/ 10 L water	
Crown and root rots	Heritage Maxx	0.4 L/ 1,000 L water	Various fungi cause root and crown rots on ornamentals. Many are a function of unsuitable environmental conditions and media properties. Medallion and Palladium give suppression of Fusarium oxysporum. Apply Rootshield or Rhapsody as a preventive drench after cuttings are stuck, seeds are sown or young plants are transplanted. Rootshield can also be applied as pre-mix granules with media. Rootshield helps suppress soil-borne pathogens such as Pythium, Rhizoctonia and Fusarium. It is registered for greenhouse ornamentals only.
	Medallion	300–600 mL/ 1,000 L water	
	Palladium	150–300mL/ 1,000 L water	
	Rhapsody	1–2 L/ 100 L water	
	Rootshield (*Trichoderma harzianum*)	see label	
	Senator 70 WP	650–850 g/ 1,000 L water	
	Torrent 400SC	see label	
Damping-off, bulb rots	Captan 50W	6–15 kg/ 1,000 L water	Use Captan as a bulb dip before storage of bulbs. Allow the fungicide to dry on the bulbs prior to storage.
	Captan 80 WDG	3.8–9.4 kg/ 1,000 L water	
Damping-off, root and stem diseases — pythium, phytophthora	Heritage Maxx	0.4 L/1,000 L water	Pythium and Phytophthora cause stem and root rots in many ornamentals, especially under saturated soil conditions where the media does not offer enough drainage (or aeration). Subdue MAXX can be used on a specific group of ornamentals (see product label). Apply Subdue MAXX to the media prior to potting or as a drench after seeding or transplanting. Irrigate within 1–2 days to ensure the product reaches the root zone. To avoid fungicide resistance, rotate Subdue MAXX with other families/groups of fungicides. Phostrol gives preventative suppression of Phytophthora root diseases only.
	Phostrol	see label	
	Presidio	60–119 mL/ 380 L water	
	Previcur	see label	
	Subdue MAXX	see label	
	Torrent 400SC	see label	
Downy mildew (*Peronospora* spp.)	Acrobat 50 WP	48 g/ 100 L water	Downy mildew is a common disease on several species of herbaceous perennials, and symptoms can vary per host. Most often they appear as purplish zones on leaves. Downy mildew is most prevalent in warm, humid conditions. Fungicides must be applied preventatively, before disease symptoms are evident, to be effective. Make the first application when conditions are favourable for disease development.
	Heritage Maxx	0.4–0.8 L/ 1,000 L water	
	Micora	300–600 mL/ 1,000 L water	
	Presidio	60–119 mL/ 380 L water	
	Torrent 400SC	see label	
Leaf spot (various fungi)	Folpan 50 WP	2 kg/ 1,000 L water	Look for distinct, brown spots on herbaceous perennials. Protect new growth with fungicides at the first sign of disease. Apply Rhapsody prior to or at the early stages of disease, and repeat every 7 days.
	Rhapsody	10–20 L/ 1,000 L water	

HERBACEOUS PERENNIALS — VARIOUS

Pest	Product	Rate	Notes
DISEASES AFFECTING HERBACEOUS PERENNIALS (cont'd)			
Powdery mildew	Compass 50 WG	15–20 g/ 100 L water	Powdery mildew appears as a white, powdery fungal growth on the tops of leaves. Early signs include small, circular whitish colonies.
	Folpan 50 WP	2 kg/ 1,000 L water	MilStop and Rhapsody can be used for the suppression of powdery mildew. Start applications at the first sign of disease.
	Heritage Maxx	0.4–1.6 L/ 1,000 L water	Regalia Maxx gives suppression of *Oidium* spp. powdery mildew only.
	MilStop	2.8–6.5 kg/ 1,000 L water	
	Palladium WG	100g/ 100 L water	
	Regalia Maxx	500–1,000 ml/ 400 L water	
	Rhapsody	1.0–2.0 L/ 100 L water	
Rhizoctonia root and crown rot	Compass 50 WG	3.8 g/ 100 L water	Rhizoctonia causes crown and root rot of several ornamentals. Apply Compass as a drench at the time of propagation. Compass may cause injury to petunia, violet and New Guinea impatiens.
	Heritage Maxx	0.4 L/1,000 L water	
	Medallion	300–600 mL/ 1,000 L water	
	Rovral WP	2 g/ 5 L water	
	Senator 70 WP	650–850 g/ 1,000 L water	

HYDRANGEA — HYDRANGEA

Pest	Product	Rate	Notes
DISEASES AFFECTING *HYDRANGEA*			
Botrytis blight (*Botrytis cinerea*)	Phyton 27	125–200 mL/ 1,000 L water	Infected plant parts develop a fuzzy, grey growth under very high humidity. Remove all fading and diseased plant parts promptly, especially when wet weather is predicted. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Cercospora leaf spot (*Cercospora hydrangeae*)	Heritage Maxx	1.6 L/ 1,000 L water	Look for circular, distinct grey lesions encircled by purplish halos. Apply fungicides to protect leaves at the first sign of disease symptoms or preventively during periods of prolonged leaf wetness.
Powdery mildew (*Erysiphe polygoni*)	Heritage Maxx	0.4–1.6 L/ 1,000 L water	Powdery mildew appears as a white, powdery fungal growth on the tops of leaves. Early signs include small, circular, whitish colonies.
	MilStop	2.8–6.5 kg/ 1,000 L water	MilStop can be used for the suppression of powdery mildew. Start application of MilStop at the first sign of disease.
	Palladium WG	1 kg/ 1,000 L water	
Rust (*Pucciniastrum hydrangeae* and others)	Heritage Maxx	0.8–1.6 L/ 1,000 L water	Look for small, orange pustules on the undersides of leaves in mid-to-late summer. Protect healthy foliage with fungicides where disease incidence is severe. Rust on hydrangea rarely impacts plant health.

JUGLANS — BUTTERNUT, WALNUT

Pest	Product	Rate	Notes
INSECTS AFFECTING *JUGLANS*			
Walnut blister mite (*Eriophyes erinea, Aceria erinea*)	There is no product registered at the time of this publication.		This mite feeds on walnut and butternut leaves, causing yellow or brown felt-like galls. Overwintering mites become active as new spring growth begins.
Walnut caterpillar (*Datana integerrima*)	Malathion 500 EC	2.5 L/ 1,000 L water	Larvae are black with long grey hairs. Larvae feed on walnut and hickory foliage. Caterpillar colonies descend tree trunks and molt, leaving a conspicuous clump of grey cast skins on the trunk. Adult moths lay eggs in early July, and larvae feed until the end of August. Spray when larvae first appear, usually in July. Spray or remove larvae clustering on the trunk.
DISEASES AFFECTING *JUGLANS*			
Butternut canker (*Sirococcus clavigignenti-juglandacearum*)	There is no product registered at the time of this publication.		Dark brown-black cankers appear on branches and/or stems. Cankers are sunken, elongated and diamond-shaped. Dying branches can often be seen in the crown. Older cankers may show successive rings of callus loosely covered with bark. During spring, thin black fluid oozes from cracks in the bark and deposits a dried, sooty black stain. There is no known treatment for this disease.

JUNIPERUS — JUNIPER

Pest	Product	Rate	Notes
INSECTS AFFECTING *JUNIPERUS*			
Juniper midge (*Contarinia juniperina*)	Cygon 480 E	2.5 L/ 1,000 L water	This midge is a problem on eastern red cedar, *Juniperus virginiana*. Tips of injured plant shoots turn brown during June and July due to midge larvae feeding from the previous summer. Injury is rarely serious. Adult midges are active from late May to July. If needed, treat the foliage at 2–3-week intervals beginning in late June.
Juniper scale (*Carulaspis juniperi*)	insecticidal soap	see label	Adults appear as a small, circular, white scale with a yellow centre. Needles of juniper and arborvitae will turn yellow. This scale insect can infest all juniper species, especially *Pfitzer* and *Savin*. Juniper scale overwinters as eggs underneath the dead female shells, which makes dormant oil treatments ineffective. Sooty mould fungus sometimes develops. Treat crawlers about mid-June and repeat as needed, starting when *Philadelphus* is in full bloom and *Catalpa* are beginning to bloom. Do not use Malathion on Savin or *Canaertii* junipers.
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
Juniper tip gall midge (*Oligotrophus apicis, O. betheli*)	There is no product registered at the time of this publication.		These midge larvae feed inside vegetative buds and cause galls to form on the ends of shoots. *Juniperus scopulorum* is particularly susceptible. *O. apices* causes an enlarged bud gall and *O. betheli* causes infested bud scales to reflex into star-shaped "flower" like structures. Prune out green galls and destroy them to reduce the number of next-generation adults that emerge.
Juniper webworm (*Dichomeris marginella*)	Cygon 480 E	2.5 L/ 1,000 L water	This webworm appears as a light brown caterpillar about 12 mm long. Larvae feed at the base of needles. Needles are webbed together during early fall and again the following spring. Treat foliage when larvae are active (late August and September).
	Lagon 480	2.5 L/ 1,000 L water	

JUNIPERUS — JUNIPER			
Pest	**Product**	**Rate**	**Notes**
DISEASES AFFECTING *JUNIPERUS*			
Blight (dieback) (*Kabatina juniperi*)	Copper Spray	4 kg/ 1,000 L water	This blight appears as a dieback of new shoots. Stressed plants and wounded shoots are more susceptible. Avoid overhead irrigation late in the day. Do not crowd plants. Maintain adequate sunlight and good air circulation. If possible, prune out infected twigs well below the site of the symptoms. Dip pruners in disinfectant as frequently as possible. Maintain healthy growth, but do not encourage soft, succulent growth through excessive pruning or over-fertilization. Shoot blight of juniper can also be caused by the fungus *Phomopsis*, but *Kabatina* is most commonly found in Ontario. Laboratory diagnosis is needed to distinguish between *Kabatina* and *Phomopsis*. Spray when spring growth starts. Repeat at 10-day intervals until growth stops.
	Dithane M-45, 80 WP	2.75–3.5 kg/ 1,000 L water	
Cedar-apple rust (*Gymnosporangium juniperi-virginianae*) Hawthorn rust (*G. globosum*) Quince rust (*G. clavipes*)	Nova 40 W	340 g/ 1,000 L water	Cedar-apple rust and hawthorn rust cause slimy, orange galls on juniper twigs in mid-spring. When dormant, cedar-apple rust galls and hawthorn rust galls can be located in juniper foliage by their orange horns. Quince rust causes cankers in the twigs. Nova 40 W have the same active ingredient. Starting in mid-summer, apply Nova 40 W every 10–14 days when infected alternate rosaceous hosts (Malus, Crataegus, Amelanchier, etc.) are sporulating. To avoid resistance, rotate Nova with registered fungicides from other chemical families where possible. Nova can also be tank-mixed with Dithane DG at the rate of 150 g/100 L (1.5 g/ L). Prune out dormant galls and cankers on infected branches before May. Separate rosaceous rust hosts from junipers. Plant resistant junipers where possible.

LARIX — LARCH			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *LARIX*			
Cutworms (various species)	Confirm 240 F	0.5 L/ha	Cutworms are moth larvae that hide in shallow soil burrows during the day and crawl up plant stems to harvest plant parts at night. Injury appears as chewed or girdled stems on woody species and clipped stems on herbaceous plants. Larvae are greyish-brown in colour, often with black spots along their sides and stripes along their body. They have three pairs of true legs, four pairs of fleshy prolegs and one pair of "claspers" at the end of their abdomen. They can be up to 3 cm long. Late instar larvae overwinter and pupate in spring. Use insecticides to reduce cutworm populations at the first sign of feeding injury. Treat plants with insecticides in the evening since the larvae feed at night. Applications of Confirm should be made with a high-volume spray and sprayed to run-off (for greenhouse use). Application of Pounce should be made under warm, moist conditions when larvae are small.
	Pounce	45–90 mL/ha	
Larch casebearer (*Coleophora laricella*)	Malathion 500 EC	2.5 L/ 1,000 L water	Larvae feed from within papery cases that resemble a killed needle. These straw-coloured larval cases protect larvae while they migrate to new feeding sites. Larvae will migrate from overwintering sites and fasten their cases to newly emerging foliage in the spring. Larvae chew a hole into the green needle and mine the tissue within. Straw-coloured mined needles make the tree appear frost-damaged. Larvae feed in needles until late summer. Treat emerging needles with insecticides to reduce young larval populations in early spring.
Larch sawfly (*Pristiphora erichsonii*)	Malathion 500 EC	2.5 L/ 1,000 L water	Larvae are grey with black heads and can be up to 20 mm long. Larvae are active in mid-to-late summer.
	Orthene 75 SP	see label	Monitor for shepherd's crooks, caused by egg-laying, in the new growth. Treat foliage in July when larvae are still young.
Tarnished plant bug (*Lygus lineolaris*)	Actara 25 WG, Flagship 25 WG	210–280 g/ha	These are small (5 mm), yellowish-brown insects. Adults have wings that are folded in an X pattern. Tarnished plant bugs feed by inserting their mouthparts inside leaf tissue and sucking out the contents, leaving the lower and upper epidermis behind. The resulting injury appears as small, clear "windows" on leaf tissue of broad-leaved plants. On conifers, feeding often causes terminal growth to yellow and become distorted and bushy. Treat in spring and early summer to manage populations of this insect.
	Ripcord 400 EC	172 mL/ha	
Woolly larch adelgid (*Adelges laricis*)	Malathion 500 EC	1.25 L/ 1,000 L water	Adelgids feed on needles and are covered by waxy, woolly, cottony threads. Heavy infestations look like snow. Damaged leaves become bent or twisted. Treat foliage thoroughly when adelgids first appear.

LIGUSTRUM — PRIVET

Pest	Product	Rate	Notes
INSECTS AFFECTING *LIGUSTRUM*			
Privet rust mite (*Aculus ligustri*)	There is no product registered at the time of this publication.		Mites become active as new leaves emerge, from May to November. Damage appears as leaf russetting. This insect is more active in cool weather.
Privet thrips (*Dendrothrips ornatus*)	Malathion 500 EC	1.4–3 L/ 1,000 L water	These tiny, narrow insects suck plant sap from inside buds and newly emerging leaves. Injury appears as yellowish flecks on leaves. Leaves look greyish or dusty. Treat at the first sign of infestation and repeat as needed.
	Orthene 75 SP	see label	
	Pyrate 480 EC	500 mL/ 1,000 L water	
	Success 480 SC	50 mL/ 1,000 L water	
DISEASES AFFECTING *LIGUSTRUM*			
Anthracnose and twig blight (*Glomerella* sp.)	Nova 40 W	340 g/ 1,000 L water	Leaves turn brown and remain attached to twigs. Prune and destroy infected branches during dry weather. Spray fungicides to protect emerging shoots in spring. *Ligustrum amurense*, *L.* x *ibolium* and *L. obtusifolium regelianum* do not appear susceptible to this fungal disease.
Leaf spot (several fungi)	Daconil 2787 F	2.5 L/ 1,000 L water	Symptoms appear as brown spots on leaves, especially after a wet spring. Treat plants during prolonged wet conditions. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Nova 40 W	340 g/ 1,000 L water	
Rhizoctonia root rot	Heritage Maxx	0.4 L/ 1,000 L water	Rhizoctonia is a fungus that causes crown and root rot on several ornamentals. Lab testing will be necessary to confirm diagnosis. Protect healthy plants with fungicides at the first sign of disease.
	Medallion	300–600 mL/ 1,000 L water	
	Compass 50 WG	3.8 g/ 100 L water	

LIRIODENDRON — TULIPTREE

Pest	Product	Rate	Notes
INSECTS AFFECTING *LIRIODENDRON*			
Tuliptree aphid (*Macrosiphum liriodendri*)	Altus	500–750 mL/ha	This is a green aphid found on the underside of leaves from late June to late September. Treat when aphids first appear and repeat as needed. Excessive fertilization or pruning can cause excessive, susceptible succulent growth that is attractive to insects.
	Beleaf 50 SG	0.12–0.16 kg/ ha	
	Closer	200 mL/ 1,000 L water	
	insecticidal soap	see label	
	Malathion 500 EC	1.25 L/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Tuliptree scale (*Toumeyella liriodendri*)	horticultural oil	20–30 L/ 1,000 L water	This scale insect appears as a dark-brown, rounded scale. Tuliptree scale attacks several deciduous tree species. Use horticultural oil as a dormant treatment in early spring. Use any of the other materials when crawlers appear in August. Landscape Oil (horticultural oil) can be used when plants are dormant or in summer when new foliage is fully expanded and hardened off. See product label for rates and tolerant plants.
	Malathion 500 EC	1.4–3 L/ 1,000 L water	

LONICERA — HONEYSUCKLE

Pest	Product	Rate	Notes
INSECTS AFFECTING *LONICERA*			
Honeysuckle aphid (*Hyadaphis tataricae*)	Altus	500–750 mL/ha	Feeding injury from this aphid causes early-season curling and dwarfing of terminal shoots. Affected stems eventually die, causing a witches' broom appearance. Injury may completely disfigure heavily affected plants. Dead shoots may be visible the following spring. Prune out witches' brooms (15 cm below the broom) when plants are dormant, before buds begin to break in early spring. Apply horticultural oil after pruning to suppress overwintering eggs. Apply treatment when buds begin to break. Repeat at least once after a 3-week interval. Susceptible varieties include *Lonicera* x *bella* 'Dropmore,' *L. korolkowii* 'Zabelli,' *L. tatarica* 'Grandiflora,' 'Rosea,' 'Hack's Red,' and 'Red Giant.'
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/1,000 L water	
	horticultural oil	see label	
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
DISEASES AFFECTING *LONICERA*			
Honeysuckle blight (*Herpobasidium deformans*)	Dithane DG	2 kg/ 1,000 L water	Symptoms appear as new leaves expand in spring. Infected leaves curl and turn brown. The veins tend to remain green at first. Many species of honeysuckle are susceptible. Spray fungicides when the leaf buds show a green tip or up to 1.25 cm of green leaf. Repeat applications in 10–14-day intervals. Avoid overhead irrigation late in the day. Remove and destroy fallen, infected leaf material in autumn to reduce inoculum the following spring.
Powdery mildew	Heritage Maxx	0.4–1.6 L/ 1,000 L water	This fungus appears as a white, powdery growth on the tops of leaves. Treat at the first sign of disease and repeat applications to protect healthy tissue.
	Nova 40 W	340 g/ 1,000 L water	
	Palladium WG	100 g/ 100 L water	

MAGNOLIA — MAGNOLIA

Pest	Product	Rate	Notes
INSECTS AFFECTING *MAGNOLIA*			
Magnolia scale (*Neolecanium cornuparvum*)	horticultural oil	20–30 L/ 1,000 L water	Mature scales are large (up to 1 cm) and pinky-orange in colour. Feeding injury causes honeydew, sooty mould and twig dieback on *Magnolia acuminata*, *M.* x *soulangiana* and *M. stellata*. Nymphs are purple in mid-summer, turning white by late summer. They overwinter as tiny nymphs on the current season's wood. Dormant oil applications can suppress overwintering nymphs in fall and/ or early spring. Landscape Oil (horticultural oil) can be used when plants are dormant or in summer when new leaves are fully expanded and hardened off. See product label for rates and tolerant plants.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 WP	see label	

MALUS — APPLE

Pest	Product	Rate	Notes
INSECTS AFFECTING *MALUS*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are small, soft-bodied insects that feed by sucking on plant tissue. They produce honeydew that often attracts other insects (e.g., ants) and sooty mould growth. Treat when adults first appear, and repeat as required. *Do not apply Kontos during bloom as this product is toxic to bee brood.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	Cygon 480 E	1.25 L/ 1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	insecticidal soap	see label	
	*Kontos	see label	
	Lagon 480	1.25 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Apple rust mite (*Aculus schlechtendali*)	Dyno-Mite	284 g/ha in 1,000 L water	Adult females overwinter in bark crevices or cracks in twigs. When leaves begin to emerge, the overwintered females move to feed on the new leaf tissue. Apple rust mites feed on both surfaces of host tree leaves, causing them to turn brown and dry. The first symptom of infestation is an upward curling of the leaf. Severe infestation can result in all the leaves turning brown. Dyno-Mite can be applied as soon as mites appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Landscape Oil (horticultural oil) can be used when plants are dormant to control overwintering females in bark and twig crevices. Bark injury may occur on Red Delicious, Empire and Mutsu apples. See product label for rates and tolerant plants.
	horticultural oil	see label	
Apple Clearwing Moth Borer *(Synanthedon myopaeformis)* Dogwood Borer *(Synanthedon scitula)*	Delegate	420g/ha	Delegate is registered for the control of dogwood borer and to reduce the numbers of apple clearwing moth. Apply using a handgun or backpack sprayer only, direct the spray to cover the lower trunk of the tree, particularly the graft union and any pruning cuts. Thorough coverage is essential. Apply 1-2 applications at a 14 day interval targeting the 1st instar larval stage (in-season/summer). Apply Delegate a maximum of two applications per year. Rimon is registered as a direct application to the tree trunk. Apply 1-2 applications in the summer at a 14 day interval targeting 25-75% egg laying to prevent egg hatch and 1st instar larvae establishment. Maximum of 2 applications of Rimon per growing season.
	Rimon 10EC	1,4 L/1,000 L water	
Brown marmorated stink bug *(Halyomorpha halys)*	Actara 25 WG, Flagship 25 WG	385 g/ha	This brown stink bug is a new pest introduced into North America. This plant bug feeds openly on fruit, making them unmarketable. It also feeds on the foliage of over 60 plants (e.g., Acer, Amelanchier, Buddleia, Catalpa, Cercis, Ilex, Juglans, Malus, Prunus, Pyrus, Rosa, Tilia, Viburnum) and can cause serious economic losses in crops. Although it has not been detected in Ontario nurseries, it has been intercepted in residential neighbourhoods (inside homes) in southern Ontario. Malathion, Flagship and Actara, as foliar treatments, provide suppression of brown marmorated stink bug.
	Malathion 85E	1.22 L/ha	

MALUS — APPLE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *MALUS* (cont'd)			
Codling moth (*Cydia piononella*)	Confirm 240 F	1 L/ha	There is a pheromone lure available for this pest. Apply insecticides just after first sustained moth catch. Apply Confirm at larval hatch. Allow 3–7 days for larval mortality. Repeat the application of Confirm every 14–21 days, with a maximum of 4 applications per year. Apply Silencer at larval hatch. Repeat application every 14 days with a maximum of 3 applciations per year. For the control of each generation, apply Delegate at first egg hatch based on pheromone trap catches and degree days after biofix dates. These pests must be controlled before the larvae penetrate the fruit so early timing is critical. Repeat at 14 day intervals to maintain control depending on pest pressure.
	Delegate	420 g/ha	
	Silencer 120 EC	83 mL/ha	
Eastern tent caterpillar (*Malacosoma americanum*)	Dipel 132 ES	0.5–1.0 L/ha	This caterpillar has one white stripe down its back. Colonies feed early in the season. Silken tents appear in the forks of branches, mainly of apple, cherry and hawthorn trees. Prune and destroy overwintering egg masses. These are silver in colour, about 1–2 cm long, in a raised band circling a twig. They hatch when buds break in spring. Treat then or at the first sign of webs. Young larvae (< 2 cm) hide in tents during the day. Where infestations are light, remove and destroy them in early spring.
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	1.0–1.6 L/ha	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Pounce	90 mL/ 1,000 L water	
	Success	25 mL/ 1,000 L water	
	Thuricide	see label	
European red mite (*Panonychus ulmi*)	Dyno-Mite	284 g/ha in 1,000 L water	These mites overwinter as tiny red eggs on twigs. Apply oil when plants show 1.25 cm of green tissue. Horticultural oil may cause bark injury on Red Delicious, Empire and Mutsu apples. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days apart. Landscape Oil (horticultural oil) can be applied when plants are dormant and in summer when new leaves are fully expanded and hardened off. Bark injury may occur on Red Delicious, Empire and Mutsu apples. See product label for rates and tolerant species.
	horticultural oil	20–30 L/ 1,000 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	2.07 L/ha	
	Vendex 50 W	0.5–1.0 kg/ 1,000 L water	
Fall cankerworm (*Alsophila pometaria*) Spring cankerworm (*Paleacrita vernata*)	Dipel 132 ES	0.5–1.7 L/ha	Cankerworms are greenish-to-black loopers (inchworms) that appear early in the season and feed on the leaves of many deciduous hosts. Place sticky bands around tree trunks, close to the ground, in the spring and fall. This traps adult females as they emerge from the ground and crawl up the tree trunk. Treat when larvae appear in mid-May, when A*cer platanoides* and *Magnolia* x *soulangiana* are blooming.
	Foray 48 B	1.0–1.6 L/ha	
	Malathion 500 EC	2.5 L/ 1,000 L water	
	Pounce	90 mL/ 1,000 L water	
	Thuricide	see label	

MALUS — APPLE

Pest	Product	Rate	Notes
INSECTS AFFECTING *MALUS* (cont'd)			
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	3.75 kg/ha	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	
Japanese beetle (*Popillia japonica*)	**Adult management:**		Japanese beetle adults are metallic green and copper in colour and about 13 mm long. They are easily recognized by the six tufts of white hair on each side of the abdomen. As the beetles feed, they consume and skeletonize foliage. Preferred hosts include members of the rosaceous family, maple, birch, linden and fruit trees. Spray adulticides when adults appear in early July, when the *Yucca filamentosa* is blooming. Larvae are C-shaped milky-white grubs about 25 mm long with brown heads and 3 pairs of legs. They can be distinguished from other white grubs by a V-shaped arrangement of spines on the underside of the abdomen. Larvae are most commonly found feeding on fibrous roots of turfgrass. Lorsban 4 E is a rescue treatment to allow shipping from infested to uninfested regions. Apply to soil when grubs are young and actively feeding near the soil surface. Apply as a coarse spray and irrigate with 1–2 cm of water to wash the insecticide into the underlying soil. For containerized stock, submerge the root ball into a solution of Lorsban 4 E (45 mL/10 L water) until all bubbling stops. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering.
	Imidan 50 WP	3.725 kg/har	
	Larval management:		
	Intercept 60 WP	467 g/ha	
	Lorsban 4 E	4.5 L/ 1,000 L water (rescue treatment for shipping)	
Leafhopper (several species)	Actara 25 WG, Flagship 25 WG	105 g/ha	Leafhoppers are tiny, yellowish-green to pale-coloured insects that jump quickly when disturbed. Wingless nymphs will often "side step" quickly to hide from potential predators. Leafhoppers have piercing-sucking mouthparts that cause distorted foliage with black margins and yellowish flecks on the leaf surface. Check regularly for infestation of nursery crops when neighbouring farms are cutting alfalfa or hay. Hang yellow sticky traps in the canopy to monitor for leafhoppers. Check by disturbing plants or looking at the leaf bottoms for leafhopper nymphs or molted skins. Treat as required.
	Altus	500–750 mL/ha	
	Tristar 70 WSP	5 solupaks	
Leafrollers: Fruit tree leafroller (*Archips argyrospila*) Redbanded leafroller (*Argyrotaenia velutinana*)	Dipel	see label	Leafrollers are caterpillars that feed while hidden in folded or rolled leaves. Fruit tree and redbanded leafrollers primarily affect fruit trees but also attack many shade trees and ornamentals. Apply the insecticide to foliage soon after leaves emerge in early June.

MALUS — APPLE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *MALUS* (cont'd)			
Oystershell scale (*Lepidosaphes ulmi*)	insecticidal soap	see label	This scale insect infests over 125 species of forest, shade, fruit and ornamental trees. In heavy infestations, greyish scales completely encrust twigs and stems and can kill branches and trees. Mature females are 3 mm long and rounded in the rear. Since this scale insect overwinters as eggs under dead female shells, dormant treatments in fall and early spring are ineffective. Use insecticides against crawlers in late May. Repeat in 10 days, when *Spiraea* x *vanhouttei* is blooming. Ensure good coverage of trunk, branches and leaf bottoms.
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
Tentiform leafminer (*Phyllonorycter blancardella*)	Confirm 240 F	see label	Use insecticides to control the first generation during the prebloom or calyx stage. Early mines are only visible from lower leaf surfaces. Later stages are visible from upper leaf surfaces. There are 3 generations per year. Controlling the first generation is more effective than controlling subsequent generations.
	Tristar 70 WSP	5 solupaks	
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	300 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	2.1 L/ha	
	Vendex 50 W	50–100 g/ 100 L water	
Western flower thrips (*Frankliniella occidentalis*)	Success	50 mL/ 1,000 L water	Western flower thrips can feed openly on new leaves or from inside terminal vegetative buds and flower buds. They have piercing-sucking mouthparts that suck out plant juices of immature leaves and flowers, resulting in major distortion and colour flecking when flowers and foliage do emerge. Injury may be confused with that of leafhoppers. Do not make more than 3 applications of Success per year.

MALUS — APPLE

Pest	Product	Rate	Notes
DISEASES AFFECTING *MALUS*			
Apple scab (*Venturia inaequalis*)	Aprovia Top 195 EC	386–643 mL/ha	Scab infection causes purplish blotches on leaves and lesions on fruit. Start fungicide applications when leaf buds begin to break and show green tip. Repeat throughout bloom and leaf emergence, every 7–10 days during spring, especially before rainy weather. Rotate fungicides of different chemical families/groups and consider using adjuvents and stckers to increase efficacy. For more information, see OMAFRA Fruit Productions Recommendation, publication 360, see table 2–3. Activity of Fungicides on Apple Diseases. Usually disease spread diminishes after new leaves harden off, cease fungicide treatment. Clean up and remove/destroy fallen leaves In autumn to help reduce winter carry-over. Prune to improve air circulation through the canopy. Try to use resistant cultivars (e.g., Sugar Tyme). Nova is a triazole fungicide and should be rotated with fungicides of other chemical families to manage resistance.
	Banner MAXX	14 mL/100 L water	
	Captan 50 WP	6 kg/ha	
	Captan 80 WDG	1.25 kg/ 1,000 L water	
	Compass 50 WG	14–17.5 g/ 100 L water	
	Daconil 2787 F	2.5 L/ 1,000 L water	
	Dithane	see label	
	Equal 65 WP	1.08–2.25 kg/ha	
	Flint	140–175/ha	
	Inspire Super	836 mL/ha	
	Maestro 80 DF	see label	
	Manzate DF	6 kg/ha	
	Microscopic Sulphur	6.5 kg/ 1,000 L water	
	Nova 40 W	340 g/ 1,000 L water	
	Polyram 80 DF	see label	
	Pristine WG	1.0–1.2 kg/ha	
	Serenade Max	3–6 kg/ha	
	Supra Captan 80 WDG	see label	
Cedar-apple rust (*Gymnosporangium juniperi-virginianae*)	Daconil 2787 F	2.5 L/ 1,000 L water	Orange spots on leaf surface appear in early summer, followed by cream-coloured, finger-like structures on the underside of leaves by mid-to-late summer. Remove alternate hosts (junipers) where possible. Treat with fungicides when sporulation (slimy orange galls) begins on the alternate host (*Juniperus*), in mid-spring. Spores from juniper can infect alternate rosaceous hosts (*Malus*, *Crataegus*, *Amelanchier*, etc.). Repeat fungicidal applications every 10–14 days if needed.
	Dithane DG, M-45, 80 WP	2 kg/ 1,000 L water	
	Ferbam 76 WDG	1.25–2 kg/ 1,000 L water	
	Manzate DF	6 kg/ha	
	Nova W	340 g/ 1,000 L water	
	Polyram 80 DF	see label	
	Pristine WG	1.0–1.6 kg/ha	

MALUS — APPLE

Pest	Product	Rate	Notes
DISEASES AFFECTING *MALUS* (cont'd)			
Fire blight (*Erwinia amylovora*)	BlightBan A506	370–530 g/ 1,000–2,000 L water	Fire blight affects succulent, vegetative growth. Dead, dry leaves persist on infected branches. Some cultivars are resistant to this disease. Spray bactericidal products at early bloom, full bloom and petal fall when the weather is warm and humid, and fire blight is a recurring problem. Avoid excessive pruning and nitrogen fertilization in spring. During dormancy, prune out infected branches about 30 cm below the cankered area when the tree is dry. Blightban and Bloomtime are biopesticides that may help suppress fire blight.
	BlightBan C9-1	370–500 g/ 1,000–2,000 L water	
	Bloomtime Biological	375–500 g/ 1,000–2,000 L water	
	Copper Spray	1.25 kg/ 1,000 L water	
	Kasumin 2L	5 L/ 1,000 L water (see label)	
	Serenade Max	2–3 kg/ha	
	Streptomycin 17	600 g/ 1,000 L water	
Powdery mildew (*Podosphaera leucotricha*)	Compass 50 WG	14–17.5 g/ 100 L water	In this disease, a white, powdery substance develops on the tops of leaves in summer. Powdery mildew may lead to stunting and leaf drop. Treat with fungicides when symptoms first appear. Repeat every 10–14 days as needed. To avoid resistance to Nova, rotate with registered fungicides from other chemical families where possible.
	Funginex DC	2.5 L/ha	
	Heritage Maxx	0.4–1.6 L/ 1,000 L water	
	Microscopic Sulphur	6.5 kg/ 1,000 L water	
	Palladium WG	100g/ 100 L water	
	Pristine WG	1.0–1.2 kg/ha	
	Nova 40 W	340 g/ 1,000 L water	
	Serenade Max	3–6 kg/ha	

ORNAMENTAL TREES AND SHRUBS — VARIOUS

Pest	Product	Rate	Notes
INSECTS AFFECTING ORNAMENTAL TREES AND SHRUBS			
Brown marmorated stink bug (*Halyomorpha halys*)	Actara 25 WG, Flagship 25 WG	280g/ha	This brown stink bug is a new pest introduced into North America. This plant bug feeds openly on fruit, making them unmarketable. It also feeds on the foliage of over 60 plants (e.g., *Acer*, *Amelanchier*, *Buddleia*, *Catalpa*, *Cercis*, *Ilex*, *Juglans*, *Malus*, *Prunus*, *Pyrus*, *Rosa*, *Tilia*, *Viburnum*) and can cause serious economic losses in crops. Although it has not been detected in Ontario nurseries, it has been intercepted in residential neighbourhoods (inside homes) in southern Ontario. Malathion, Actara and Flagship, as foliar treatments, provide suppression of brown marmorated stink bug.
	Malathion 85E	See label	

PACHYSANDRA — PACHYSANDRA

Pest	Product	Rate	Notes
INSECTS AFFECTING *PACHYSANDRA*			
Euonymus scale (*Unaspis euonymi*)	Cygon 480 E	2 L/ 1,000 L water	This greyish, pear-shaped scale found commonly on euonymus also affects bittersweet (*Celastrus*) and *Pachysandra*. It produces 2 generations a year; the second generation appears about 6 weeks after the first. Examine plants during the dormant season, prune out highly infested regions and use dormant oil. Apply insecticides as nymphs emerge. *Catalpa speciosa* are beginning to bloom at this time; *Kolkwitzia* and *Philadelphus* are also blooming. Repeat treatment after 7 days. Landscape Oil (horticultural oil) can be used when plants are dormant or in the summer when foliage is fully expanded and hardened off. See product label for rates and tolerant plants.
	horticultural oil	20 L/ 1,000 L water	
	insecticidal soap	see label	
	Lagon 480 E	2 L/ 1,000 L water	
	Orthene 75 SP	see label	

PHLOX — PHLOX

Pest	Product	Rate	Notes
DISEASES AFFECTING *PHLOX*			
Powdery mildew	Folpan 50 WP	2 kg/ 1,000 L water	Powdery mildew appears as a white, powdery fungal growth on the tops of leaves. Early signs include small, circular, whitish colonies. MilStop and Rhapsody can be used for the suppression of powdery mildew. Start application at the first sign of disease.
	Heritage Maxx	0.4–1.6 L/ 1,000 L water	
	MilStop	2.8–6.5 kg/ 1,000 L water	
	Nova 40 W	340 g/ 1,000 L water	
	Palladium WG	100g/ 100 L water	
	Rhapsody	1.0–2.0 L/ 1,000 L water	
Rust (various)	Nova 40 W	250–340 g/ 1,000 L water	In this disease, orange-brown lesions form on leaves. Protect healthy tissue with fungicide applications, especially during warm, wet conditions.

PICEA — SPRUCE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *PICEA*			
Bagworm (*Thyridopteryx ephemeraeformis*)	Lagon 480 E	2 L/ 1,000 L water	This moth pest is a native of North America. It has a wide host range but is most commonly found on spruce. Look for masses of dead needles hanging like small bags from the tips of branches. Eggs overwinter inside the bags. Larvae feed on needles, partially enclosed in a small woven case. Larvae form bags on branch tips in late summer and pupate inside. Males emerge and fly to bags containing flightless females to mate. As many as 1,000 eggs are laid inside each bag. Remove and destoy bags by early spring. Insecticides may be effective on young larvae only.
	Orthene 75 SP	see label	
Black vine weevil Taxus weevil (*Otiorhynchus sulcatus*)	Demand CS	360 mL/ 1,000 L water	The weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larvae control is difficult. Adults are black snout beetles that hide in lower branches and soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack arborvitae, hemlock, azaleas and rhododendrons. The beetles have fused wing covers and cannot fly. To control adults, treat foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. To test product safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied in late summer/early autumn and in mid-spring to suppress larval populations. See label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25WG	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Met 52	see label	
	Silencer 120 EC	300 mL/ 1000 L water	
Cooley spruce gall adelgid (*Adelges cooleyi*)	Malathion 500 EC	1.25 L/ 1,000 L water	Nymphs of this adelgid feed inside long, plump galls on the current year's shoots of blue Colorado spruce, Engelmann spruce and Sitka spruce. Douglas fir is an alternate host. Feeding injury causes needles to twist and turn yellow. This adelgid does not form a gall on Douglas fir. Treat in early spring before bud break or in early October. Thoroughly cover crevices in the bark of terminal twigs and the bases of buds. On blue spruce, use only wettable powders to prevent foliage discolouration. If possible, remove and destroy galls in June.
	Pyrate 480 EC	375 mL/ 1,000 L water	
Cutworms (various species)	Confirm 240 F	500 mL/ha	Cutworms are moth larvae that hide in shallow soil burrows during the day and crawl up plant stems to harvest plant parts at night. Injury appears as chewed or girdled stems on woody species (and clipped stems on herbaceous plants). Larvae are greyish-brownish in colour, often with black spots along their sides and stripes along their body. They have three pairs of true legs, four pairs of fleshy prolegs and one pair of "claspers" at the end of their abdomen. They can be up to 3 cm long. Late instar larvae overwinter and pupate in spring. Use insecticides to reduce cutworm populations at the first sign of feeding injury. Treat plants with insecticides in the evening since the larvae feed at night. Applications of Confirm should be made with a high-volume spray and sprayed to run-off (for greenhouse use). Applications of Pounce should be made under warm, moist conditions when larvae are small.
	Pounce	180 mL/ha	

PICEA — SPRUCE

Pest	Product	Rate	Notes
INSECTS AFFECTING *PICEA* (cont'd)			
Eastern spruce gall adelgid (*Adelges abietis*)	horticultural oil	20 L/ 1,000 L water	Nymphs of these adelgids feed inside pineapple-shaped galls at the base of current-year shoots on Norway, white, red and black spruce. Old galls remain attached for long periods, turning black and making the tree look unsightly. With light infestations, remove and destroy galls before midsummer. Use horticultural oil as a dormant treatment. Use any of the other materials when adelgids migrate to new shoots in mid-May. On blue spruce, use only wettable powders to prevent foliage discolouration, and avoid horticultural oils because they remove the blue hue of blue spruce foliage.
	Malathion 500 EC	1.25 L/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae appear as dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	
Pine needle scale (*Chionaspis pinifoliae*)	Cygon 480 E	1.5 L/ 1,000 L water	Pine needle scale causes whitish flecks on pine and spruce needles. Reddish crawlers appear in late May, then turn yellowish. There are 2 generations per year. Infestations often start on lower branches. Prune out small infestations in late winter and early spring. Dormant treatments are ineffective because pine needle scale overwinter as eggs underneath the dead female shells. Crawlers are active when *Syringa vulgaris* and *Spiraea* x *vanhouttei* are blooming in late May. Treat at that time and again about 10 days later. Landscape Oil (horticultural oil) can be applied when plants are dormant and in summer when foliage is fully expanded and hardened off. Permanent discolouration of foliage will occur to *Pinus strobus* and blue cultivars of both *Juniperus* and *Picea*. See product label for rates and tolerant plants.
	horticultural oil	20–30 L/ 1,000 L water	
	insecticidal soap	see label	
	Lagon 480	1.5 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
Spruce bud scale (*Physokermes piceae, P. hemieryphus*)	horticultural oil	20–30 L/ 1,000 L water	This scale insect is a rounded, mahogany-brown scale that clusters on spruce. Lower branches become ragged, with some dieback. Monitor for honeydew and sooty mould. Spray to control the crawlers in mid-July. Repeat 10 days later. Landscape Oil (horticultural oil) can be applied when plants are dormant and in summer when new leaves are fully expanded and hardened off. Permanent discolouration of foliage will occur to blue cultivars of both Juniperus and Picea. See product label for rates and tolerant plants.
	insecticidal soap	see label	
	Lagon 480 E	1.5 L/ 1,000 L water	
	Malathion 500 EC	2.5 L/ 1,000 L water	

PICEA — SPRUCE

Pest	Product	Rate	Notes
INSECTS AFFECTING *PICEA* (cont'd)			
Spruce budworm (*Choristoneura fumiferana*) Also see under *Abies*.	Cygon 480 E	1.5 L/ 1,000 L water	This is a widespread and important defoliator of balsam fir and spruce. It is seldom a problem on landscape trees. Larvae begin to feed as buds break, and they continue to feed until mid-to-late June. They have a black head and brownish body with four light spots on the back of each segment. There is 1 generation per year. In mid-spring, apply general-coverage spray to control larvae. Use Mimic to control early instar larvae; allow 3–7 days for larval mortality. A second application of Mimic may be needed. On balsam fir, overwintering larvae become active about 2 weeks before bud break. Apply general-coverage spray to control larvae from mid-May to mid-June.
	Dipel	see label	
	Dragnet	160 mL/ 1,000 L water	
	Foray 48 B	1.6–2.4 L/ha	
	Lagon 480	1.5 L/ 1,000 L water	
	Lannate	270–540g/ ha	
	Malathion 500 EC	2.5 L/ 1,000 L water	
	Mimic 240 LV	290 mL/ha	
	Pounce	45–90 mL/ha	
	Thuricide	see label	
Spruce needleminer (*Taniva albolineana, Endothenia albolineana*)	Lagon 480 E	1.5 L/ 1,000 L water	Needleminer larvae bore into the bases of old needles. Young larvae feed in groups, while older larvae feed alone. Larvae build unsightly nests of dead needles and frass, held together by fine silk strands. Small grey moths appear throughout infested plants in late May and June. Apply insecticide to foliage about mid-June and repeat in late June. In the fall, or in spring before buds swell, dislodge nests with a strong stream of water.
	Malathion 500 EC	2.5 L/ 1,000 L water	
	Orthene 75 SP	see label	
Spruce spider mite (*Oligonychus ununguis*)	Cygon 480 E	1.5 L/ 1,000 L water	Overwintered eggs hatch in early May, when *Amelanchier laevis* and *Magnolia* x *soulangiana* are in full bloom. Mites prefer older needles as feeding sites. To monitor for mites, use a hand lens to check the undersides of twigs and needles for tiny reddish eggs or brown mites with black backs. Shake a branch over a white sheet of paper and look for crawling specks. Apply miticides when mites first appear. Kanemite is effective against mobile life stages but may also reduce egg viability. Use horticultural oil as a dormant treatment in early spring to target eggs and newly hatched nymphs. Do not use horticultural oil on white pine or blue cultivars of Colorado spruce or juniper. Landscape Oil is a brand of horticultural oil that can be used on labelled plants in summer, when leaves are fully expanded and hardened off (see product label). If mite populations are still significant, make 2 applications of other miticides at 10-day intervals when mites exist in spring. Many predatory mites co-exist with pest mite populations. To conserve predatory mites, try miticides that have less impact on these beneficials, such as Vendex and Floramite.
	Floramite SC	625 mL/ 1,000 L water	
	horticultural oil	20–30 L/ 1,000 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Lagon 480	1.5 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375–500 mL/ 1,000 L water	
	Vendex 50 W	50–100 g/ 100 L water	
Strawberry root weevil (*Otiorhynchus ovatus*)	Met 52	see label	Strawberry root weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark from larger roots. The reddish-brown flightless adult is less than 6 mm long and is much smaller than the black vine weevil. Adults hide during the day and feed at night. Adults are active in late June and early July, when *Wiegela florida* and *Syringa reticulata* are blooming. Adults injure plants by puncturing or girdling the current season's shoots while feeding. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. These pests have a large host range. Commonly injured plants include white cedar, spruce and juniper. To monitor for adults, wrap a sheet of burlap around infested plant bases. Adult weevils will hide in the burlap during the day. Place a white sheet under the plant, and shake the plant vigorously to dislodge any adults. Pounce is registered for use on seedlings. To test treatment safety, treat some conifer seedlings before treating a larger area.
	Pounce	45–90 mL/ 1,000 L water	

PICEA — SPRUCE

Pest	Product	Rate	Notes
INSECTS AFFECTING *PICEA* (cont'd)			
Tarnished plant bug (*Lygus lineolaris*)	Actara 25 WG, Flagship 25 WG	210–280 g/ha	Plant bugs are small (5 mm), yellowish-brown insects. Adults have wings that form an X pattern when folded closed. They feed by inserting their mouthparts inside leaf tissue and sucking out the contents, leaving the lower and upper epidermis behind. The resulting injury appears as small, clear "windows" on leaf tissue of broad-leaved plants. On conifers, feeding often causes terminal growth to yellow and become distorted and bushy. Treat in spring and early summer to manage populations of this insect.
	Ripcord 400 EC	172 mL/ha	
White grubs: European chafer (*Rhizotrogus majalis*) June beetle (*Phyllophaga* sp.)	**Larval management:**		These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including *Cornus* sp.). To expose grubs to natural predators, cultivate infested fields before planting. Sevin T&O is registered as a foliar spray for adults. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application. Avoid overwatering. Apply Acelepryn any time that larvae are present or during the mating period/egg-laying period to egg-hatch.
	Acelepryn	5.6–8.8 mL/ 100 m^2	
	Lorsban 4E	4.5 L/ 1,000 L water (rescue treatment for shipping)	
	Intercept 60 WP	467 g/ha	
	Adult management:		
	Imidan 50 WP	1.25 kg/ 1,000 L water	
White pine weevil (*Pissoides strobi*)	There is no product registered at the time of this publication.		This is a small, brownish snout beetle that attacks only vertical terminals on pines and spruce. It kills at least 2 years' growth. Attacks cause crooked, forked or multiple-stemmed trees. Legless, white larvae are found in the terminal shoots. Remove and destroy infested, flagging leaders in June and July.
Yellow-headed spruce sawfly (*Pikonema alaskensis*)	Dragnet	160 mL/ 1,000 L water	Sawfly larvae overwinter as late instar larvae in spun cocoons in the soil under the host tree. Adult sawflies are reddish brown and 8–10 mm long. Adults emerge in mid-late spring to mate and lay eggs in the branches at the base of needles. Larvae are green with lighter longitudinal stripes and yellow-brown heads. They feed on needles for 4–6 weeks. Target pesticide applications to young larvae where possible.
	Pounce	45–90 mL/ha	
	Success 480 SC	25 mL/ 1,000 L water	
DISEASES AFFECTING *PICEA*			
Botrytis (*Botrytis cinerea*)	Rovral WP	1.5–2 kg/ 1,100 L water	This disease can be an issue on seedlings in cold storage. Look for grey, fuzzy mould on tissue. Treat with fungicides at the first sign of disease.
Canker, branch dieback (*Cytospora valsa*)	There is no product registered at the time of this publication.		This canker is often associated with the death of scattered lower branches. The first symptoms are browning and needle loss. Norway and Colorado spruce are very susceptible. Prune out diseased branches and twigs when the bark is dry. Maintain good growing conditions. Avoid damaging the trunk and branches.
Damping off, root rot and stem rot (*Phytophthora, Pythium*)	Heritage Maxx	0.4 L/1,000 L water	Stem rot and root rot cause rapid dieback and mortality and are often characterized by reddish-brown discolouration of the cambium. Subdue MAXX can be used as a drench or a pre-incorporated treatment for media to help protect conifer seedlings and transplants from *Pythium* and *Phytophthora*. Subdue MAXX is registered on conifer seedbeds, plugs and 2-0 transplants only. See product label for rates and application information.
	Presidio	60–119 mL/ 380 L water	
	Previcur	see label	
	Subdue MAXX	1.2 L/ha (drench)	
	Torrent 400SC	see label	

PICEA — SPRUCE

Pest	Product	Rate	Notes
DISEASES AFFECTING *PICEA* (cont'd)			
Needlecast (*Rhizosphaera kalkhoffii*) Stigmina needle cast *(Stigmina lautii)*	Banner MAXX	350 mL/ 1,000 L water	Symptoms of needlecast appear between early spring and early summer when needles infected the previous season turn purple or lavender and stomates turn from white to black. By mid-season, infected needles drop, leaving only current season growth. Blue Colorado spruce is very susceptible. Apply the first fungicide treatment in spring when new growth is 1–2 cm long. Repeat at 3–4-week intervals. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Copper Spray	4 kg/ 1,000 L water	
	Daconil 2787 F	9.5 L/ 1,000 L water	
	Flint	240g/ha	
Needlecast (*Stigmina lautii*)	Banner MAXX	350 mL/ 1,000 L water	Needles infected with Stigmina often remain green, but stomates turn from white to black. Black fruiting structures emerging out of stomates have small dark appendages, similar to arms on a spider (visible with a hand lens). In contrast, fruiting structures emerging out of stomates of Rhizosphaera-infected needles are smooth and black. Banner MAXX gives preventive control of needlecast diseases when applied when shoot emergence Is less than 5 cm.
Tip blight (*Sirococcus conigenus*)	Copper Spray	4 kg/ 1,000 L water	Apply the first treatment in spring when new growth is 1–2 cm long. Repeat at 3–4-week intervals. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Daconil 2787 F	3.6–6 L/ 1,000 L water	

PINUS — PINE

Pest	Product	Rate	Notes
INSECTS AFFECTING *PINUS*			
Cutworms (various species)	Confirm 240 F	0.5 L/ha	Cutworms are moth larvae that hide in shallow soil burrows during the day and crawl up plant stems to harvest plant parts at night. Injury appears as chewed or girdled stems on woody species (and clipped stems on herbaceous plants). Larvae are greyish-brownish in colour, often with black spots along their sides and stripes along their body. They have three pairs of true legs, four pairs of fleshy prolegs and one pair of "claspers" at the end of their abdomen. They can be up to 3 cm long. Late instar larvae overwinter and pupate in spring. Use insecticides to reduce cutworm populations at the first sign of feeding injury. Treat plants with insecticides in the evening since the larvae feed at night. Applications of Confirm should be made with a high-volume spray and sprayed to run-off (for greenhouse use). Applications of Pounce should be made under warm, moist conditions when larvae are small.
	Pounce	180 mL/ha	
European pine shoot moth (*Rhyacionia buoliana*)	Cygon 480 E	2 L/ 1,000 L water	These larvae are brown with black heads. They feed inside emerging shoots in the spring. Feeding injury causes "hooking" of new candles and pitch proliferation. The adult is a small, orange-flecked moth, usually active in late June to early July. Egg hatch coincides with the bloom of *Catalpa speciosa*. There is 1 generation per year. In late April, apply spray to the area between buds on terminals and laterals when *Acer rubrum* and *Cornus mas* are blooming. Spray terminals about mid-July to prevent injury the following year. Delaying shearing until mid-July will destroy many eggs. Use pheromone traps to monitor for adult activity.
	Lagon 480 E	2 L/ 1,000 L water	

PINUS — PINE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *PINUS* (cont'd)			
Northern pine weevil (*Pissoides approximatus*)	There is no product registered at the time of this publication.		This weevil can be a problem on all pines, especially nursery production. It is often found on *Pinus sylvestris*. Damage includes flagging and browning of new shoots and seedlings. Adult feeding injury may result in small, circular wounds at the base of the damage that exude pitch resin. Remove freshly cut stumps and recently dead and dying trees by late spring to eliminate adult breeding grounds. Stressed trees are most susceptible. To control adults, treat the tender bark of seedlings and young shoots of larger trees in April or late August.
Pales weevil (*Hylobius pales*)	There is no product registered at the time of this publication.		This is a small, brownish-black weevil that feeds on tender pine twig bark, causing branches to turn brown and die. This weevil is a common pest in nursery production. Larvae bore into stem tissue at the soil line, girdling the tree. The white, legless larvae have brown heads. Larvae feed in long underground tunnels along the wood grain and on the outside of major roots. Remove freshly cut stumps and recently dead and dying trees by late spring to eliminate adult breeding grounds. Stressed trees are most susceptible. To manage adults, treat the tender bark of seedlings and young shoots of larger trees in April or late August.
Pine bark adelgid (*Pineus strobi*)	horticultural oil	20 L/ 1,000 L water	This adelgid mainly affects white pine, although other pine species may be infested. Adelgids appear covered in white, woolly masses on trunks, stems and branches. In early spring, use horticultural oil on the trunk and branch bark as a dormant treatment. Horticultural oil may remove the waxy hue of white pine foliage. Avoid contacting white pine foliage with horticultural oil. Apply other insecticides to newly hatched nymphs in mid-late May. Repeat the application in 2–3 weeks. Ensure good coverage.
	Malathion 500 EC	1.25 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Tristar 70 WSP	3 solupaks	
Pine false webworm (*Acantholyda erythrocephala*)	There is no product registered at the time of this publication.		This insect is a web-spinning sawfly that feeds on pine. The larvae feed on clipped needles from the safety of their webbed and frass-covered masses on branches against the trunk (mainly white pine). Pine false webworms overwinter as late instar larvae and pupae in soil cocoons below the host. Adults emerge in early spring. Adults are large and black; the females have an orange head, while the males have a yellow face. Adults can be seen flying around foliage in May. Eggs are laid end-to-end along needles of white pine. Larvae are yellowish-brown with two dark longitudinal stripes on each side and obvious antennae. The short thoracic legs and absence of fleshy, abdominal prolegs gives this insect a very wobbly appearance when it moves around. Apply a strong stream of water with sufficient pressure to penetrate the webbing and knock out larvae. In light infestations, hand-pick or prune out nests.
Pine needle scale (*Chionaspis pinifoliae*)	Cygon 480 E	1.5 L/ 1,000 L water	Reddish crawlers appear in late May, and then turn yellowish. Feeding injury causes yellow spots on pine and spruce needles. There are 2 generations per year. Infestations often start on lower branches. Prune out small infestations in late winter and early spring. Dormant treatments are ineffective, because pine needle scale overwinter as eggs underneath the dead female shells. Crawlers are active when *Syringa vulgaris* and *Spiraea* x *vanhouttei* are blooming in late May. Treat at that time and again about 10 days later. Landscape Oil (horticultural oil) can be applied when plants are dormant and in summer when foliage is fully expanded and hardened off. Discolouration of foliage will occur in *Pinus strobus* and blue cultivars of both *Juniperus* and *Picea*. See product label for rates and tolerant species.
	horticultural oil	20–30 L/ 1,000 L water	
	insecticidal soap	see label	
	Lagon 480	1.5 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	

PINUS — PINE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *PINUS* (cont'd)			
Pine pitch mass borer (*Vespamima pini, Synanthedon pini*)	There is no product registered at the time of this publication.		Pinkish-white borer larvae feed inside bark and can be found on established pine trees in the landscape. Large pitch resin masses appear on trunks. This moth has a 2–3-year life cycle. Stressed and wounded plants are most susceptible. Maintain good tree health, since no registered chemical controls exist. Larvae and pupae are found under the pitch masses. They can be removed and killed. Remove severely infested trees.
Pine root collar weevil (*Hylobius radicis*)	There is no product registered at the time of this publication.		This weevil feeds on many species of pine. White, Scots and Austrian are most susceptible. Infested trees often appear in isolated pockets or on sandy soils. The white, legless, grub-like larvae feed at the root collar, causing the trunk to swell. Pitch resin masses mixed with soil also appear. Prune off bottom branches. Pull away fallen needles and other organic matter to expose a circle of bare soil 60 cm across around the trunk. This increases light and temperature at the tree base, discouraging adult weevils.
Pine sawflies (open feeding): European pine sawfly (*Neodiprion sertifer*) Redheaded pine sawfly (*Neodiprion lecontei*)	Cygon 480 E	1 L/ 1,000 L water	European pine sawfly has a dark-greenish body with dark longitudinal stripes and a black head. It appears in late May/June. Redheaded pine sawfly has a yellow body with six rows of black spots and a reddish head. It feeds on older foliage in July and August. Multiple generations can be present at one time and will attack all foliage. Initial feeding begins in small, easily removed colonies. Spot-treat foliage when small larvae are first observed feeding.
	Dragnet	160 mL/ 1,000 L water	
	Lagon 480	1 L/ 1,000 L water	
	Malathion 500 EC	2.5 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pounce	45–90 mL/ha	
	Pyrate 480 EC	500 mL/ 1,000 L water	
	Success	25 mL/ 1,000 L water	
	Tristar 70 WSP	1 solupaks	
Pine shoot beetle (*Tomicus piniperda*)	There is no product registered at the time of this publication.		This introduced bark beetle was found in Ohio in 1992 and in Ontario in 1993. By 1994, it was regulated under the *Plant Protection Act*. Pines from many areas of the province are subject to quarantine. The primary host is Scots pine, *Pinus sylvestris*. The 3–mm-long adult beetles tunnel within the current season's growth, causing flagging and dropping of shoots. Adult beetles overwinter at the base of trees (within the first 30 cm above the soil), just inside the outer bark. The adults start to emerge in February–March, when temperatures reach 10°C. They bore into bark to lay their eggs, causing sap to flow out of these wounds. The larvae form galleries in the bark, thereby destroying the cambium and weakening or killing the tree. Maintain plant health, since no registered chemical controls exist. Do not plant nursery pines and Christmas trees near abandoned pine plantations. To discourage egg laying, remove stumps, pine debris, dying trees and pruned limbs from the area by February 1. Place uninfested "trap logs" (with a diameter greater than 6 cm) to attract mating adults, and destroy the logs by May 31. Contact the Canadian Food Inspection Agency for the Pest Alert Factsheet on pine shoot beetle.
Pine spittlebug (*Aphrophora cribrata*)	Malathion 500 EC	2.5 L/ 1,000 L water	Several different pines are susceptible hosts for pine spittlebug, with Scots pine often heavily infested. Young nymphs feed on sap from new growth and cover themselves with white, foam-like spittle. Several nymphs may be found in one spittle mass. This pest rarely causes serious damage. Treat when spittle masses first appear in mid-to-late May.
	Pyrate 480 EC	88–150 mL/ 1,000 L water	

PINUS — PINE

Pest	Product	Rate	Notes
INSECTS AFFECTING *PINUS* (cont'd)			
Pine tortoise scale (*Toumeyella numismaticum, T. parvicornis*)	horticultural oil	20–30 L/ 1,000 L water	This reddish-brown oval, convex scale, about 6 mm long, infests several kinds of pine. It removes plant sap and secretes large amounts of honeydew. Remove heavily infested limbs and trees in late winter and early spring. In late June, treat twigs to control nymphs. There are several natural predators. Landscape Oil (horticultural oil) can be applied when plants are dormant and in summer when foliage is fully expanded and hardened off. Permanent discolouration of foliage will occur to *Pinus strobus* and blue cultivars of both *Juniperus* and *Picea*. See product label for rates and tolerant plants.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
Spruce spider mite (*Oligonychus ununguis*)	Cygon 480 E	1.5 L/ 1,000 L water	Overwintered eggs hatch in early May, when *Amelanchier laevis* and *Magnolia* x *soulangiana* are in full bloom. Mites prefer older needles as feeding sites. To monitor for mites, use a hand lens to check the undersides of twigs and needles for tiny reddish eggs or brown mites with black backs. Shake a branch over a white sheet of paper and look for crawling specks. Apply miticides when mites first appear. Kanemite is effective against mobile life stages but may also reduce egg viability. Use horticultural oil as a dormant treatment in early spring to target eggs and newly hatched nymphs. Horticultural oil (including Landscape Oil) will discolour foliage of white pine. Permanent discolouration of foliage will occur to blue cultivars of both *Juniperus* and *Picea*. To prevent foliar discolouration on blue Colorado spruce, use only wettable powders and avoid horticultural oil. Horticultural oil (including Landscape Oil) can be used on other species when plants are dormant. Landscape Oil can be used in summer when leaves are fully expanded and hardened off. See product label. If populations are still significant, make 2 applications of other miticides at 10-day intervals when mites exist in spring. Many predatory mites co-exist with pest mite populations. To conserve predatory mites, try miticides that have less impact on these beneficials, such as Vendex and Floramite.
	Floramite SC	625 mL/ 1,000 L water	
	horticultural oil	20 L/ 1,000 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	see label	
	Lagon 480	1.5 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375–500 mL/ 1,000 L water	
	Vendex 50 W	50–100 g/ 100 L water	
Strawberry root weevil (*Otiorhynchus ovatus*)	Met 52	see label	Strawberry root weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark from larger roots. The reddish-brown flightless adult is less than 6 mm long and is much smaller than the black vine weevil. It hides during the day and feeds at night. Adults are active in late June and early July, when *Wiegela florida* and *Syringa reticulata* are blooming. Adults injure plants by puncturing or girdling the current season's shoots while feeding. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. These pests have a large host range. Commonly injured plants include white cedar, spruce and juniper. To monitor for adults, wrap a sheet of burlap around infested plant bases. Adult weevils will hide in the burlap during the day. Place a white sheet under the plant, and shake the plant vigorously to dislodge any adults. Pounce is registered for use on seedlings. To test product safety, treat some conifer seedlings, especially pine, before treating a larger area.
	Pounce	45–90 mL/ 1,000 L water	
Tarnished plant bug (*Lygus lineolaris*)	Actara 25WG, Flagship 25WG	210–280 g/ha	These are small (5 mm), yellowish-brown insects. Adults have wings that are folded in an X pattern. Tarnished plant bugs feed by inserting their mouthparts inside leaf tissue and sucking out the contents, leaving the lower and upper epidermis behind. The resulting injury appears as small, clear "windows" on leaf tissue of broad-leaved plants. On conifers, feeding often causes terminal growth to turn yellow and become distorted and bushy. Treat in spring and early summer to manage populations of this insect.
	Ripcord 400 EC	172 mL/ha	

PINUS — PINE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *PINUS* (cont'd)			
White grubs: European chafer (*Rhizotrogus majalis*) June beetle (*Phyllophaga* sp.)	**Larval management:**		These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including *Cornus* sp.). To expose grubs to natural predators, cultivate infested fields before planting. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering. Apply Acelepryn any time that larvae are present or during the mating period/egg-laying period to egg-hatch.
	Acelepryn	5.6–8.8 mL/ 100 m^2	
	Lorsban 4E	4.5 L/ 1,000 L water (curative treatment for larvae)	
	Intercept 60 WP	467 g/ha	
	Adult management:		
	Imidan 50 WP	1.25 kg/ 1,000 L water	
White pine aphid (*Cinara strobi*)	Malathion 500 EC	1.4–3 L/ 1,000 L water	These are black aphids that often cluster together on shoots. Look for honeydew and sooty mould on needles. Treat active stages in May.
	Orthene 75 SP	see label	
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
White pine weevil (*Pissoides strobi*)	There is no product registered at the time of this publication.		This is a small, brownish snout beetle that lays its eggs into the bark of vertical terminals of pine and spruce when the Forsythia blooms (late April). Legless, white larvae feed under the bark from May to July, killing last year's and this year's leader. Attacks cause wilting and dying of terminal.Remove and destroy infested, flagging leaders in June and early July.
Zimmerman pine moth (*Dioryctria zimmermani*)	Cygon 480 E	2 L/ 1,000 L water	These grey-green larvae cause pitch resin to collect on pine trunks. Pitch masses appear at the branch whorls, on the trunk or on shoots near terminal branches. Individual branches may die back completely. Remove larvae from pitch masses in June and July. Prune damaged shoots and remove heavily infested trees. Chemical control is difficult. Spray bark thoroughly in late April to early May when overwintering larvae are breaking dormancy (when *Acer platanoides* is blooming). Treat again in mid-August when larvae hatch. Use pheromone traps to monitor adult activity.
	Lagon 480	2 L/ 1,000 L water	

PINUS — PINE

Pest	Product	Rate	Notes
DISEASES AFFECTING *PINUS*			
Brown spot (*Scirrhia* or *Mycosphaerella*)	Daconil 2787 F	9.5 L/ 1,000 L water	Apply treatment in spring when new growth is 12 cm long. Repeat at 3–4-week intervals. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Canker (*Ascocalyx abietina* or *Scleroderris abietina*)	Daconil 2787 F	2.4–4.8 L/ 1,000 L water	This canker may affect many pine species, especially Scots and red pine. Trees under 2 m are most susceptible. Symptoms appear in spring after infection. Bases of infected needles turn reddish brown by May or June. Needles may be bent. Cool, moist weather encourages infection. To reduce spread, prune out lower branches of pine windbreaks around nurseries. Apply treatment in spring when new growth reaches 1–5 cm. Repeat at 3–4-week intervals.
Damping off, root rot and stem rot (*Phytophthora, Pythium*)	Heritage Max	0.4 L/1,000 L water	Stem rot and root rot cause rapid dieback and mortality and are often characterized by reddish-brown discolouration of the cambium. Subdue MAXX can be used as a drench or a pre-incorporated treatment for media to help protect conifer seedlings and transplants from *Pythium* and *Phytophthora*. Subdue MAXX is registered for conifer seedbeds, plugs and 2-0 transplants only. See product label for rates and application information.
	Presidio	60–119 mL/ 380 L water	
	Previcur	see label	
	Subdue MAXX	1.2 L/ha in 200 L water (drench)	
	Torrent 400SC	see label	
Diplodia tip blight (*Sphaeropsis sapinea* or *Diplodia pinea*)	Copper Spray	4 kg/ 1,000 L water	New shoots do not elongate in spring. They appear brown and stunted by June. Recent research suggests this fungus sporulates all year round. Maintain tree health, since infection is difficult to manage. Apply fungicides at bud break, using a maximum of 3 applications per year at 2-week intervals to help protect new shoots. Removing infected branches does not reduce infection, since spores are also produced on seed cones. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Lophodermium needlecast (*Lophodermium seditiosum*)	Copper Spray	4 kg/ 1,000 L water	This fungus severely defoliates pines, especially Scots and Austrian pine. Only the current season's needles remain on the tree over winter. The previous season's needles turn red in late winter and early spring. Infected needles drop from late spring to early summer. Black, football-shaped fruiting bodies appear on cast needles in mid-summer. Apply treatment in mid-July to early August before infection occurs. Repeat at 3–4-week intervals as required. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Daconil 2787 F	2.4–4.8 L/ 1,000 L water	
	Dithane DG, M-45, 80 WP	2.5 kg/ 1,000 L water	
	Manzate DF	2.5 kg/ 1,000 L water	
Sweetfern blister rust (*Cronartium comptoniae*)	There is no product registered at the time of this publication.		This rust disease affects hard two- and three-needle pines, especially jack pine (*Pinus banksiana*). It can cause serious losses in nurseries and young plantations. Cankers often appear on the trunk, less than 2 m above the ground. Trees with basal diameters of more than 8 cm seem resistant. Destroy diseased pines. Eliminate alternate hosts such as sweet fern (*Comptonia peregrina*) and sweet gale (*Myrica gale*) from plantations and from the immediate vicinity of pine nursery stock.
Tip blight (*Sirococcus*)	Copper Spray	4 kg/ 1,000 L water	Apply treatment in spring when new growth is 12 cm long. Repeat at 3–4-week intervals. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Daconil 2787 F	3.6–6 L/ 1,000 L water	
White pine blister rust (*Cronartium ribicola*)	There is no product registered at the time of this publication.		This rust is a serious disease of five-needle pines, especially white pine, *Pinus strobus*. It infects the needles, eventually causing a perennial canker on branches and trunks. It can also cause an insignificant leaf spot. When plants are dormant, prune out girdled pine branches before the canker reaches the main stem. Prune infected, flagging branches 30 cm below the cankered area. Separate white pine nurseries and plantations from alternate host *Ribes* sp. by at least 600 m.

PLATANUS — LONDON PLANE, SYCAMORE

Disease	Product	Rate	Notes
DISEASES AFFECTING *PLATANUS*			
Anthracnose (*Apiognominia veneta*)	Daconil 2787 F	2.5 L/ 1,000 L water	As with frost damage, new leaves turn black-brown. Light-brown dead areas appear along the veins of mature leaves. Twigs that are 20–25 cm long may show signs of cankers and dieback. Treat up to 3 times, especially in cool, wet weather: as buds swell, at bud break and about 7 days after bud break. Prune out and destroy cankered twigs and branches. Collect and remove fallen, infected leaves. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Dithane DG, M-45, 80 WP	2.75–3.5 kg/ 1,000 L water	
	Manzate DF	2.75–3.5 kg/ 1,000 L water	

POPULUS — POPLAR

Pest	Product	Rate	Notes
INSECTS AFFECTING *POPULUS*			
Forest tent caterpillar (*Malacosoma disstria*)	Dipel	0.5–1.0 L/ha	Forest tent caterpillar larvae are hairy with a series of keyhole- or footstep-shaped white spots along their backs. The larvae are present early in the season. They feed in colonies. Forest tent caterpillar larvae do not form a tent on their host. Larvae may completely defoliate broadleaf trees, particularly poplars. Treat foliage in mid-to-late May to reduce populations of larvae. Orthene may damage sugar maple leaves.
	Foray	1.0–1.6 L/ha	
	Orthene 75 SP	see label	
	Pounce	90 mL/ 1,000 L water	
	Pyrate 480 EC	500 mL/ 1,000 L water	
	Thuricide	1.5–2.0 L/ 1,000 L water	
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gyspsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs but prefer basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	
Poplar and willow borer (*Cryptorhynchus lapathi*)	Pyrate 480 EC	500 mL/ 1,000 L water	This borer is a stout, black, rough-bodied snout beetle with pink outer wing covers. White, legless larvae honeycomb the trunks and larger branches of willows and poplars. Cut and destroy badly infected branches and trees before the end of June. Treat trunk and branch bark in mid-August and September with insecticides.

POPULUS — POPLAR

Pest	Product	Rate	Notes
DISEASES AFFECTING *POPULUS*			
Canker (several different fungi)	There is no product registered at the time of this publication.		Most poplar species are susceptible to canker, especially when stressed. Prune out and destroy infected branches during dry weather. Remove and destroy severely infected trees. Do not wound or injure trees. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Leaf spot (several fungi)	Daconil 2787 F	2.5 L/ 1,000 L water	Brown spots appear on leaves, followed by defoliation. Collect and remove fallen, infected leaves. Treat at bud break, then twice more at 10–14-day intervals. Applications of Senator can be repeated every 10–14 days, with a maximum of 3 applications per year.
	Senator 70 WP	1.1 kg/ 1,000 L water	

POTENTILLA — POTENTILLA

Pest	Product	Rate	Notes
INSECTS AFFECTING *POTENTILLA*			
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	

PRUNUS — BLACK CHERRY, CHOKECHERRY, FLOWERING CHERRY, PIN CHERRY, PEACH, PLUM			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *PRUNUS*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are small, soft-bodied insects that suck plant sap from stems and leaves. Injury appears as distorted foliage, and plants may be severely weakened. Treat when aphids first appear, and repeat as required. Excessive fertilization or pruning can cause undesirable levels of succulent growth. *Do not apply Kontos during bloom as this product is toxic to bee brood.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	insecticidal soap	see label	
	*Kontos	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Apple Clearwing Moth Borer *(Synanthedon myopaeformis)* Dogwood Borer *(Synanthedon scitula)*	Delegate	420g/ha	Delegate is registered for the control of dogwood borer and to reduce the numbers of apple clearwing moth. Apply using a handgun or backpack sprayer only, direct the spray to cover the lower trunk of the tree, particularly the graft union and any pruning cuts. Thorough coverage is essential. Apply 1–2 applications at a 14 day interval targeting the 1st instar larval stage (in-season/summer). Apply Delegate a maximum of two applications per year. Rimon is registered as a direct application to the tree trunk. Apply 1–2 applications in the summer at a 14 day interval targeting 25–75% egg laying to prevent egg hatch and 1st instar larvae establishment. Maximum of 2 applications of Rimon per growing season.
	Rimon 10 EC	1,4 L/1,000 L water	
Eastern tent caterpillar (*Malacosoma americanum*)	AceCap 97	see label	This caterpillar has one white stripe down its back. Colonies feed early in the season. Silken tents appear in the forks of branches, mainly of apple, cherry and hawthorn trees. Prune and destroy overwintering egg masses. These are silver in colour, about 1–2 cm long, in a raised band circling a twig. They hatch when buds break in spring. Treat then or at the first sign of webs. Young larvae (< 2 cm) hide In tents during the day. Where infestations are light, remove and destroy the tents in early spring. AceCap 97 applications must be made post-bloom as this product is toxic to bees and bee brood.
	Dipel 132 ES	0.5–1.0 L/ha	
	Dragnet	230 mL/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Pounce	90 mL/ 1,000 L water	
	Success	25 mL/ 1,000 L water	
	Thuricide	1.5–2.0 L/ 1,000 L water	
European red mite (*Panonychus ulmi*)	Dyno-Mite	284 g/ha in 1,000 L water	These mites overwinter as tiny red eggs on twigs. Apply oil when plants are dormant or show 2.5 cm of green tissue and flowers are in a tight cluster. This can improve control of European red mite. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days.
	horticultural oil	20 L/ 1,000 L water	
	Vendex 50 W	0.5–1.0 kg/ 1,000 L water	

PRUNUS — BLACK CHERRY, CHOKECHERRY, FLOWERING CHERRY, PIN CHERRY, PEACH, PLUM

Pest	Product	Rate	Notes
INSECTS AFFECTING *PRUNUS* (cont'd)			
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	3.75 kg/ha	
	Orthene 75 SP	see label	
	Success	182 mL/ 1,000 L water	
	Thuricide HPC	7.4–12 L/ 1,000 L water	
Japanese beetle (*Popillia japonica*)	**Adult management:**		The adult beetles are metallic green and copper, about 13 mm long. They are easily recognized by six tufts of white hair on each side of the abdomen. As the beetles feed, they consume and skeletonize foliage. Preferred hosts include members of the rosaceous family, maple, birch, linden and fruit trees. Spray adulticides when adults appear in early July, when the *Yucca filamentosa* is blooming. Larvae are C-shaped, milky-white grubs (about 25 mm long) with brown heads and 3 pairs of legs. They are distinguishable from other white grubs by a V-shaped arrangement of spines on the underside of the abdomen. Larvae are most commonly found feeding on the fibrous roots of turfgrass. Lorsban 4 E is a rescue treatment to allow shipping from infested to uninfested regions. Apply to soil when grubs are young and actively feeding near the soil surface. Apply as a coarse spray, and irrigate with 1–2 cm of water to wash the insecticide into underlying soil. For containerized stock, submerge the root ball into a solution of Lorsban 4 E (45 mL/10 L water) until all bubbling stops. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering.
	Imidan 50 WP	3.75 kg/ha	
	Larval management:		
	Intercept 60 WP	467 g/ha	
	Lorsban 4 E	4.5 L/ 1,000 L water (rescue treatment for shipping)	
Leafrollers: Fruit tree leafroller (*Archips argyrospila*) Redbanded leafroller (*Argyrotaenia velutinana*)	Dipel	see label	Leafrollers are caterpillars that feed while hidden in folded or rolled leaves. Fruit tree and redbanded leafrollers primarily affect fruit trees but also attack many shade trees and ornamentals. Apply insecticides to foliage soon after leaves unfold in early June.

PRUNUS — BLACK CHERRY, CHOKECHERRY, FLOWERING CHERRY, PIN CHERRY, PEACH, PLUM

Pest	Product	Rate	Notes
INSECTS AFFECTING *PRUNUS* (cont'd)			
Peachtree borer (*Synanthedon exitiosa*) Lesser peachtree borer (*Synanthedon pictipes*)	Delegate	420 g/ha	Peachtree borers attack tree/shrub bases of *Prunus* (e.g., *Prunus x cistena*) at the soil line. Lesser peachtree borers attack higher limbs and are found mainly on fruit tree species of Prunus. Adults are clear-winged moths and resemble wasps when flying. Borers overwinter in bark or wood as partly grown larvae. Feeding resumes in spring, with gum and frass accumulating near the burrows. Treat in mid-to-late spring, when *Philadelphus* is blooming. Repeat twice at 3-week intervals. Spray with a gun, covering the trunk and scaffold limbs thoroughly. Use pheromone traps to monitor adult activity. Delegate is registered for the suppression of peachtree borer and lesser peachtree borer, apply 420 grams of Delegate Insecticide per hectare. A spray volume of 1500–2000 L/ha is recommended. Using a handgun or back pack sprayer only, direct the spray to cover the tree trunk and any scaffold limbs from ground level to 1.5 m above ground, particularly the graft union and any pruning cuts. Thorough coverage is essential. Target the 1st instar larval stage, beginning 7–10 days after the first adult trap catch. Repeat applications at 14–21 day intervals. Apply a maximum of three applications per year. Rimon is registered as a direct application to the tree trunk and scaffold limbs. Maximum of 3 applications per growing season. Apply when economic thresholds are reached. Apply Rimon at 3 week intervals (21 days) starting 7–10 days after first trap catch.
	Rimon	1.4 L/ha	
Pearslug (*Caliroa cerasi*)	insecticidal soap	see label	Small, dark, clear-bodied sawfly larvae feed from the undersides of leaves and cause significant defoliation. Treat with insecticides at the first sign of larval damage.
	Orthene 75 SP	see label	
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	2.07 L/ha	
	Vendex 50 W	50–100 g/ 100 L water	
Uglynest caterpillar (*Archips cerasivorana*)	Thuricide	see label	These caterpillar larvae are dark yellow-green with black heads. They favour low-growing shrubs as hosts. Larvae feed on choke, pin and black cherry. Webbed nests appear at branch ends between May and September. Prune out nests when found. Chemical control is seldom used because insects are so well protected inside the nest.

PRUNUS — BLACK CHERRY, CHOKECHERRY, FLOWERING CHERRY, PIN CHERRY, PEACH, PLUM

Pest	Product	Rate	Notes
DISEASES AFFECTING *PRUNUS*			
Bacterial canker (*Pseudomonas syringae*)	Copper Spray	6 kg/ 1,000 L water (dormant rate)	This disease often develops after plastic film is removed from cold frames (container production) and plants experience extreme shifts in temperature. Apply bactericidal products before autumn rains and again when most leaves have fallen. Do not crowd plants. Maintain adequate sunlight and good air circulation. Excessive fertilization or pruning can cause undesirable succulent growth that is susceptible to this disease.
Black knot (*Apiosporina morbosa* or *Dibotryon morbosa*)	Maestro 80 DF	3.75–4.5 kg/ 1,000 L water	Black knot causes large black swellings up to 10 cm long on branches and small twigs, eventually girdling and killing the branch. Spray fungicide at green tip, pre-bloom and blossom time. In late winter and early spring, prune and destroy infested twigs and branches 20–30 cm below knots. Eliminate wild or neglected *Prunus* species from the area.
Blossom and twig blight (*Monilina fructicola*)	Captan 50 WP	2 kg/ 1,000 L water	This disease causes blossoms and new shoots to suddenly collapse and turn brown. Shoot or twig blight appears in early spring. Fruit will turn brown, rot and hang on the tree. Spray just before blossom buds open. Repeat in 10 days if wet weather persists. Prune out and destroy infected twigs. Remove infected fruit from the tree and the adjacent ground.
	Captan 80 WDG	1.25 kg/ 1,000 L water	
	Daconil 2787 F	2.5 L/ 1,000 L water	
	Funginex DC	750 mL/ 1,000 L water (or 2.5 L/ha)	
Peach leaf-curl (*Taphrina deformans*)	Ferbam 76 WDG	1.75–3.5 kg/ 1,000 L water	Peach leaf-curl spores lodged in winter buds cause infections during spring. As leaves unfold in spring, they become puckered and curled. Thickened areas eventually turn pinkish. Infected leaves become weakened and drop. Apply fungicide in fall (preferred time) just after complete leaf drop or apply in early spring just before buds swell.
Powdery mildew (various)	Compass 50 WG	14–21 g/ 100 L water	This fungus appears as a white, powdery growth on the tops of leaves. Apply fungicides at the first sign of disease, and repeat applications to protect healthy foliage. Switch 62.5 WG gives suppression of *Sawadea* and *Erysiphe* powdery mildews only.
	Heritage Maxx	0.4–1.6 L/ 1,000 L water	
	Palladium WG	1 kg/ 1,000 L water	
Shothole leaf spot (*Blumeriella jaapii*)	Captan 80 WP	1.25–1.5 kg/ 1,000 L water	In this disease, leaf spots appear as leaves expand to full size. New spots appear until late summer. Disease spots fall out with age, giving a shothole appearance. (Note that similar symptoms can be caused by insect pests.) Avoid overhead irrigation late in the day. Do not crowd plants. Maintain adequate sunlight and good air circulation.

PSEUDOTSUGA — DOUGLAS FIR

Pest	Product	Rate	Notes
INSECTS AFFECTING *PSEUDOTSUGA*			
Cooley spruce gall adelgid (*Adelges cooleyi*)	Malathion 500 EC	1.25 L/ 1,000 L water	This pest causes galls on spruce. Douglas fir is an alternate host for this insect. Open-feeding, woolly nymphs cause new needles of Douglas fir to twist and turn yellow. Cooley spruce gall adelgid does not form a gall on this host. To catch newly hatched nymphs as they migrate to new foliage, treat in early spring as buds are breaking and new foliage is emerging.
	Pyrate 480 EC	375 mL/ 1,000 L water	

PSEUDOTSUGA — DOUGLAS FIR

Pest	Product	Rate	Notes
INSECTS AFFECTING *PSEUDOTSUGA* (cont'd)			
Tarnished plant bug (*Lygus lineolaris*)	Actara 25WG, Flagship 25WG	210–280 g/ha	These are small (5 mm), yellowish-brown insects. Adults have wings that are folded in an X pattern. Tarnished plant bugs feed by inserting their mouthparts inside leaf tissue and sucking out the contents, leaving the lower and upper epidermis behind. The resulting injury appears as small, clear "windows" on leaf tissue of broad-leaved plants. On conifers, feeding often causes terminal growth to yellow and become distorted and bushy. Treat in spring and early summer to manage populations of this insect.
	Ripcord 400 EC	172 mL/ha	
DISEASES AFFECTING *PSEUDOTSUGA*			
Needlecast (various fungi)	Dithane DG, M-45, 80 WP	2.75–3.5 kg/ 1,000 L water	Various pathogens cause needlecast diseases on this host. Protect emerging needles in spring with fungicide to reduce fungal infections.

PYRACANTHA — FIRETHORN

Pest	Product	Rate	Notes
INSECTS AFFECTING *PYRACANTHA*			
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	
DISEASES AFFECTING *PYRACANTHA*			
Fire blight (*Erwinia amylovora*)	Copper Spray	1.25 kg/ 1,000 L water	Fire blight affects succulent vegetative growth. Dead, dry leaves persist on infected branches. Spray bactericidal products at early bloom, full bloom and petal fall when the weather is warm and humid and fire blight is a recurring problem. Avoid excessive pruning and nitrogen fertilization in spring. During dormancy, prune out infected branches about 30 cm below the cankered area when the tree is dry.
	Serenade Max	2–3 kg/ha	
Scab (*Spilocaea pyracanthae*)	Banner MAXX	14 mL/ 100 L water	Scab infection causes dark zones on leaves that develop into yellow lesions. Infected leaves may drop, and dull scabs may appear on twigs and fruit. Plant scab-resistant cultivars. Clean up and destroy fallen leaves. Prune to improve air circulation through the canopy. Start fungicide applications when leaf buds begin to break. Repeat every 7–10 days during mid-spring, especially in rainy weather. Apply Banner MAXX every 14 days, beginning when leaf buds are at the green tip stage. Rotate Banner with fungicides from other chemical families to avoid resistance. Do not exceed 4 applications of Banner per year. Stop treatments if no infection exists when foliage is hardened off.
	Daconil 2787 F	2.5 L/ 1,000 L water	

PYRUS — PEAR

Pest	Product	Rate	Notes
INSECTS AFFECTING *PYRUS*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are small, soft-bodied insects that suck plant sap from stems and leaves. Injury appears as distorted foliage, and plants may be severely weakened. Treat when aphids first appear, and repeat as required. Do not make more than 3 applications of Endeavor per year. Do not apply more than 3 kg/ha of Endeavor per year.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/1,000 L water	
	Endeavor	10–20 g/100 L water	
	Tristar 70 WSP	3 solupaks	
European red mite (*Panonychus ulmi*)	Dyno-Mite	284 g/ha in 1,000 L water	These mites overwinter as tiny red eggs on twigs. Apply horticultural oil when plants are dormant and continue applications until the plants reach the green tip stage and flower buds are in a tight cluster. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days.
	horticultural oil	20 L/ 1,000 L water	
	Kanemite 15 SC	2.07 L/ha	
	Vendex 50 W	0.5–1.0 kg/ 1,000 L water	
Pear rust mite (*Epitrimerus pyri*)	Dyno-Mite	284 g/ha in 1,000 L water	Adult females overwinter in bark crevices or cracks in twigs. When leaves begin to emerge, the overwintered females move to feed on the bud scales. Pear rust mites feed on the leaves and fruit, causing browning of foliage and russeting on the skin of the fruit. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days.
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	300 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	2.07 L/ha	
	Vendex 50 W	50–100 g/ 100 L water	

PYRUS — PEAR			
Pest	**Product**	**Rate**	**Notes**
DISEASES AFFECTING *PYRUS*			
Fire blight (*Erwinia amylovora*)	BlightBan A506	370–530 g/ 1,000–2,000 L water	Fire blight affects succulent vegetative growth. Dead, dry leaves persist on infected branches. Some cultivars are resistant to this disease. Spray bactericidal products at early bloom, full bloom and petal fall when the weather is warm and humid and fire blight is a recurring problem. Avoid excessive pruning and nitrogen fertilization in spring. During dormancy, prune out infected branches about 30 cm below the cankered area when the tree is dry. Blightban and Bloomtime are biopesticides that may help to suppress fire blight.
	BlightBan C9-1	370–530 g/ 1,000–2,000 L water	
	Bloomtime Biological	370–530 g/ 1,000–2,000 L water	
	Copper Spray	2.2 kg/ 1,000 L water	
	Kasumin 2L	5 L/ 1,000 L water (see label)	
	Serenade Max	2–3 kg/ha	
	Streptomycin 17	600 g/ 1,000 L water	
Pear trellis rust (*Gymnosporangium sabinae* [*G. fuscum*])	Nova 40 W	340 g/ 1,000 L water	Pear trellis rust affects all species of pear. It causes bright orange-red lesions on the leaves of pear trees that start to show around late spring–early summer. Over the summer months, the undersides of the leaf lesions develop swellings that later produce cream-coloured, lantern-shaped sporulating structures in early autumn. These spores travel to the alternate host, *Juniperus sabinae* (Savin juniper) and infect current season's growth, forming a perennial gall. The disease is carried over the winter in the juniper galls. These galls sporulate, producing orange, slimy projections during warm, wet conditions in early spring. The spores from the juniper galls can infect newly emerging leaves on pear trees, and the cycle begins again. This disease does not overwinter on pear and therefore cannot be carried on dormant pear nursery stock or on overwintering foliage. Pear trellis rust on pear requires annual infection by the juniper host galls each spring. Protect emerging foliage of pear trees before warm, wet conditions in early spring with fungicides. Where possible, flag sporulating galls on juniper and remove and destroy them when dormant. To reduce disease severity on established pear trees in the landscape, employ cultural methods that reduce soil compaction and increase soil moisture during drought periods.
	Pristine WG	1–1.6 kg/ha	

QUERCUS — OAK

Pest	Product	Rate	Notes
INSECTS AFFECTING *QUERCUS*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are small, soft-bodied insects that suck plant sap from stems and leaves. Injury appears as distorted foliage, and plants may be severely weakened. Treat when aphids first appear, and repeat as required. *Do not apply Kontos during bloom as this product is toxic to bee brood.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/1,000 L water	
	insecticidal soap	see label	
	*Kontos	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
Fall cankerworm (*Alsophila pometaria*) Spring cankerworm (*Paleacrita vernata*)	Dipel 132 ES	0.5–1.7 L/ha	Cankerworms are greenish-to-black loopers (inchworms) that appear early in the season and feed on leaves of many deciduous hosts. Place sticky bands around tree trunks, close to the ground, in the spring and fall. This traps adult females as they emerge from the ground and crawl up the tree trunk. Treat when larvae appear in mid-May, when *Acer platanoides* and *Magnolia* x *soulangiana* are blooming.
	Foray 48 B	1.0–1.6 L/ha	
	Malathion 500 EC	2.5 L/ 1,000 L water	
	Pounce	90 mL/ 1,000 L water	
	Thuricide	1.5–2.0 L/ 1,000 L water	
Golden oak scale (*Asterolecanium variolosum*)	Cygon 480 E	2 L/ 1,000 L water	Yellowish-golden scale feeds in small pits on white and English oak twigs, branches and trunks. Infestations can cause branch dieback. Use horticultural oil as a dormant treatment in early spring. Use any of the other materials against crawlers in late June. Crawlers can appear on first year and current season wood. Landscape Oil (horticultural oil) can be used when the plants are dormant or in the summer when foliage has fully expanded and hardened off. See product label for rates and tolerant plants.
	horticultural oil	20–30 L/ 1,000 L water	
	insecticidal soap	see label	
	Lagon 480	2 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	
Gypsy moth (*Lymantria dispar*)	AceCap 97	773 mg/ cartridge 1 cartridge per 10.16 cm	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs but prefer basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow). AceCap 97 applications must be made post-bloom, as this product is toxic to bees and bee brood.
	Dipel 132 ES	1.6–2.4 L/ha	
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	

QUERCUS — OAK			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *QUERCUS* (cont'd)			
Lacebug (*Coruthuca arcuata*)	Malathion 500 EC	1.25 L/ 1,000 L water	Lacebugs are flat, rectangular insects, 4–6 mm long with broad, transparent, lace-like wing covers. Adults and nymphs feed on the underside of leaves. The leaves become pale and mottled, with white splotches. Lower leaf surfaces develop black and brownish dots. Heavily infested leaves may turn entirely brown and fall off. Most species have 2 generations a year. Lacebugs usually occur on a single host. Other trees commonly attacked by lacebugs include elm, hickory, linden, sycamore and walnut. Apply insecticides to leaf undersides when insects first appear.
	Orthene 75 SP	see label	
Lecanium or European fruit lecanium (*Lecanium corni*)	horticultural oil	20 L/ 1,000 L water	This scale infests many deciduous trees and shrubs. When adults are mature in late spring/summer, they appear as a large, reddish-brown, spherical scale usually found on the underside of twigs. Use horticultural oil as early-spring dormant treatment to reduce populations of overwintering nymphs. To suppress crawlers, spray insecticides when the *Sambucus canadensis* begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	1 kg/ 1,000 L water	
	Pyrate 480 EC	2 L/ 1,000 L water	
	Trounce	50 L/ 1,000 L water	
Oak leaf gall (several species)	There is no product registered at the time of this publication.		Many gall makers infest oak roots, bark, twigs, leaves, flowers and acorns. Each gall has a characteristic appearance. Many are conspicuous and interesting, but few cause serious damage.
Oak leafminer (*Profenusa lucifex*)	Malathion 500 EC	1.4–3 L/ 1,000 L water	Oak leafminer larvae cause flat, blister-like mines from mid-June to July. Larvae are pale with stubby black legs and are found inside hollowed-out tissue within the leaf. Early treatment is most effective. Treat foliage to control larvae beginning the first week of June.
	Orthene 75 SP	see label	
Oak leaftier (*Croesia semipurpurana*)	There is no product registered at the time of this publication.		Small, whitish larvae enter unopened buds in May. They feed on the young leaves, then tie the leaves together and shred the tissue. Treat with insecticides to reduce populations of larvae when leaves are partially expanded.
Oak mite (*Oligonychus bicolor*)	horticultural oil	see label	Feeding from mites causes bronzing and bleaching of oak leaves. Treat upper leaf surfaces from mid-June to mid-July. These mites are closely related to spruce spider mites (same genus). Weather and predators often keep populations under control. Landscape Oil (horticultural oil) can be used when the plants are dormant or in the summer when foliage has fully expanded and is hardened off. See product label for rates and tolerant plants.
	Orthene 75 SP	see label	
Oak skeletonizer (*Bucculatrix ainsliella*)	Malathion 500 EC	2.5 L/ 1,000 L water	Small yellowish-green larvae skeletonize the lower surface of oak leaves. There is 1 generation in June and a second in August/September. Treat foliage when damage first appears in mid-June. Repeat in August. Collect and destroy leaves in the autumn to reduce overwintering populations.
Oak twig pruner (*Elaphidionoides villosus*)	There is no product registered at the time of this publication.		This is a long-horned beetle that attacks oak and some other deciduous trees. Larvae tunnel inside the twigs. Foliage on infested branches begins to wilt in mid-summer, and damaged twigs fall to the ground. Collect and destroy fallen twigs before mid-May and in the autumn to remove pupae. Chemical control is difficult and impractical.
Orangestriped oakworm (*Anisota senatoria*)	Malathion 500 EC	2.5 L/ 1,000 L water	The black larvae have orange or yellow stripes running lengthwise down the sides and back. Two stiff, black horns project from the top of the second body segment. There are small, sharp spines on the other body segments. If necessary, treat in August when larvae are young and concentrated on the lower branches.

QUERCUS — OAK

Pest	Product	Rate	Notes
INSECTS AFFECTING *QUERCUS* (cont'd)			
Red oak clearwing moth (*Paranthrene simulans*)	There is no product registered at the time of this publication.		Larvae bore into the wood of red oak trees, causing dieback in the canopy and sometimes tree mortality. Look for large holes with sawdust on tree trunks. Bore holes and tunnels often ascend up into the trunk. Insert a piece of flexible wire in the bore hole to destroy larvae. Adults are clearwing moths and resemble wasps when they are flying. Monitor adult populations with clearwing moth pheromone traps in late spring. High densities of pheromone traps may interrupt mating in small stands of red oak.
DISEASES AFFECTING *QUERCUS*			
Anthracnose (*Gnomonia quercina* or *Apiognomonia quercina*)	Daconil 2787 F	2.5 L/ 1,000 L water	This disease appears as irregular leaf-margin browning on red and white oak. Areas between veins also turn brown. Anthracnose often develops after a cool, wet spring. Collect and destroy fallen leaves in the fall. Do not crowd plants. Maintain adequate sunlight and good air circulation.
	Dithane DG, M-45, 80 WP	2.75–3.5 kg/ 1,000 L water	
	Manzate DF	2.75–3.5 kg/ 1,000 L water	
Leaf spot (several fungi)	Daconil 2787 F	2.5 L/ 1,000 L water	Well-defined brown or black spots appear on the leaves. Treat when plants are dormant or at bud swell. Do not crowd plants. Maintain adequate sunlight and good air circulation.
PHYSIOLOGICAL DISORDERS AFFECTING *QUERCUS*			
Chlorosis or leaf yellowing	A pesticide application would not be effective.		This is a physiological problem for pin oak (*Quercus palustris*) and red oak (*Q. rubra*) on high-pH soils (pH > 6). Chlorosis is also caused by poor soil conditions such as water logging and compaction.
Leaf scorch (physiological)	A pesticide application would not be effective.		Irregular browning appears on leaf margins and between veins in response to hot, dry conditions. It occurs late in the season and during dry weather.

RHODODENDRON — RHODODENDRON, AZALEA

Pest	Product	Rate	Notes
INSECTS AFFECTING *RHODODENDRON*			
Black vine weevil, Taxus weevil (*Otiorhynchus sulcatus*)	Demand CS	360 mL/ 1,000 L water	The weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larvae control is difficult. Adults are black snout beetles that hide in soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack arborvitae, euonymus, yew and hemlock. They are a significant pest in container production. The beetles have fused wing covers and cannot fly. To control adults, treat foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied in late summer/early autumn and in mid-spring to suppress larval populations. See product label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25WG	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Met 52	see label	
	Heterohabditis megidis	see label	
	Silencer 120 EC	300 mL/ 1000 L water	

RHODODENDRON — RHODODENDRON, AZALEA

Pest	Product	Rate	Notes
DISEASES AFFECTING *RHODODENDRON*			
Dieback, canker (*Phytophthora*)	Daconil 2787 F	2.5 L/ 1,000 L water	This canker is visible on the stem. Terminal buds and leaves turn brown, and leaves droop and curl. This pathogen may also affect the root and crown, resulting in water-soaked tissue that turns brown. Treat with Daconil as new leaves emerge. Repeat every 7–14 days during wet weather. Prune out infected branches, and avoid overhead irrigation late in the day. Do not crowd plants. Maintain adequate sunlight and good air circulation. Maintain media air porosity, and reduce watering where root rot exists. Do not grow near lilacs, a common host for this disease.
	Presidio	60–119 mL/ 380 L water	
	Previcur	see label	
	Torrent 400SC	see label	
	Truban 25% EC	see label	
	Truban 30% WP	see label	
Powdery mildew	Banner MAXX	35 mL/ 100 L water	Symptoms appear as white, powdery growth on the tops of leaves, especially during hot days and cool nights. Apply fungicides at the first sign of disease, and repeat every 10–14 days as required. Rotate fungicides with those from other chemical families to avoid resistance. Do not exceed a maximum of 4 applications per year.
	Heritage Maxx	0.4–1.6 L/ 1,000 L water	
	Nova 40 W	340 g/ 1,000 L water	
	Palladium WG	100g/ 100 L water	
Stem rot of cuttings	Captan 50 W	5–8 g/ 1 L water	Various fungi will cause a stem rot on *Rhododendron*. Protect cuttings with fungicides during the propagation phase and any time high moisture and humidity is a problem. When using Captan, dip cuttings for 20–30 min and drain before planting.
	Captan 80 WDG	5–9.4 g/ 10 L water	
Sudden oak death (*Phytophthora ramorum*)	Acrobat 50 WP	48 g/100 L water	Sudden oak death is a foliar blight and stem canker found on Camellia, Rhododendron, Pieris, Kalmia, Viburnum and Syringa. The Canadian Food Inspection Agency has designated it a quarantinable, regulated pest. Apply preventive fungicides to protect growth during cool, wet conditions. For resistance management, rotate Subdue MAXX with other fungicides that belong to a different chemical group. Apply Acrobat 50 WP in at least 200 L of water/ha. Micora gives suppression of Phytophthora ramorum.
	Aliette WG	5 kg/ha	
	Micora	300–600 mL/ 1,000 L water	
	Presidio	60–119 mL/ 380 L water	
	Subdue MAXX	7.8–15.6 mL/ 100 L water	

RIBES — CURRANT

Pest	Product	Rate	Notes
INSECTS AFFECTING *RIBES*			
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	2.1 L/ha	
	Vendex 50 W	50—100 g/ 100 L water	

ROBINIA — LOCUST

Pest	Product	Rate	Notes
INSECTS AFFECTING *ROBINIA*			
Locust borer (*Megacyllene robiniae*)	Pyrate 480 EC	500 mL/ 1,000 L water	Locust borer larvae are fleshy, white grubs that tunnel in black locust stems. Weakened trees break in the wind. The black and yellow beetles feed on goldenrod pollen in late summer. Remove and destroy heavily infested trees. Maintain tree vigour, since chemical control is difficult. Treat the bark or trunk and larger branches to control adult beetles from mid-August to late September when goldenrod is blooming.
Locust leafminer (*Odontota dorsalis*)	Orthene 75 SP	see label	In their adult and larval stages, leafminers feed on black locust leaves. Heavy infestations make trees unsightly. There are 2 generations a year. The adult is a small, wedge-shaped black beetle with bright orange wing covers. To control adult beetles, treat foliage in spring, when leaves open fully, and in early July.

ROSA — ROSE

Pest	Product	Rate	Notes
INSECTS AFFECTING *ROSA*			
Aphids (various)	Altus	500–700 mL/ha	Aphids are small, soft-bodied insects that feed by sucking plant sap from tissue. Feeding injury often causes distortion of growth. Aphids produce honeydew that attracts ants and sooty mould. Do not make more than 3 applications of Endeavor per year. Do not apply more than 3 kg of Endeavor/ha/yr. *Do not apply Kontos during bloom as this product is toxic to bee brood.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	Cygon 480 E	1.25 L/ 1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	insecticidal soap	see label	
	*Kontos	see label	
	Lagon 480 E	1 L/ 1,000 L water	
	Pyganic EC	2.32–4.65 L/ha	
	Tristar 70 WSP	see label	
	Trounce	50 L/ 1,000 L water	
Japanese beetle (*Popillia japonica*)	**Adult management:**		The adult beetles are metallic green and copper, about 13 mm long. They are easily recognized by six tufts of white hair on each side of the abdomen. As the beetles feed, they consume and skeletonize foliage. Preferred hosts include members of the rosaceous family, maple, birch, linden and fruit trees. Spray adulticides when adults appear in early July, when the *Yucca filamentosa* is blooming. Larvae are C-shaped, milky-white grubs about 25 mm long with brown heads and 3 pairs of legs. Japanese beetle larvae are distinguishable from other white grub species by a V-shaped arrangement of spines on the underside of the abdomen. Larvae are most commonly found feeding on the fibrous roots of turfgrass. Lorsban 4 E is a rescue treatment to allow shipping from infested to uninfested regions. Apply to the soil when grubs are young and actively feeding near the soil surface. Apply as a coarse spray, and irrigate with 1–2 cm of water to wash the insecticide into the underlying soil. For containerized stock, submerge the root ball into a solution of Lorsban 4 E (45 mL/10 L water) until all bubbling stops. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering.
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Larval management:		
	Intercept 60 WP	467 g/ha	
	Lorsban 4 E	4.5 L/ 1,000 L water (rescue treatment for shipping)	

ROSA — ROSE

Pest	Product	Rate	Notes
INSECTS AFFECTING *ROSA* (cont'd)			
Leafhopper (several species)	Actara 25WG, Flagship 25WG	105 g/ha	Leafhoppers are tiny, yellowish-green to pale-coloured insects that jump quickly when disturbed. Wingless nymphs will often "side step" quickly to hide from potential predators. Leafhoppers have piercing-sucking mouthparts that cause yellowish flecks on the leaf surface. Check regularly for infestation of nursery crops when neighbouring farms are cutting alfalfa or hay. Hang yellow sticky traps in the canopy to monitor for leafhoppers. Check by disturbing plants or looking at the leaf bottoms for leafhopper nymphs or molted skins. Treat as required.
	Altus	500–750 mL/ha	
	Tristar 70 WSP	5 solupaks	
Rose chafer (*Macrodactylus subspinosus*)	There is no product registered at the time of this publication.		Rose chafer adults are slender, long-legged, tan beetles. They are densely covered with short, dull-yellow hairs. Beetles swarm in early June and feed on the opening buds of many hosts. They later attack the flowers, fruit and foliage. The larvae feed mostly on turfgrass roots but may attack the roots of woody ornamentals. Monitor for rose chafer in June. It is often a problem in sandy soils. With small infestations, pick off beetles by hand. Adult control is difficult. Treat foliage thoroughly when beetles appear.
Roseslug (*Endelomyia aethiops, Allantus cinctus*)	insecticidal soap	see label	These sawflies feed on the undersides of leaves from late May to mid-June. Treat both leaf surfaces with insecticides. *A. cinctus* may need a second treatment in mid-to-late August.
	Trounce	50 L/ 1,000 L water	
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Cygon 480 E	1.25 L/ 1,000 L water	
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21 L/ 500 L water	
	Lagon 480	1 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Vendex 50 W	50–100 g/ 100 L water	
DISEASES AFFECTING *ROSA*			
Bacterial canker (*Pseudomonas syringae*)	Clean Crop Copper Spray	6 kg/ 1,000 L water	Bacterial canker appears as a blackening of new tissue and is often associated with low-temperature events. Do not crowd plants. Maintain adequate sunlight and good air circulation. Excessive fertilization or pruning can cause undesirable levels of succulent growth. Treat with copper once in October and once in January. Treat during warm, humid blight conditions in April and May with 1 g/L of active ingredient (2 g 50% wettable powder). Repeat at 7–10-day intervals.

ROSA — ROSE

Pest	Product	Rate	Notes
DISEASES AFFECTING *ROSA* (cont'd)			
Black spot (*Diplocarpon rosae*)	Banner MAXX	33 mL/ 100 L water	Black spot is a common disease on rose. It appears on leaves and stems as purplish-black spots with yellow halos. Leaves may turn yellow and drop. Where possible, use resistant cultivars. Remove and destroy cankered canes. Where disease occurs, use fungicides every 7–10 days from mid-May (as leaves begin to emerge) until frost kills the foliage. Apply Senator every 10–14 days, and rotate with fungicides from other chemical families to avoid resistance. Reduce spray intervals in cool, wet weather. Avoid overhead irrigation, especially late in the day. A 6-hr period of wet foliage will permit infection to start. Do not crowd plants. Maintain adequate sunlight and good air circulation. Tivano fungicide provides suppression only.
	Captan 50 W, Captan 50 WP	2–2.5 kg/ 1,000 L water	
	Captan 80 WDG	1.2–1.4 kg/ 1,000 L water	
	Clean Crop Copper 53 W	6 kg/ 1,000 L water	
	Compass 50 WG	15–20 g/ 100 L water	
	Daconil 2787	1.8 L/ 1,000 L water	
	Funginex DC	1 L/ 1,000 L water	
	Nova 40 W	340 g/ 1,000 L water	
	Rhapsody ASO	1.0–2.0 L/ 100 L water	
	Senator 70 WP	500–750 g/ 1,000 L water	
	Tivano	see label	
Botrytis (*Botrytis cinerea*)	Daconil 2787 F	1.8 L/ 1,000 L water	Botrytis can be an issue on roses in cold storage. Look for grey, velvety fungal growth on plants. Apply fungicide before lifting for storage. Repeat during storage. Apply fungicides at the first sign of disease, and repeat every 10–14 days if needed.
	Senator 70 WP	500–750 g/ 1,000 L water	
Botrytis flower blight (*Botrytis cinerea*)	Captan 50 W	2–2.5 kg/ 1,000 L water	Botrytis is a grey, velvety fungus that may grow on succulent tissue (e.g., flowers). Apply fungicides when the disease first appears, and repeat at 7–10-day intervals.
	Daconil 2787	1.8 L/ 1,000 L water	
Crown gall (*Agrobacterium tumefaciens*)	Dygall	160 g/ 50 L water	This gall appears as large, abnormal growths on stems and roots. Susceptible plants (*Euonymus*, *Rosa*, *Salix*) must be treated before disease exposure or final field placement. Wounding (e.g., pruning) and damaging plants facilitate entry and infection by this pathogen. Remove and destroy infected plants and soil. This is a soil-borne bacteria. Avoid planting susceptible species into soil with a history of this disease.
Downy mildew (*Peronospora sparsa*)	Acrobat 50 WP	48 g/ 100 L water	This fungus causes purplish to brownish blotches on the upper leaf surface. Under cool, moist conditions, slight symptoms of sporulation (fuzzy appearance) may be evident on the lower leaf surface below the lesion. These spores will disappear quickly once it warms up. Downy mildew infections often lead to premature leaf drop. Increase air circulation around susceptible plants, and reduce leaf wetness periods by watering only in the mid-morning.
	Heritage Maxx	400–800 mL/ 1,000 L water	
	Micora	300–600 mL/ 1,000 L water	
	Presidio	60–119 mL/ 380 L water	
	Torrent 400SC	see label	

ROSA — ROSE

Pest	Product	Rate	Notes
DISEASES AFFECTING *ROSA* (cont'd)			
Powdery mildew (*Sphaerotheca pannosa* var. *rosae*)	Banner MAXX	35 mL/ 100 L water	This fungus appears as a white, powdery growth on leaves and shoot ends. Leaves become stunted and curled. Treat when symptoms first appear. Apply fungicides every 10 days. Apply Nova every 10–14 days, and rotate with fungicides from other chemical families to avoid resistance. Senator can be applied every 10–14 days as needed. Do not apply sulphur when temperatures exceed 27°C. Do not crowd plants. Maintain adequate sunlight and good air circulation. Overhead watering during the day may reduce the spread and development of the disease, but avoid overhead irrigation late in the day. MilStop can be used for the suppression of powdery mildew. Start application of MilStop at the first sign of disease. Rhapsody is a biological fungicide that can help protect healthy tissues at the first sign of disease. Tivano fungicide provides disease suppression only.
	Clean Crop Copper 53 W	6 kg/ 1,000 L water	
	Folpan 50 WP	2 kg/ 1,000 L water	
	Funginex DC	1 L/ 1,000 L water	
	Heritage Maxx	0.4–1.6 L/ 1,000 L water	
	MilStop	2.8–6.5 kg/ 1,000 L water	
	Nova 40 W	340 g/ 1,000 L water	
	Rhapsody	1.0–2.0 L/ 100 L water	
	Senator 70 WP	500–750 g/ 1,000 L water	
	sulphur	see label	
	Tivano	see label	

SALIX — WILLOW

Pest	Product	Rate	Notes
INSECTS AFFECTING *SALIX*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are small, soft-bodies insects that feed by sucking on plant sap. Feeding causes distortion and weakens the plant. Treat when aphids first appear, and repeat as needed. Do not make more than 3 applications of Endeavor per year. Do not apply more than 3 kg of Endeavor/ha/yr.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/ 1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	

SALIX — WILLOW

Pest	Product	Rate	Notes
INSECTS AFFECTING *SALIX* (cont'd)			
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs but prefer basswood, birch, hawthorn, oak, poplar and willow. Females lay eggs in brown, fuzzy masses July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	
Imported willow leaf beetle (*Plagiodera versicolora*)	Malathion 500 EC	2.5 L/ 1,000 L water	Adults are small, oval, metallic-blue beetles. Adults and larvae skeletonize willow and Lombardy poplar leaves. There are 2 or more generations per year. Larvae are black, slug-like grubs. Treat at the first sign of leaf feeding after leaves appear, in late May to early June. Repeat the application in early July if necessary. A pupal parasite exists, so avoid insecticide applications at the time of pupation.
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
Poplar and willow borer (*Cryptorhynchus lapathi*)	Pyrate 480 EC	500 mL/ 1,000 L water	This borer is a stout, black, rough-bodied snout beetle with pink outer wing covers. The white, legless larvae honeycomb the trunks and larger branches of willows and poplars. Cut and destroy badly infected branches and trees before the end of June. Treat trunk and branch bark in mid-August and September with insecticides.
Spiny elm caterpillar (*Nymphalis antiopa*)	Malathion 500 EC	2.5 L/ 1,000 L water	Adult moths are called the "mourning cloak butterfly." Larvae are black with scattered white dots and are covered with large, branched spines. They feed in groups on elm, willow and poplar. Treat when caterpillars first appear and are small.
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of twice per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	

SALIX — WILLOW

Pest	Product	Rate	Notes
DISEASES AFFECTING *SALIX*			
Blight scab and black canker complex	There is no product registered at the time of this publication.		This fungal infection causes leaves to turn brown to black. Branches and twigs die back. Prune out infected wood. Do not crowd plants. Maintain adequate sunlight and good air circulation.

SORBUS — MOUNTAIN ASH

Pest	Product	Rate	Notes
INSECTS AFFECTING *SORBUS*			
European red mite (*Panonychus ulmi*)	horticultural oil	20–30 L/ 1,000 L water	Use horticultural oil as a dormant spray in early spring when plants show 2.5 cm of green tissue and flower buds are a tight cluster. Use other materials about mid-spring. Landscape Oil (horticultural oil) can be used when the plants are dormant. See product label for rates and tolerant plants.
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
Mountain ash sawfly (*Pristiphora geniculata*)	Malathion 500 EC	2.5 L/ 1,000 L water	Sawfly larvae are yellow with black spots on all body segments except the last one. There are four lines of spots along each side of the larvae. Two broken lines run down the back. Sawflies feed in colonies from June to early August. A second generation appears from late August to early September. Young larvae feed in colonies and are easily pruned out. Treat foliage to control larvae during late spring. Repeat the treatment in areas where the second generation appears in August.
Pearleaf blister mite (*Eriophyes pyri* or *Phytoptus pyri*)	horticultural oil	see label	Feeding injury from this mite causes small blisters on the leaf undersides of pear, apple and mountain ash. There are several generations per year. Mites overwinter under the outer bud scales, resuming activity in the spring. Apply horticultural oil as a dormant treatment in the spring. Landscape Oil (horticultural oil) can be used when the plants are dormant and, in some cases, as a summer application. See product label.
DISEASES AFFECTING *SORBUS*			
Fire blight (*Erwinia amylovora*)	Copper Spray	1.25 kg/ 1,000 L water	Fire blight affects succulent vegetative growth. Dead, dry leaves persist on infected branches. Spray bactericidal products at early bloom, full bloom and petal fall when the weather is warm and humid and fire blight is a recurring problem. Avoid excessive pruning and nitrogen fertilization in spring. During dormancy, prune out infected branches about 30 cm below the cankered area when the tree is dry.
	Serenade Max	2–3 kg/ha	

SYRINGA — LILAC

Pest	Product	Rate	Notes
INSECTS AFFECTING *SYRINGA*			
Japanese beetle (*Popillia japonica*)	**Adult management:**		The adult beetles are metallic green and copper coloured, about 13 mm long. They are easily recognized by six tufts of white hair on each side of the abdomen. As the beetles feed, they consume and skeletonize foliage. Preferred hosts include members of the rosaceous family, maple, birch, linden and fruit trees. Spray adulticides when adults appear in early July, when the *Yucca filamentosa* is blooming. Larvae are C-shaped, milky-white grubs about 25 mm long with brown heads and 3 pairs of legs. Larvae are distinguishable from other white grub species by a V-shaped arrangement of spines on the underside of the abdomen. Larvae are most commonly found feeding on fibrous roots of turfgrass. Lorsban 4 E is a rescue treatment to allow shipping from infested to uninfested regions. Apply to soil when the grubs are young and actively feeding near the soil surface. Apply as a coarse spray, and irrigate with 1–2 cm of water to wash the insecticide into the underlying soil. For containerized stock, submerge the root ball into a solution of Lorsban 4 E (45 mL/10 L water) until all bubbling stops. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering.
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Larval management:		
	Intercept 60 WP	467 g/ha	
	Lorsban 4 E	4.5 L/ 1,000 L water (rescue treatment for shipping)	
Lilac borer (*Podosesia syringae* var. *syringae*)	Pyrate 480 EC	500 mL/ 1,000 L water	Lilac borer larvae bore into the trunk near the base. Stressed trees are most susceptible to borers. Cut and destroy infested wood before May. Prevent mechanical damage to wood and bark. The adults are dark-brown, wasp-like moths, present from late May to late July. They emerge through holes 1–1.5 cm in diameter. They are clearwing moths and resemble wasps when flying. Use pheromone traps to monitor adult activity. Begin treatment 10 days after peak catch numbers. Treat trunk and large branches, especially around wounds. Repeat twice at 10-day intervals.
Lilac leafminer (*Caloptilia syringella* or *Gracillaria syringella*)	Cygon 480 E	1.25 L/ 1,000 L water	The adult is a small, dark-brown moth, active in late May to early June. Larvae are pale yellow and feed between leaf surfaces, causing brown blotches to form. For small infestations, pick and destroy affected leaves. Treat when pest activity first appears (immediately after flowering) and repeat 6 weeks later. Privet (*Ligustrum*) is an alternate host.
	Lagon 480	1.25 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
Oystershell scale (*Lepidosaphes ulmi*)	insecticidal soap	see label	Oystershell scale can be found on over 125 forest, shade, fruit and ornamental tree species. In heavy infestations, greyish scales completely encrust twigs and stems. This can cause branch and tree mortality. Mature females are 3 mm long and rounded at the rear, resembling oyster shells. Eggs overwinter under dead female shells, rendering them completely resistant to pesticides applied in fall or early spring (dormant applications of horticultural oil are ineffective). Use insecticides when crawlers are present in late May. Apply again 10 days later, about the time *Spiraea* x *vanhouttei* is blooming. Ensure good coverage of trunk, branches and leaf bottoms. Landscape Oil (horticultural oil) can be used in the summer when leaves are fully expanded and hardened off. See product label.
	horticultural oil	20–30 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see labell	
	Pyrate 480 EC	2 L/ 1,000 L water	

SYRINGA — LILAC			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *SYRINGA* (cont'd)			
White grubs: European chafer (*Rhizotrogus majalis*) June beetle (*Phyllophaga* sp.)	**Larval management:**		These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including *Cornus* sp.). To expose grubs to natural predators, cultivate infested fields before planting. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering. Apply Acelepryn any time that larvae are present or during the mating period/egg-laying period to egg-hatch.
	Acelepryn	5.6–8.8 mL/ 100 m^2	
	Lorsban NT	4.5 L/ 1,000 L water (rescue treatment for shipping)	
	Intercept 60 WP	467 g/ha	
	Lorsban 4 E	4.5 L/ 1,000 L water (rescue treatment for shipping)	
	Adult management:		
	Imidan 50 WP	1.25 kg/ 1,000 L water	
DISEASES AFFECTING *SYRINGA*			
Bacterial canker (*Pseudomonas syringae*)	Copper Spray	6 kg/ 1,000 L water (dormant rate)	In this disease, young shoots or leaves turn black between early spring and early summer, especially during wet, cool weather. Bacterial canker can kill young twigs during wet springs. It can be found on container-grown plants after plastic film has been removed from the cold frame in early spring. It is commonly found after low-temperature injury. Apply treatment once in October and again in January. During blight conditions in April and May, apply 1 g/L of active ingredient (2 g 50% wettable powder). Repeat at 7–10-day intervals. Avoid overhead irrigation late in the day. Prune out infected twigs. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Powdery mildew (*Microsphaera alni*)	Nova 40 W	340 g/ 1,000 L water	This white-to-grey powdery mould appears on leaves in late summer and early autumn. It does not usually require chemical control. Do not crowd plants. Maintain adequate sunlight and good air circulation. Overhead watering during the day may reduce the spread and development of this disease, but avoid overhead irrigation late in the day. Apply fungicide when first symptoms appear in mid-to-late August. Repeat at 5–10-day intervals. Do not apply sulphur when temperatures exceed 27°C.
	Palladium WG	100g/ 100 L water	
	sulphur	see label	
Rhizoctonia root rot	Heritage Maxx	0.4 L/ 1,000 L water	Rhizoctonia causes a stem blight and root rot at or below the soil line. Lab testing is needed to confirm the identification of this disease. Protect healthy plants with fungicides at the first sign of disease.
	Medallion	300–600 mL/ 1,000 L water	
	Compass 50 WG	3.8 g/ 100 L water	

TAXUS — YEW

Disease	Product	Rate	Notes
DISEASES AFFECTING *TAXUS*			
Black vine weevil, Taxus weevil (*Otiorhynchus sulcatus*)	Demand CS	360 mL/ 1,000 L water	The weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larvae control is difficult. Adults are black snout beetles that hide in lower branches and soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack arborvitae, hemlock, azaleas and rhododendrons. The beetles have fused wing covers and cannot fly. To control adults, treat foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. To test product safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied in late summer/early autumn and in mid-spring to suppress larval populations. See label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25WG	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Met 52	see label	
	Silencer 120 EC	300 mL/ 1000 L water	
Fletcher scale (*Lecanium fletcheri*)	Cygon 480 E	2 L/ 1,000 L water	The adult is a reddish-brown sphere that appears on branches. Look for black honeydew and black sooty mould on the needles in mid-to-late spring. Heavily infested plants look off-colour. Treat newly emerged crawlers in early July when *Yucca filamentosa* is blooming, or in September when the nymphs migrate. Repeat the application in about 10 days to catch all nymphs. Apply horticultural oils, with caution of phytotoxicity, when plants are dormant. Apply Landscape Oil (horticultural oil) to target crawlers when new foliage is fully expanded and hardened off. See product label for rates and tolerant plants.
	horticultural oil	see label	
	insecticidal soap	see label	
	Lagon 480	2 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
Taxus mealybug (*Pseudococcus cuspidatae* or *Dysmicoccus wistariae*)	Cygon 480 E	2 L/ 1,000 L water	Taxus mealybug is a slow-moving, white, woolly insect that can completely cover heavily infested branches and trunks with a waxy secretion. Feeding discolours needles and causes excessive needle cast. This mealybug attacks all yew species. Use insecticide on the bark of small branches and twigs to control nymphs when the *Aesculus hippocastanum* is blooming. See product label.
	insecticidal soap	see label	
	Lagon 480	2 L/ 1,000 L water	
	Malathion 500 EC	2.5 L/ 1,000 L water	
	Trounce	50 L/ 1,000 L water	

THUJA — EASTERN WHITE CEDAR, ARBORVITAE			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *THUJA*			
Black vine weevil, Taxus weevil (*Otiorhynchus sulcatus*)	Demand	360 mL/ 1,000 L water	The weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larvae control is difficult. Adults are black snout beetles that hide in soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack euonymus, hemlock, yew, azaleas and rhododendrons. They can be a significant pest in container production. The beetles have fused wing covers and cannot fly. To control adults, treat foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied in late summer/early autumn and in mid-spring to suppress larval populations. See label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25WG	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Met 52	see label	
	Silencer 120 EC	300 mL/ 1000 L water	
Cedar leafminer, Arborvitae leafminer (*Argyresthia thuiella* and other species)	Cygon 480 E	2 L/ 1,000 L water	Four caterpillar species mine cedar foliage, but *A. thuiella* is the most common. Feeding causes branch tips to turn brown. The adult is a small, light-grey moth that appears in late June to early July. Prune out infected tips before June to provide some suppression. To manage larvae, spray with Cygon in early May or late August. Use Malathion in June to suppress populations of adult moths.
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
Fletcher scale (*Lecanium fletcheri*)	Cygon 480 E	2 L/ 1,000 L water	The adult is a reddish-brown sphere that appears on branches. Look for black sooty mould and honeydew on the needles in mid-to-late spring. Heavily infested plants look off-colour. Treat newly emerged crawlers in early July when *Yucca filamentosa* is blooming or in September when the nymphs move around before settling on twigs and foliage. Repeat the application in about 10 days to catch all nymphs.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Trounce	50 L/ 1,000 L water	
Juniper scale (*Carulaspis juniperi*)	insecticidal soap	see label	This small, circular, white scale with a yellow centre causes juniper and arborvitae needles to turn yellow. Treat crawlers in late June when *Philadelphus* is at full bloom and *Catalpa* are beginning to bloom. Repeat as needed about 10 days later.
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	

THUJA — EASTERN WHITE CEDAR, ARBORVITAE

Pest	Product	Rate	Notes
INSECTS AFFECTING *THUJA* (cont'd)			
Spruce spider mite (*Oligonychus ununguis*)	Cygon 480 E	2 L/ 1,000 L water	Overwintered eggs hatch in early May, when *Amelanchier laevis* and *Magnolia* x *soulangiana* are in full bloom. Mites prefer older needles as feeding sites. To monitor for mites, use a hand lens to check the undersides of twigs and needles for tiny reddish eggs or brown mites with black backs. Shake a branch over a white sheet of paper and look for crawling specks. Apply miticides when mites first appear. Kanemite is effective against mobile life stages but may also reduce egg viability. Use horticultural oil as a dormant treatment in early spring to target eggs and newly hatched nymphs. Do not use horticultural oil on white pine or blue cultivars of Colorado spruce or juniper. Landscape Oil is a brand of horticultural oil that can be used on labelled plants in summer, when leaves are fully expanded and hardened off (see product label). If mite populations are still significant, make 2 applications of other miticides at 10-day intervals when mites exist in spring. Many predatory mites co-exist with pest mite populations. To conserve predatory mites, try miticides that have less impact on these beneficials, such as Vendex and Floramite.
	Floramite SC	625 mL/ 1,000 L water	
	horticultural oil	20 L/ 1,000 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Lagon 480	2 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375–500 mL/ 1,000 L water	
	Vendex 50 W	50–100 g/ 100 L water	
Strawberry root weevil (*Otiorhynchus ovatus*)	Met 52	see label	The weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark from larger roots. The reddish-brown flightless adult is less than 6 mm long and is much smaller than the black vine weevil. Adults hide during the day and feed at night. Adults are active in late June and early July, when *Wiegela florida* and *Syringa reticulata* are blooming. Adults injure plants by puncturing and girdling the current season's shoots while feeding. These pests have a large host range. Commonly injured plants include white cedar, spruce and juniper. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. To monitor for adults, wrap a sheet of burlap around infested plant bases. Adult weevils will hide in the burlap during the day. Place a white sheet under the plant, and shake the plant vigorously to dislodge any adults. Adults remain immobile during daylight hours and feed at night. Pounce is registered for use on seedlings. To test treatment safety, treat some conifer seedlings before treating a larger area.
	Pounce	see label	
Tarnished plant bug (*Lygus lineolaris*)	Actara 25WG, Flagship 25WG	210–280 g/ha	This plant bug is a small (5 mm), yellowish-brown insect. Adults have wings that form an X pattern when folded over their back. Tarnished plant bugs feed by inserting their mouthparts inside leaf tissue and sucking out the contents, leaving the lower and upper epidermis behind. The resulting injury appears as small, clear "windows" on leaf tissue of broad-leaved plants. On conifers, feeding often causes terminal growth to yellow and become distorted and bushy. Treat in spring and early summer to manage populations of this insect.
	Ripcord 400 EC	172 mL/ha	
White grubs: European chafer (*Rhizotrogus majalis*) June beetle (*Phyllophaga* sp.) Japanese beetle (*Popillia japonica*)	**Larval management:**		These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including *Cornus* sp.). To expose grubs to natural predators, cultivate infested fields before planting. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering. Apply Acelepryn any time that larvae are present or during the mating period/egg-laying period to egg-hatch.
	Acelepryn	5.6–8.8 mL/ 100 m^2	
	Lorsban NT	4.5 L/ 1,000 L water (rescue treatment for shipping)	
	Intercept 60 WP	467 g/ha	
	Adult management:		
	Imidan 50 WP	1.25 kg/ 1,000 L water	

THUJA — EASTERN WHITE CEDAR, ARBORVITAE

Pest	Product	Rate	Notes
DISEASES AFFECTING *THUJA*			
Botrytis (*Botrytis cinerea*)	Rovral 50 WP	1.5–2 kg/ 1,100 L water	During very humid conditions, a fuzzy, grey growth develops on infected plant parts. Treat twigs and buds in spring before new leaves emerge. Treat conifer seedlings at the onset of botrytis. Remove all fading and diseased plant parts promptly, especially when wet weather is predicted. Do not crowd plants. Maintain adequate sunlight and good air circulation.
Damping off, root rot and stem rot (*Phytophthora, Pythium*)	Heritage Maxx	0.4 L/ 1,000 L water	*Pythium* and *Phytophthora* cause root and stem rots during conditions of high humidity and moisture (e.g., propagation). Protect healthy tissue with preventive fungicides or treat at the first sign of disease. Subdue MAXX can be used as a drench or a pre-incorporated treatment for media to help protect conifer seedlings and transplants from *Pythium* and *Phytophthora*. See product label.
	Presidio	60–119 mL/ 380 L water	
	Previcur	see label	
	Subdue MAXX	1.2 L/ha in 200 L (drench)	
	Torrent 400SC	see label	
Leaf blight (*Didymascella thujina*)	Copper Spray	4 kg/ 1,000 L water	This leaf blight mainly attacks western red cedar (*Thuja plicata*). Apply fungicides at 10–14-day intervals starting at bud break to protect new growth.
	Dithane M-45, 80 WP	2.75–3.5 kg/ 1,000 L water	
	Manzate 200 DF	2.75–3.50 kg/ 1,000 L water	

TILIA — LINDEN, BASSWOOD

Pest	Product	Rate	Notes
INSECTS AFFECTING *TILIA*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are small, soft-bodied insects that suck plant sap. Feeding injury often causes distortion and weakens the plant. Apply insecticides at the first sign of aphids. Do not make more than 3 applications of Endeavor per year. Do not apply more than 3 kg of Endeavor/ha/yr. *Do not apply Kontos during bloom as this product is toxic to bee brood.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	*Kontos	see label	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Fall cankerworm (*Alsophila pometaria*) Spring cankerworm (*Paleacrita vernata*)	Dipel 132 ES	1.6–2.4 L/ha	Green and dark-grey inchworms (loopers, geometrids) can be found feeding on leaf undersides and edges in spring. Cankerworm can cause significant defoliation to deciduous trees. Treat with insecticides when larvae are small.
	Orthene 75 SP	see label	
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	

TILIA — LINDEN, BASSWOOD

Pest	Product	Rate	Notes
INSECTS AFFECTING *TILIA* (cont'd)			
Japanese beetle (*Popillia japonica*)	**Adult management:**		The adult beetles are metallic green and copper coloured, about 13 mm long. They are easily recognized by six tufts of white hair on each side of the abdomen. As the beetles feed, they consume and skeletonize foliage. Preferred hosts include members of the rosaceous family, maple, birch, linden and fruit trees. Spray adulticides when adults appear in early July, when the *Yucca filamentosa* is blooming. Larvae are C-shaped, milky-white grubs about 25 mm long with brown heads and 3 pairs of legs. Japanese beetle larvae are distinguishable from other white grubs by a V-shaped arrangement of spines on the underside of the abdomen. Larvae are most commonly found feeding on the fibrous roots of turfgrass. Lorsban 4 E is a rescue treatment to allow shipping from infested to uninfested regions. Apply to soil when grubs are young and actively feeding near the soil surface. Apply as a coarse spray, and irrigate with 1–2 cm of water to wash the insecticide into the underlying soil. For containerized stock, submerge the root ball into a solution of Lorsban 4 E (45 mL/10 L water) until all bubbling stops. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering.
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Larval management:		
	Intercept 60 WP	467 g/ha	
	Lorsban 4 E	4.5 L/ 1,000 L water (rescue treatment for shipping)	
Linden looper (*Erannis tiliaria*)	Malathion 500 EC	2.5 L/ 1,000 L water	Linden looper larvae are bright yellow with rusty-brown heads and 10 wavy black lines down the back. Larvae are present from early spring to early summer. This looper feeds on a wide variety of deciduous tree leaves. Band specimen trees with sticky trapping materials in late summer. This will trap wingless females as they climb up the trunk to lay their eggs. Treat foliage when larvae first appear.
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of 2 times per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha in 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	

TSUGA — HEMLOCK

Pest	Product	Rate	Notes
INSECTS AFFECTING *TSUGA*			
Black vine weevil, Taxus weevil (*Otiorhynchus sulcatus*)	Demand CS	360 mL/ 1,000 L water	The weevil larvae are small, white, legless grubs that eat fibrous roots or strip bark off larger roots. Infested plants grow slowly or fail to grow. They look dry and off-colour. Transplants often die without becoming established. Larvae control is difficult. Adults are black snout beetles that hide in soil litter during the day and cut crescent-shaped notches in needle margins at night. They also attack arborvitae, euonymus, yew, azaleas and rhododendrons. They can be a significant pest in container production. The beetles have fused wing covers and cannot fly. To control adults, treat foliage, trunk bark and branches during the last week of June and in early July. Spray in the evening, as adult activity increases about an hour after sunset. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., *Heterohabditis* sp.) are available to help suppress populations of larvae. Nematodes work very well in infested containers but with less success in the field. Nematodes can be applied in late summer/early autumn and in mid-spring to suppress larval populations. See product label for complete directions. To monitor for adults, place a piece of plywood around infested plant bases. Adult weevils will hide under the wood during the day. Or place a white sheet under the plant, and shake the plant vigorously to dislodge any adults.
	Flagship 25WG	10.5–14 g/ 100 L water	
	Heterohabditis bacteriophora	see label	
	Silencer 120 EC	300 mL/ 1,000 L water	
Eastern hemlock looper (*Lambdina fiscelleria*)	Foray 48 B	2.4–3.2 L/ha	This looper is 3 cm long, greyish and flecked with black dots. It prefers hemlock, balsam fir and white spruce but will feed on several other coniferous and broadleaf hosts. Apply Mimic to control early instar larvae. Allow 3–7 days for larval mortality. A second application of Mimic may be required.
	Mimic 240 LV	290 mL/ha	
Hemlock woolly adelgid (*Adelges tsugae*)	Landscape Oil	20 L/ 1,000 L water	This is a serious pest of eastern hemlock. Look for white egg sacs on the undersides of young twigs in early spring (April and May). It is the only adelgid species on hemlock with eggs sacs in early spring. Treat with multiple applications of contact insecticides when nymphs hatch, usually starting in early-mid May. Nymphs are tiny, blue, aphid-like insects that feed by sucking plant sap. Treat with injectable, systemic insecticides any time trees are actively transpiring.
White grubs: European chafer (*Rhizotrogus majalis*) June beetle (*Phyllophaga* sp.)	**Larval management:**		These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including *Cornus* sp.). To expose grubs to natural predators, cultivate infested fields before planting. Apply Intercept 60 WP once per year, during the mating period/egg-laying period and up to egg hatch (usually late June/early July in southern Ontario). In the field, sufficient irrigation (5–10 mm) should occur within 24 hr after application; avoid overwatering. Apply Acelepryn any time that larvae are present or during the mating period/ egg-laying period to egg-hatch.
	Acelepryn	5.6–8.8 mL/ 100 m^2	
	Lorsban NT	4.5 L/ 1,000 L water (rescue treatment for shipping)	
	Intercept 60 WP	467 g/ha	
	Adult management:		
	Imidan 50 WP	1.25 kg/ 1,000 L water	

ULMUS — ELM

Pest	Product	Rate	Notes
INSECTS AFFECTING *ULMUS*			
Aphids (various)	Altus	500–750 mL/ha	Aphids are small, soft-bodied insects that suck plant sap. Feeding injury often causes distortion and weakens the plant. Apply insecticides at the first sign of aphids. Do not make more than 3 applications of Endeavor per year. Do not apply more than 3 kg of Endeavor/ha/yr.
	Beleaf 50 SG	0.12–0.16 kg/ha	
	Closer	200 mL/1,000 L water	
	Endeavor	10–20 g/ 100 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	

ULMUS — ELM

Pest	Product	Rate	Notes
INSECTS AFFECTING *ULMUS* (cont'd)			
Elm bark beetle: European elm bark beetle (*Scolytus multistriatus*) Native elm bark beetle (*Hylurgopinus rufipes*)	Pyrate 480 EC	see label	Elm bark beetles are vectors of the Dutch elm disease fungus. The smaller European elm bark beetle feeds in the crotches of small twigs. The native elm bark beetle attacks rough-barked branches and stems, causing distinct gallery formations. Both are small, brownish beetles about 3 mm long. Destroy elms infected with Dutch elm disease before overwintering adult beetles emerge and lay eggs. To control beetles, treat on suitable days in March and April, before leaves appear on the trees. Apply a second treatment in late July.
Elm casebearer (*Coleophora ulmifoliella*)	Malathion 500 EC	2.5 L/ 1,000 L water	Overwintering casebearer larvae feed on emerging leaves. The larvae mine leaves. Heavy infestations cause leaf browning or scorching. All elms are potential hosts. Treat foliage in early June as mines begin to appear.
Elm flea weevil (*Orchetes alni*)	There is no product registered at the time of this publication.		Adult weevils overwinter in leaf litter and become active as leaves start to emerge in early spring. Adult flea weevils are very tiny (2–3 mm) and brown with black spots on their back. Adults feed on new leaves, and injury ranges from small holes to skeletonized leaves. Adults lay eggs in leaf veins, and larvae hatch to feed inside leaf tissue as leafminers do. Larvae are very tiny, white and legless. The preferred host is Siberian elm (*Ulmus pumila*).
Elm leaf beetle (*Pyrrhalta luteola*)	Orthene 75 SP	see label	The adult beetle is olive green with a dark stripe on each wing cover. The beetles chew holes in developing leaves, while the black larvae skeletonize the underside. They may attack all elm species. Treat the upper and lower leaf surfaces when they are about three-quarters expanded. Do not apply Orthene on American elm.
	Success	25 mL/ 1,000 L water	
Elm leafminer (*Fenusa ulmi*)	insecticidal soap	see label	Treat foliage around late May to early June to control larvae as mines first become apparent. For small infestations, mined leaves can be picked off and destroyed. The adults are tiny, black sawflies that appear in early spring. Spray insecticides to target adults.
European elm scale (*Gossyparia spuria*)	horticultural oil	see label	Overwintering scale nymphs become active in early spring. Crawlers are covered in white, waxy, cottony strands. By June, females can easily be recognized by the white margins around the scale. Treat when young crawlers have emerged in early summer. Horticultural oils can be used when plants are dormant. See the product label for rates and tolerant plants.
	insecticidal soap	see label	
European red mite (*Panonychus ulmi*)	Dyno-Mite	284 g/ha	These mites overwinter as eggs. Apply horticultural oils when plants are dormant. See product label for rates and tolerant plants.
	horticultural oil	20 L/ 1,000 L water	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
Fall cankerworm (*Alsophila pometaria*) Spring cankerworm (*Paleacrita vernata*)	Dipel 132 ES	1.6–2.4 L/ha	Green and dark-grey inchworms (loopers, geometrids) can be found feeding on leaf undersides and edges in spring. Cankerworm can cause significant defoliation to deciduous trees. Treat with insecticides when larvae are small. Do not use Orthene on American elm.
	Orthene 75 SP	see label	
Gypsy moth (*Lymantria dispar*)	Dipel 132 ES	1.6–2.4 L/ha	Gypsy moth larvae are dark, hairy caterpillars with five pairs of blue spots (tubercles) followed by six pairs of red ones along their backs. They feed in the spring and early summer, reaching about 6 cm long at maturity. They consume foliage of many trees and shrubs, most notably basswood, birch, hawthorn, oak, poplar and willow. Adult females lay eggs in brown, fuzzy masses in July and August. Remove and destroy egg masses before they hatch. Newly hatched larvae produce webs in order to disperse via wind to other hosts. Wait until larvae settle on hosts and begin feeding before applying Dipel or Foray. A folded burlap cloth wrapped around a tree provides a daytime shelter for larger larvae or pupae. Collect them from these shelters and destroy them. Orthene may damage sugar maple leaves. Success may be applied to larvae at any time during larval development. Dipel and Foray are most effective when sprayed before larvae become mature (before the head capsule turns yellow).
	Dragnet	230 mL/ 1,000 L water	
	Foray 48 B	2.4–4 L/ha	
	Imidan 50 WP	1.25 kg/ 1,000 L water	
	Orthene 75 SP	see label	
	Success	25 mL/ 1,000 L water	
	Thuricide HPC	7.14–12 L/ 1,000 L water	

ULMUS — ELM			
Pest	**Product**	**Rate**	**Notes**
INSECTS AFFECTING *ULMUS* (cont'd)			
Leafhopper (several species)	Actara 25WG, Flagship 25WG	105 g/ha	Leafhoppers are tiny, yellowish-green to pale-coloured insects that jump quickly when disturbed. Wingless nymphs will often "side step" quickly to hide from potential predators. Leafhoppers have piercing-sucking mouthparts that cause yellowish flecks on the leaf surface. Check regularly for infestation of nursery crops when neighbouring farms are cutting alfalfa or hay. Hang yellow sticky traps in the canopy to monitor for leafhoppers. Check by disturbing plants or looking at the leaf bottoms for leafhopper nymphs or molted skins. Treat as required.
	Altus	500–750 mL/ ha	
	Tristar 70 WSP	5 solupaks	
Lecanium or European fruit lecanium (*Lecanium corni*)	horticultural oil	20 L/ 1,000 L water	This scale insect infests many deciduous trees and shrubs. When adults are mature in late spring/summer they appear as a large, reddish-brown, spherical scale usually found on the underside of twigs. Use horticultural oil as an early-spring dormant treatment to reduce populations of overwintering nymphs. To reduce populations of crawlers, spray insecticides when the *Sambucus canadensis* begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
	insecticidal soap	see label	
	Malathion 500 EC	1.4–3 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	2 L/ 1,000 L water	
Two-spotted spider mite (TSSM) (*Tetranychus urticae*)	Apollo SC	80 mL/ha	TSSM overwinters as adult mites in the soil or media around host plants. It becomes active during warm weather (late spring in the field). Attacked leaves become dull-coloured, stippled or bronzed. Check the undersides of leaves for mites and webs. These mites are very tiny. A hand lens will be needed to see the two faint black spots on their backs. Treat leaf undersides with miticides/insecticides when mites appear, and repeat as needed. Monitor for mites by examining lower leaf surfaces with a hand lens or vigorously shaking a branch over a sheet of white paper and looking for tiny, moving specks. Apollo SC acts primarily on mite eggs but has an effect on young mobile stages as well. It is not effective against adult mites. Apollo SC should be applied when mite populations are predominantly in the egg stage, with few young nymphs present. Do not make more than 1 application of Apollo SC per season. Apply Dyno-Mite when mites first appear. Apply Dyno-Mite a maximum of twice per season at an interval of 28 days. Apply Kanemite as mites appear. Kanemite may reduce the viability of eggs. Two-spotted spider mite does not overwinter on the plant, and populations are not reduced with a dormant horticultural oil treatment.
	Dyno-Mite	284 g/ha 1,000 L water	
	Floramite SC	333 mL/ 1,000 L water	
	Forbid	30 mL/ 100 L water	
	insecticidal soap	see label	
	Kanemite 15 SC	0.21–0.46 L/ 500 L water	
	Vendex 50 W	50–100 g/ 100 L water	
DISEASES AFFECTING *ULMUS*			
Dutch elm disease (*Ceratocystis ulmi*) (*Ophiostoma ulmi*)	Arbotect 20-S	see label	This disease often begins as the wilting of large branches, sometimes on one side of the tree. Leaves turn yellow and begin to flag or droop. Stripping away bark reveals stained wood. Control elm bark beetles that carry fungus from diseased trees to healthy ones. Remove diseased and dead materials to control the beetle populations that breed in them. Arbotect 20-S is a trunk-inject unit that introduces a fungicide into the plant system. Arbotect 20-S is registered for use by trained arborists or others trained in trunk injection techniques. This product may be effective when used where: • less than of canopy is showing wilt symptoms • infested branches are removed at the first sign of wilt • leaves have fully expanded and the plant is actively transpiring (late May, June and early July)

VIBURNUM — VIBURNUM

Pest	Product	Rate	Notes
INSECTS AFFECTING *VIBURNUM*			
Snowball aphid (*Neoceruraphis viburnicola*)	Altus Beleaf 50 SG	500–750 mL/ha 0.12–0.16 kg/ha	This aphid overwinters as eggs in *Viburnum opulus* buds. It does not seem to infest other species of *Viburnum*. Overwintering eggs hatch as buds begin to open in the spring. Feeding causes severe leaf distortion and twists young shoots. Treat foliage when aphids first appear (about mid-May) and repeat as needed.
	Closer insecticidal soap	200 mL/ 1,000 L water see label	
	Malathion 500 EC	1.25 L/ 1,000 L water	
	Orthene 75 SP	see label	
	Pyrate 480 EC	375 mL/ 1,000 L water	
	Tristar 70 WSP	3 solupaks	
	Trounce	50 L/ 1,000 L water	
Viburnum crown borer (*Synanthedon viburni, S. fatifera*)	Rimon 10EC	1.4 L/ha	The larvae of this clearwing moth borer are cream coloured with a small brown head. They can be found boring in stems at the soil line (similar to peach tree borer). Signs of larval infestation include sawdust at the soil surface, disintegration of bark at the soil line, wilting and shrub dieback after it leafs out in spring. Rimon is registered as a direct application to the tree trunk and scaffold limbs. Maximum of 3 applications per growing season. Apply when economic thresholds are reached. Apply at 3 week intervals (21 days) starting 7-10 days after first adult moth trap catch. Remove and destroy infested plants before the larvae pupate (before mid-May). Pheromone traps are available to monitor for the adult stage of this pest.
Viburnum leaf beetle (*Pyrrhalta viburni*)	Flagship 25WG	280 g/ha	Adults and larvae of this beetle skeletonize foliage of Viburnum opulus, European cranberry and their cultivars. Eggs overwinter in twigs of last year's growth. Larvae hatch and begin feeding on leaf undersides as leaves emerge in the spring. Apply insecticides when larvae are newly hatched. Flagship 25WG is toxic to bees; avoid applications of Flagship when *Viburnum* is blooming. Prune out and destroy terminal shoots (containing eggs) before May 1.
	Success	25 mL/ 1,000 L water	
DISEASES AFFECTING *VIBURNUM*			
Downy mildew (*Peronospora viburni*)	Acrobat 50 WP	48 g/ 100 L water	Symptoms of this disease appear as angular lesions between leaf veins. The undersides of leaves have a woolly appearance caused by fungal growth. Plants often defoliate in response to infection. Downy mildew needs moist conditions and cool or warm (not hot) temperatures. Do not crowd plants. Maintain adequate sunlight and good air circulation. Avoid overhead irrigation late in the day. Collect and destroy infected plant material.
	Heritage Maxx	400–800 mL/ 1,000 L water	
	Micora	300–600 mL/ 1,000 L water	
	Presidio	60–119 mL/ 380 L water	
	Torrent 400SC	see label	
Powdery mildew (*Microsphaera sparsa*)	Daconil 2787 F	2.5 L/ 1,000 L water	This fungus appears as a white, powdery growth on the tops of leaves. Apply fungicides at the first sign of disease. Do not crowd plants. Maintain adequate sunlight and good air circulation. Overhead watering during the day may reduce the spread and development of the disease. Avoid overhead irrigation late in the day. Apply fungicides when symptoms are first noticed, in mid-summer. Reapply at 5–10-day intervals.
	Palladium WG	100g/ 100 L water	

3. Crop Protection: Weeds

CHEMICAL WEED CONTROL

Selective and non-selective herbicides may be used to control weeds. Use selective chemicals to control weeds in crops. Use non-selective chemicals to control perennial weeds or weeds on land not in crops such as roadsides, fencerows and areas that are difficult to cultivate. A list of herbicides registered for weed management in nursery crops (Tables 4–1 and 4–2) and a list of herbicides registered for weed management in specific woody crops (Table 4–3) are provided later in this chapter.

Herbicide Licensing Requirements

An exterminator's licence is required to apply herbicides for commercial use. Any person operating an extermination business must hold an operator's licence. For further information about pesticide licensing or to obtain an application package, please contact the Ministry of Environment, Conservation and Parks, Environmental Assessment and Approvals Branch:

Toronto: 416-314-8001
Toll Free: 1-800-461-6290

In April 2009, the Ministry of the Environment amended the *Pesticides Act* with the *Cosmetic Pesticides Ban Act, 2008*, and Ontario Regulation 63/09. Pesticides are now classified for sale and use under 12 different classes. Note that agriculture (including nursery production) is excepted. There is also an exception for the use of pesticides to maintain the health of trees. For more information on the legislation, see the Ministry of Environment, Conservation and Parks' website at ontario.ca/pesticides.

Applying Chemical Herbicides

To successfully control weeds, the correct amount of herbicide must be applied uniformly over the target area. While small areas can be treated with a garden sprayer or even a watering can, power equipment will be required for larger areas. Whatever application method is used, it is important to wet all weed foliage.

Herbicides are applied as emulsions, solutions or suspensions. The volume to apply per hectare depends on the herbicide being used and the crop being treated. Generally, apply low volumes (50–200 L/ha) of postemergent chemical solutions on emerged weeds. Higher volumes (150–300 L/ha) are usually required for preemergent herbicides. Read the herbicide label and manufacturer's recommendations for the correct volume and pressure.

General Precautions

Selective weed control requires precision spraying equipment, expertly used.

Herbicide drift can damage nearby plants. High-pressure, small-nozzle tips, herbicide dusts and herbicide mists increase the risk of damage. Take all possible precautions to prevent drift from treated areas into non-target areas.

Never apply herbicides in enclosed structures (cold frames or greenhouses) unless the manufacturer specifically recommends this use.

Equipment used with 2,4-D–like chemicals must never be used to spray other solutions on 2,4-D–susceptible crops.

To minimize drift, do not apply herbicides using mist sprayers or air-blast sprayers in agricultural areas of Ontario.

Herbicide Drift

Herbicides can drift away from the intended target, damaging neighbouring plants and crops and impacting the environment. Drift injuries depend on the extent of herbicide escape and the susceptibility of the crops or plants it reaches. High-pressure sprayers and windy conditions increase the danger of drift.

When spraying herbicides, always guard against physical spray drift and vapour drift. Physical spray drift occurs when wind carries spray particles away from the intended target areas. Vapour drift comes from herbicide evaporation or volatilization. Vapours can escape during application or from droplets deposited on plant or soil surfaces. In addition to causing damage, vaporization reduces herbicide effectiveness.

To minimize drift, do not spray in hot weather, windy weather or when humidity is low. Use low pressures, larger nozzles and a higher water volume. Since large droplets drift less than small ones, use the largest droplet size that gives the desired coverage and distribution. To choose nozzles that produce large droplets, follow these guidelines:

- A nozzle with a narrow spray angle produces large droplets.
- A larger orifice produces larger droplets.
- A lower operating pressure produces larger droplets.

When to Use Herbicides

Apply herbicides when both crop resistance and weed susceptibility are high. The timing depends on the herbicide, the weeds to be managed and the crop. Several different terms describe when herbicides may be applied. Unless otherwise stated, these terms refer to the crop plant's developmental stage.

Application Technology

Herbicide application should be a precision operation. Recent advances in equipment and control systems can make the job relatively simple and precise.

Pesticides applied incorrectly may result in wasted pesticide, poor or no control, damage to crops (possibly the neighbour's) or environmental contamination. Every effort must be made to apply chemicals properly.

For detailed information on best practices in the safe, efficient and effective operation of agricultural sprayers, check www.Sprayers101.com. Sprayers 101 has practical information from industry professionals on sprayer settings, nozzles, coverage, maintenance, pesticide mixing, drift and more. A Sprayers 101 downloadable manual is also available.

Developments in New Equipment

In building sprayers that accurately apply herbicides, equipment manufacturers work closely with the crop-protection industry. Innovations, such as closed-injection systems with herbicide concentrate carried separately from the water carrier, are now in use. Electronic rate controllers provide more accurate spray application by utilizing speed sensors, flow controllers and microprocessors to maintain the desired application rate. This technology has also included radar to accurately sense true ground speed of the sprayer. Rate controllers are commonly used by professional applicators. GPS guidance control systems with possible auto steer allow sprayers to cover the field with minimal overlap swath to swath. This allows for complete field spray coverage while not double applying product in certain areas.

The industry is currently working towards the closed-injection system. Work continues in the area of drift reduction using air assist and electrostatic spray methods.

Air-induction nozzles significantly reduce spray drift and are available in a range of sizes from a number of suppliers. Operating these nozzles within their working pressure range is crucial to ensure designed spray angle development, proper air induction into the nozzle and necessary droplet size for the job at hand. Before buying air induction spray tips, make sure your sprayer pump can produce sufficient pressure to operate these tips under all conditions. Check with the nozzle manufacturers for operating pressures required. Most nozzle manufacturers produce a variety of air induction nozzles, including both low-pressure and high pressure designs.

Sprayers for Small Areas

Use a 9–14 L knapsack or compressed-air garden sprayer on small areas. A nozzle tip producing coarse spray minimizes spray drift. Keep spray pressure low. Although many smaller sprayers can create pressures up to 700 kPa, high pressures produce smaller spray droplets that can drift in light winds to susceptible garden plants. If the sprayer is to be used for herbicides, it should only be used for herbicides and not for other types of pesticides.

To find out what products are excepted for use around the home in Ontario, check the Ministry of the Environment, Conservation and Parks' website ontario.ca/pesticides.

Field Sprayers

The most common type of sprayer used in herbicide application is the boom sprayer. This sprayer applies a uniform amount of spray solution across the width of the boom.

The main requirements for field spraying are:

- uniform pressure across the whole boom
- nozzles that all have the same output and a good spray pattern
- a constant forward speed in actual field conditions
- the ability to adjust boom height so that the required nozzle-to-target height can be achieved
- a stable boom height to ensure proper overlap of the nozzle-tip patterns

Most commercially built sprayers can be adapted and used safely to apply liquid fertilizers. Extra agitation may be required. Ensure that the sprayer components being used will resist the corrosive nature of some fertilizer formulations and follow the manufacturer's recommendations.

Air-Blast or Mist Sprayers

These machines should never be used to apply herbicides, especially hormone-type herbicides such as 2,4-D. The danger of causing off-target crop injury at a great distance from the treated area is very high.

Wiper Applicators for Selective Weed Control

Wiper applicators (rope-wick, roller applicator or similar devices) containing glyphosate can be used when the target weeds are taller than the crop so as to avoid contact with a crop sensitive to that herbicide. Other products may exist that can be wick applied. Refer to intended product labels for use of this application technique. The main criteria for using wiper applicators are:

- contact enough of the target plant to get herbicidal effectiveness
- keep the wick application above the crop to avoid crop injury

Travel speeds should be 4–10 km/h for wick application. Two passes in opposite directions may be beneficial, especially in heavy weed infestations and where higher vehicle speed is contemplated. Care must be taken not to contact sucker growth in orchards, vineyards and shelterbelts. This may result in crop injury.

Care and Use of Equipment

Spraying Speeds

Since herbicides must be uniformly applied, the forward speed of a sprayer must be constant whenever the nozzles are delivering liquid. If the driving wheels of a tractor slip on the soil surface, the tractor's speedometer does not indicate a change in forward speed. To be certain that the forward speed is constant in spite of wheel slippage on hills or loose soil, use an independent speedometer powered by a non-driven wheel or use newer radar or GPS speed sensors. Spray monitors and other electronic rate controllers also may be installed. Only rate controllers will automatically adjust for variation in tractor speed to maintain a constant rate of application.

Water

Use only clean water that contains no debris, soil or organic matter. On your farm water supply, use a frost-free water hydrant located outside a building. An anti-backflow or anti-siphon valve should always be installed on any hydrant or water supply. Never allow the suction screen to rest on the bottom of a farm pond while filling a sprayer. The intake line near the screen must, by law, be equipped with a spring-loaded check valve or anti-backflow device to prevent contamination of the pond or stream when the pump is shut off. Tank-refilling nozzles, volume-booster nozzles or injection pumps should not be used to refill the sprayer tank from farm ponds or streams. These tank-refilling aids may cause pond or stream contamination.

Agitation

When chemical formulations in solution are used (e.g., 2,4-D and water) at least 2–14 L of spray solution should be returned to the tank each minute to provide adequate agitation. Higher rates will apply with wettable powders. To be effective, the agitation line from the pump should pass through a control valve and deliver the liquid to the bottom (not the top) of the tank. Agitation propellers, agitation nozzles or a sparge tube should always be used to ensure sufficient liquid circulation in the tank.

When wettable powder herbicides are used, the return to the tank should be 14–27 L/min for each 450 L of tank capacity. A dedicated line from the pressure side of the pump (not the pressure regulator) to the tank must be used to supply the

liquid necessary for hydraulic agitation in the tank. Always use a venturi jet or sparge tube. This flow can be reduced if the sprayer has a mechanical agitator. Sparge tube agitation requires more water than venturi nozzles to give the same agitation.

Preparing a Wettable Powder and Oil or Emulsifiable Concentrate Mix

To prepare a tank mix of wettable powder and an oil or emulsifiable concentrate, follow these steps (unless the product label states differently):

1. Fill the sprayer tank with water to the half-full mark.
2. Start the agitator.
3. Add a pre-mixed slurry of wettable powder and water.
4. Agitate for 2–3 minutes before adding more water.
5. Add the oil or emulsifiable concentrate last.

Avoid excessive agitation of the mixture, as it may turn into an invert emulsion, a grease-like mass that will settle to the bottom of the tank and cannot be pumped. Excessive agitation may also cause foaming, resulting in pumping problems. To prevent a build-up of oil in the sprayer, the tank should be emptied completely before refilling. After any break in the spraying operation, agitate thoroughly before resuming operation. Immediately after use, clean the tank and sprayer with a detergent or solvent and flush with clean water.

Pumps

The pump is the most important part of the sprayer and should have adequate capacity to maintain the desired pressure, volume and agitation. Piston, diaphragm and centrifugal pumps are best for pumping wettable-powder suspensions. For liquid herbicide applications, roller pumps may be used in addition to the above types. When used for wettable powders or flowable formulations, choose a pump with an abrasion resistant housing. Carefully follow the manufacturer's care and storage instructions for the best pump performance.

CAUTION: Running a spray pump without water may cause damage or premature wear.

Nozzle Tips

Numerous companies make spray nozzles. Nozzles from different suppliers may be similar in design but may differ in set-up requirements. Always follow the manufacturer's recommendations for nozzle spacing and nozzle-to-target distances. These distances may vary according to the spray angle of the nozzle. Proper spacing and orientation of nozzles is essential to ensure adequate overlap of adjacent nozzle spray plumes.

Care should be taken to maintain a stable boom height to ensure uniform overlap of the nozzle spray patterns.

The success of the spray application is dependent in part on the condition of the nozzle tips and the uniformity of application across the whole spray boom. The spray pattern of all nozzles should be examined prior to their use. In addition, every nozzle should be checked when calibrating the sprayer.

Materials used for nozzle tips include brass, stainless steel, hardened stainless steel, as well as plastics/polymers and ceramics. All product formulations and carriers cause wear of the nozzle orifice. Wettable powders cause abrasive wear, more than other formulations.

Sprayers should be calibrated regularly. (See *Sprayer Calibration*, on page 98.)

Nozzle tips should be replaced when they deliver 10% more than the manufacturer's rated output specifications or when their distribution pattern becomes unacceptable.

Flat-Fan Nozzle Tips

Flat-fan nozzle tips work well with boom-type herbicide sprayers. Flat-fan tips may be colour-coded for size (i.e., output). Some colour-coded tips have stainless steel, ceramic or plastic/polymer inserts or are used for specialized applications. Always read manufacturers' labels carefully. Set spacings, boom height and pressure according to the manufacturer's recommendations. Unless the instructions state otherwise, maintain spray pressure at 275 kPa for standard elliptical-orifice flat-fan tips. Some flat-fan nozzle tips operate at a reduced pressure of approximately 140 kPa. These tips reduce the risk of drift.

Maintain a full overlap spray pattern by using 110-series flat-fan nozzle tips (instead of 80-series tips) with the same 51-cm spacing and the same height as the 80-series tips. This reduces misses in the event the boom bounces while crossing rough ground. Special "even spray" nozzle tips are available for herbicide band applications. The spray bandwidth is controlled by a combination of the nozzle's tip height, the spray angle and the orientation to the direction of travel. Follow the manufacturer's directions closely.

Flooding-Fan Nozzle Tips

Flooding-fan nozzle tips have a wide spray angle. They can be used closer to the ground and at lower pressures than flat-fan tips. This reduces drift. Flooding-fan nozzle tips come in brass, plastic/polymers and stainless steel. They cover roughly twice the width as flat-fan nozzle tips. However, they tend to distribute herbicides less evenly than flat-fan tips.

Broadcast Nozzle Tips

Broadcast nozzle tips cover a very wide swath. Use broadcast nozzle tips for lanes and fencerows where a uniform spray pattern is not needed. Never use a broadcast-type nozzle tip near a susceptible crop. The spray may drift severely with even a light breeze.

Full and Hollow Cone Nozzle Tips

Use full or hollow cone nozzle tips to spray the soil surface when the herbicide is incorporated into the soil with a disk harrow, cultivator or similar tillage implement.

> **NOTE:** When using any nozzle for spraying wettable powders or micronutrients, it is essential to calibrate the sprayer frequently because, as a nozzle wears, the quantity of spray material delivered increases, and distribution is uneven. Worn nozzles usually result in a poor spray pattern.

Nozzle Screens

Ball-check and plain nozzle screens are available. Ball-check screens use a diaphragm check valve on each nozzle to minimize dripping from the boom. Never mix screen types in a spray boom, since different screen types produce different flow rates through the nozzle. Always clean nozzle screens thoroughly. Using protective gloves, remove them from the nozzle body and wash them with soap, water and a bristle brush. Flushing water through the boom and nozzles will not remove pesticide residue build-up on the nozzle screens.

Cleaning the Sprayer

Before cleaning the sprayer, dispose of surplus tank mix. As suggested in the Grower Pesticide Safety Course, one method of disposal is to dilute the remaining spray solution at least 10:1 with water. This diluted solution can be applied to the previously treated area as long as the maximum labelled product rate is not exceeded.

Clean out the sprayer immediately after finishing the day's work or when changing chemicals. At the end of each spray day, thoroughly flush out the boom with plenty of water to rinse lines, diaphragm check valves and nozzles. Delaying clean-out, even overnight, can allow the formation of hard-to-remove deposits. The sprayer tank is much more difficult to clean out if it is allowed to dry. Don't forget to also clean out the measuring containers.

Steps

1. Read the product label to determine the recommended cleaning procedure. Have all the materials required for the clean-up ready, including appropriate personal safety equipment.
2. Drain the spray tank.
3. Fill the tank with water and add detergent, ammonia or other tank cleaner product and agitate for 10–20 minutes (clean the whole tank, not just the bottom half). Flush boom and hoses with solution, allow to stand for several hours (or overnight if possible) and then flush boom and nozzles again and drain the tank. When flushing the boom, open the boom ends to get particles out of the boom.
4. Inspect the inside of the tank for visual residues. Rinse the inside of the tank if necessary. Repeat step 2.
5. Wash the outside of the sprayer with soap or mild detergent and water.
6. Remove nozzles and screens, and wash them separately in a bucket containing cleaning solution. Wash out measuring containers with the cleaning solution.
7. Remove all boom end plugs or caps. Product residues collected in the ends of the various boom pipe sections could cause crop injury. Thoroughly clean out the plugs or caps and pipe ends with cleaning solution. Carefully replace all the boom end plugs or caps.

Thoroughly rinse the tank, hoses, booms, nozzles and screens with clean water for a minimum of 10 minutes. Repeat immediately before the next use.

Use household detergent at rate of 250 mL/100 L or 1 kg/150 L of water. Use ammonia (3%) at 1 L/100 L of water. Use other cleaning agents according to label directions. Never mix ammonia with chlorine bleach. Chlorine gas is produced, which may cause severe eye, nose, throat or lung irritation.

NOTE: Contact the manufacturer of pesticides being used to determine the best methods and product(s) to clean residue from tanks and associated equipment. Read the label, since many products provide specific tank-cleaning information on their label.

When surfactants or fertilizer solutions (e.g., AGRAL 90, 28% UAN) are used in a labelled mix with herbicides, there may be some inadvertent cleaning of previous residues from the tank/equipment that could affect the crop. Proper clean-out when changing products is essential to prevent crop injury.

The wash water contains herbicide. Never allow wash water to run into a well, lake, pond, river or other water source.

Do not leave puddles of herbicide solution, tank cleaning water or rinse water that may be accessible to children, pets, farm animals or wildlife.

Environmental Issues When Cleaning

Equipment used with phenoxy herbicides (e.g., 2,4-D, MCPA) must never be used to spray other types of solutions on phenoxy-susceptible crops or garden plants. Never store these products near greenhouses or other areas with susceptible crops. The wash water contains herbicide. Never allow wash water into a well, lake, pond, river or other water source. For more information, see the Pesticide Application and Safety section at ontario.ca/crops.

Sprayer Calibration

Field Boom-Type Sprayer Calibration — Determining application rates in L/ha.

There are many ways of determining the rate of spray material that is being applied to 1 ha of land.

Instructions

1. Measure the time.
   - Place 2 stakes 50 m apart in the field.
   - Select the gear and throttle setting (rpm) at which you plan to spray. Half-fill the sprayer with water.
   - Drive the distance between the stakes 3 times, timing each pass. Each time, make sure the tractor is at the desired speed as you pass the first stake. Continue driving at this speed until you pass the second stake.
   - Note the average time of the 3 passes.
2. Measure the average nozzle output.
   - Park the sprayer with the PTO engaged and the throttle adjusted to reach the PTO speed set in the test run.
   - Adjust the pressure regulator to the desired working pressure with full flow to the boom.
   - Collect the output from each nozzle for the average length of time needed to travel the 50 m in the test run.
   - Enter the nozzle outputs into the equation below.
   - If any nozzle is more than 10% above or below the average output, it should be cleaned, re-tested and, if still 10% off, replaced.
3. Measure the nozzle spacing in metres.
4. Use the following formula to determine the sprayer output:

$$\text{Application rate (L/ha)} = \frac{(\text{mL of liquid per nozzle}) \times 0.2}{\text{nozzle spacing (m)}}$$

5. Calculate the area sprayed per full tank of spray solution. Re-check the sprayer calibration after each tank of spray is applied by dividing the volume sprayed by the area sprayed. The nature of some products may slightly alter the calibration from that of clean water.
6. Growers who are more comfortable with litres/acre or gallons/acre can use the following conversion guide.

   Litres/hectare × 0.4 = L/acre
   Litres/hectare × 0.09 = Imp. gal/acre
   Litres/hectare × 0.11 = U.S. gal/acre

Sample Calculation

Aver. time to travel 50 m (164 ft)	= 24.5 sec
Aver. amount of liquid collected per nozzle for 24.5 sec	= 525 mL
Nozzle spacing on the boom	= 0.5 m (~ 20 in.)
210 L/ha × 0.4	= 84 L/acre
210 L/ha × 0.09	= 18.9 imp. gal/acre
210 L/ha × 0.11	= 23 U.S. gal/acre

Band Spraying: The same formula can be used to calibrate when banding. Instead of using nozzle spacing in metres, use width of area sprayer per nozzle in metres.

NOTE 1: Sprayer-calibration bottles or kits are available from a number of suppliers. For further information contact your local office of the Ontario Ministry of Agriculture, Food and Rural Affairs or manufacturers of sprayers, sprayer parts or herbicides.

NOTE 2: For banded-spray applications, measure the width of the spray band (at the soil surface or surface of the crop canopy) and enter this value into the formula instead of the "nozzle spacing." Note that in band spraying, the acreage sprayed is NOT the same as the crop acreage (When broadcast spraying a row crop with 1-m rows, the whole field is treated. A band spray may only treat 30 cm over each row. Therefore, only about one-third of the field is actually treated.). The herbicide rates referred to in most herbicide publications and labels refer to the actual area sprayed unless otherwise stated.

Hand-Held/Backpack Sprayer Calibration

Many people use small hand-held or backpack sprayers for treating problem areas or spraying areas that were missed. Calibration of these sprayers is as important as calibrating your field sprayer.

Method I

1. Measure an area that is 100 m^2 — e.g., 10 m × 10 m or 25 m × 4 m
2. Fill the spray tank with water. Mark the level on a measuring stick. Pump to the pressure that will be used during the pesticide application.
3. Spray the water over the 100 m^2 area. Walk at a steady pace, taking care to apply it as evenly as possible, just as you would when applying pesticide.
4. Measure the amount of water needed to refill the spray tank to the mark on the measuring stick. This amount will be the sprayer output per 100 m^2.

Method II

1. Set 2 stakes 50 m apart in the field.
2. Half-fill the sprayer with water.
3. Walk the 50 m 3 times at a steady pace. Calculate your average time to travel the 50 m.
4. Measure the width of the band sprayed by the nozzle (in metres) at your walking pace.
5. Pump the sprayer for the same amount of time as calculated in step #3, collecting the liquid from the nozzle in a measuring device.
6. Use the following formula to determine the sprayer output:

$$\text{Application rate (L/ha)} = \frac{(\text{mL of liquid per nozzle}) \times 0.2}{\text{nozzle spacing (m)}}$$

Method III

1. Partially fill sprayer. Pump to the pressure you will use during the pesticide application.
2. Spray to determine width of swath (in metres).
3. Walk at a steady pace for 15 seconds. Measure the distance (in metres).
4. Multiply spray width times distance travelled to provide the area (in square metres) sprayed in 15 seconds.
5. Spray into a measuring device for 15 seconds – gives amount of solution sprayed in 15 seconds.
6. Use the following formula to determine the sprayer output:

$$\text{Application rate (L/ha)} = \frac{\text{amount sprayed}}{\text{area (length} \times \text{width)}} - \frac{\text{L} \times 10{,}000}{\text{m}^2}$$

To convert the application rate of any pesticide to the amount required for a small area, follow this guide:

- solids: 1 kg/ha = 10 grams/100 m^2
- liquids: 100 L/ha = 1 L/100 m^2

(*Source: Ontario Pesticide Education Program Manual 1995*).

Determining Amount of Herbicides Needed

Determining Amount of Product Required per Hectare

Most rates suggested in this publication are given in terms of both active ingredients (common name) per hectare and product (TRADE NAME) per hectare. However, where the amount of active ingredient in the formulations varies considerably (e.g., glyphosate is available in concentrations of 360 g/L, 480 g/L, 500 g/L and 540 g/L), the rate may be given in terms of active ingredient only.

NOTE: Throughout this publication, the common name of each herbicide (its active ingredient) is printed in lowercase letters (e.g., atrazine, dicamba), whereas the product trade name (the name of the liquid or powder etc., inside the container as supplied by the manufacturer) is printed in capital letters (e.g., AATREX, BANVEL II), and its formulation is listed within brackets following the trade name.

Determining Amount of Product Required per Tankful

After determining how much commercial product is needed per hectare, calibrate the sprayer and determine the number of hectares each tank will cover. Determine the quantity of herbicide needed to add to the spray tank using the following formula:

Area covered per tankful
= sprayer tank size (L)/application rate (L/ha)
= hectares

Product required/tank
= hectares covered by tank × product rate/ha

Sample Calculations

(a) product/tank = 4.1 ha × 2.2 kg/ha
= 9.02 kg LOROX/tank

(b) product/tank = 4.1 ha × 2.1 L/ha
= 8.61 L AATREX/tank

Materials, Mixing and Mixtures

Dry herbicide formulations include granules, soluble powders and wettable powders. Granules do not require prior mixing into a slurry. They are ready to be mixed in water. Soluble powders can be dissolved in water. Wettable powders will not dissolve but will form a suspension that requires constant agitation. Follow the manufacturer's recommendations on mixing order and procedures.

Liquid herbicide formulations either mix in water to form a solution or may be oil-based and form an emulsion that will require agitation.

Pesticide labels usually provide mixing directions for registered tank-mixes, often describing the order of mixing. Whenever a label provides mixing directions, they should be followed. Consult the package labels for information on the compatibility of different herbicide products as certain formulations may react when mixed together, resulting in materials with different properties and activities than the original ones. If the pH or hardness of the water requires adjustment, adjustments should be made prior to the addition of spray material to the tank.

When the label does not provide mixing instructions for a registered tank-mix, pesticides should generally be mixed using the following procedure:

- Fill the spray tank with water to half of the total spray volume required and start agitation. Add the different formulation types in the order listed below, allowing time for complete mixing and dispersion after adding each product.
  1. dissolvable packs
  2. wettable powders
  3. water-dispersible granules and dry flowables
- Maintain agitation and fill spray tank to three-quarters of total spray volume. Then add:
  4. water-based solutions
  5. emulsifiable concentrates
  6. spray adjuvants
- Finish filling the spray tank to the required volume. Maintain continuous agitation during mixing and final filling, and throughout application.

Mixtures of different herbicides or mixtures of herbicides with pesticides or foliar fertilizers should not be applied in a single application unless registered for use in this way.

Unless specifically mentioned in this publication or on a herbicide label, the addition of a surfactant or a detergent to a spray solution is not recommended.

Where water is known to have an excessive salt content, compatibility of the water and the chemical at field strength should be tested first on a small scale. See note on "Agitation" in the section on *Care and Use of Equipment* section, page 95.

Application Indicators

Colourants/Foam Markers for Pesticides Application

Colourants added to the pesticide solution help show where pesticides have been applied. Foam marking systems help minimize overlap. Adding a colourant to the basal sprays of herbicides on cut stumps of woody plants helps assure thorough coverage without respraying. Examples of colourants are listed below:

- Blazon: blue, water soluble
- Bas-oil Red: red, oil soluble
- Red Dye Foam

Colourants are available from agricultural chemical dealers.

A COMPENDIUM OF HERBICIDES WITH THEIR RECOMMENDED USES IN ONTARIO — AS OF JANUARY 1, 2019

All listed products are registered for the listed purpose. The order in which products appear does not constitute a preference ranking. Information is presented as it appears on the product label.

Classification of Pesticides for Sale and Use in Ontario

In April 2009, the Ministry of the Environment amended the *Pesticides Act* with the *Cosmetic Pesticides Ban Act, 2008*, and Ontario Regulation 63/09. Pesticides are now classified for sale and use under 12 different classes. It should be noted that agriculture (including nursery production) is excepted. For more information on the legislation, see the Ministry of Environment, Conservation and Parks website at ontario.ca/pesticides.

Notes on Herbicides

These notes are listed below as a reference for applicators. Complete information on each herbicide is available on the product label located on the herbicide container. The federal Pest Management Regulatory Agency also provides pesticide labels under their "Search Pesticide Labels" section at www.pmra-arla.gc.ca. Many herbicide manufacturers also list product labels and/or material safety data sheets (MSDS) on their websites. For a list of herbicides registered on nursery crops in Ontario, see *Table 3–1. Herbicides Registered for Nursery Crops in Ontario (by Trade Name)* and *Table 3–2. Herbicides Registered for Nursery Crops in Ontario (by Common Name)*. Lists of ratings of weed susceptibility to herbicides for broadleaf annuals, broadleaf perennials and annual grasses can be found later in this chapter.

Table 3–1. Herbicides Registered for Nursery Crops in Ontario (by Trade Name)

Trade Name	Common Name
AIM	carfentrazone-ethyl
AMITROL	amitrole
AUTHORITY	pyroxasulfone, sulfentrazone
BASAMID	dazomet
BONANZA	trifluralin
BROADSTAR	flumioxazin
CASORON	dichlobenil
DACTHAL	chlorthal dimethyl
DEVRINOL	napropamide
DUAL II MAGNUM	s-metolachlor
FRONTIER MAX	dimethenamid-p
GALLERY	isoxaben
GARLON	triclopyr
GOAL 2XL	oxyfluorfen
GRAMOXONE	paraquat
KATANA	flazasulfuron
KERB	propyzamide
PRINCEP NINE-T	simazine
RIVAL	trifluralin
PROWL H2O	pendimethalin
RONSTAR	oxadiazon
ROUNDUP	glyphosate
SIMADEX	simazine
SUREGUARD	flumioxazin
SPECTICLE	indaziflam
TREFLAN	trifluralin
VAPAM	metam sodium
VENTURE L	fluazifop-p-butyl

Table 3–2. Herbicides Registered for Nursery Crops in Ontario (by Common Name)

Common Name	Trade Name
amitrole	AMITROL
carfentrazone-ethyl	AIM
chlorthal dimethyl	DACTHAL
dazomet	BASAMID
dichobenil	CASORON
dimethenamid-p	FRONTIER MAX
flazasulfuron	KATANA
fluazifop-p-butyl	VENTURE L
flumioxazin	BROADSTAR, SUREGUARD
glyphosate	Various products (including ROUNDUP)
isoxaben	GALLERY
indaziflam	SPECTICLE
metam sodium	VAPAM
napropamide	DEVRINOL
oxadiazon	RONSTAR
oxyfluorfen	GOAL 2XL
paraquat	GRAMOXONE
propyzamide	KERB
pendimethalin	PROWL H2O
pyroxasulfone, sulfentrazone	AUTHORITY
s-metolachlor	DUAL II MAGNUM
simazine	PRINCEP NINE-T, SIMADEX
triclopyr	GARLON
trifluralin	BONANZA, RIVAL, TREFLAN

PREPLANTING TREATMENTS

Some preplant herbicides act on germinating seedlings, while others kill weed seeds in addition to seedlings. Apply preplant herbicide treatments before sowing or planting the crop. Incorporate preplanting herbicides (e.g., Treflan) into the soil soon after application. Incorporation instructions are provided on the label.

Soil Fumigants

Fumigants generally control nematodes and soil diseases. At higher application rates, they can also control weeds.

Before applying fumigants for nematode control, have the soil tested for nematode count. See *Appendix E, Diagnostic Services*, on page 138, for sampling instructions. Ensure that nematodes are the problem before using chemicals. Carefully follow the fumigant manufacturer's directions for dosage and methods of use. Wear a suitable respirator and full protective gear when using fumigants. Telone, Vapam, Vorlex and methyl bromide are extremely toxic to the applicator.

To use preplant fumigants effectively:

- Fumigate in the fall when soil temperatures are above 4°C. Fumigant dispersal improves at warmer soil temperatures (above 15°C).
- Remove trash and old root systems.
- Work the soil to a depth of 25–30 cm. Soil moisture is important for fumigant efficacy.
- Inject the fumigant about 30–40 cm deep.
- Pack or water immediately after injection to seal the soil surface.
- Ideally, leave the soil undisturbed until spring. If fall planting is necessary, delay it until at least 1 week after the fumigant injection.
- Work and aerate the soil for about a week before planting. Colder soils (below 15°C) require longer periods between injection and aeration. For fall planting, aerate the soil for at least 2 weeks after working.
- Fall ryegrass has been recently linked with high populations of root lesion nematodes. To avoid this problem, try using non-traditional types of annual cover crops such as pearl millet and sorghum. Italian ryegrass may also be an option because it is a poor host for root lesion nematode.

The following chemicals may be used as preplant treatments.

Common Name: dazomet

Trade Name: **BASAMID**
Chemical Family: **dithiocarbamate**

Rates of Application

dazomet	500.0 kg/ha
BASAMID (98 Gr)	510.0 kg/ha

Sensitive Weeds

Most germinating weed seeds.

Uptake and Translocation

Breaks down on contact with soil moisture and releases toxic gases that control germinating weed seeds.

Basis of Selectivity
Non-selective. Chemical must dissipate completely from the seedbed before planting, otherwise, crop injury may occur.

Application Methods
Apply granular product to a well-worked seedbed and incorporate evenly. Seal soil immediately after incorporation by rolling and flooding or by covering with heavy polyethylene plastic and sealing the edges. After waiting 10–40 days, depending on soil temperature, aerate the soil. Conduct a safety germination test before using the treated soil. Do not use when soil temperature is below 6°C. See the manufacturer's directions for specific details on sealing soil, evacuating gases and performing the safety germination test.

Residual Activity
Depends on the rate applied, soil moisture and soil temperature. The gases are toxic to all growing plants. Perform a safety germination test before planting.

Unique Characteristics
Also controls unencysted nematodes and soil fungi.

Manufacturer: Mitsui & Co. (Canada) Ltd.

Common Name: metam sodium

Trade Name: **VAPAM**
Chemical Family: **thiocarbamate**

Rates of Application

metam sodium	1,250.0 kg/ha
VAPAM (380 g/L)	3,287.5 L/ha

Remarks
Use on field replant sites of ornamentals and forest tree stock. For summer and fall treatment of seedbeds, plant beds, lawns, greenhouses and other limited areas.

Sensitive Weeds
Most scarified weed seeds and fleshy vegetative parts, including rhizomes and germinating seedlings. Vapam controls germinating weed seeds such as annual grasses, Bermuda grass, chickweed, dandelion, henbit, Johnson grass, lamb's-quarters, pigweed, purslane, ragweed and wild morning glory. It suppresses perennial weeds such as quackgrass. It also controls nematodes and symphylans (the garden centipede) as well as soil-borne fungus diseases, particularly damping-off and root rot, including diseases caused by species of *Rhizoctonia*, *Pythium*, *Fusarium*, *Phytophthora*, *Verticillium*, *Sclerotinia*, oak root fungus and clubroot of crucifers.

Basis of Selectivity
Most plant parts are sensitive. Do not plant crops until all fumigant dissipates from the soil. When moisture is present, Vapam releases methyl isothiocyanate gas. This kills most scarified seeds and fleshy vegetative parts (including rhizomes and germinating seedlings).

Application Methods
Apply as a drench to soil, wetting at least 8 cm deep. Apply uniformly using injectors, water or other incorporation tools that carry the product to the desired depth. It may be applied via the irrigation system. No gas-proof cover is needed unless the soil is very porous. Apply water via sprinklers to provide a surface water seal. Do not plant for 10–14 days (or longer if the weather is cool). To prevent crop injury, make sure all traces of toxic gas have dissipated from the treated soil before planting crops.

Residual Activity
Expect 10–40 days of residual activity, depending on soil temperature and the amount of organic matter in the soil. Vapam persists longer if temperatures are low or organic matter levels are high. Plant crop at least 12–16 days after treatment following a lettuce seedling bioassay that indicates no injury.

Unique Characteristics
Also controls nematodes, soil fungi and soil insects.

Manufacturer: Amvac Chemical Corp.

Common Name: chlorthal dimethyl

Trade Name: DACTHAL W-75
Chemical Family: phthalate
Site of Action: Group 3

Rates of Application

Field applications

chlorthal dimethyl	5.02–16.88 kg/ha
DACTHAL	6.75–22.5 kg/ha

Remarks

Use on established nursery stock: abelia, alyssum, baby's breath, barberry, candytuft, deutzia, English ivy, euonymus, feverfew, forsythia, gladiolus, holly, juniper, locust, maple, marigold, oak, peony, petunia, salvia, spiraea, sycamore, tulip tree, walnut, weigela, willow and yew. Can also be used on established ornamental plantings (e.g., flower gardens).

Do not use on bugleweed, button pink, carnation, celosia, germander, geum, mesembryanthemum, pansy, phlox, snapdragon, sweet William, telanthera or *Vinca minor*.

Sensitive Weeds

Carpetweed, common chickweed, common lamb's-quarters, green foxtail, groundcherry, large crabgrass, lovegrass, purslane, redroot pigweed, smooth crabgrass, witch grass and yellow foxtail.

Uptake and Translocation

Absorbed by roots, not foliage. Not translocated through the plant.

Basis of Selectivity

Inhibits growth of germinating seeds.

Application Methods

Must be applied before weed seed germination. Rain or irrigation is needed for activation. Remove all existing weeds before application, as only germinating weeds will be controlled.

Residual Activity

Average half-life is 100 days in most soil types. Effective weed control can be maintained for as long as 2 months.

Manufacturer: AMVAC Chemical Corporation

Common Name: dichlobenil

Trade Name: CASORON G-4
Chemical Family: nitriles
Site of Action: Group 20

Rates of Application

Field applications

dichlobenil	4.4–7 kg/ha
CASORON (4 Gr)	110–175 kg/ha

Container applications

dichlobenil	4.4 kg/ha
CASORON (4 Gr)	110 kg/ha

Container bed preparation

dichlobenil	4.4–7 kg/ha
CASORON (4 Gr)	110–175 kg/ha

Remarks

Use on field woody nursery stock: ash, birch (cutleaf weeping), boxwood, caragana, crabapple, eastern red cedar, eastern white cedar (arborvitae), elm, euonymus, forsythia, heather, holly (*Ilex* sp., except *I. crenata*, *I. rotunda*, *I. vomitoria*), honeysuckle, juniper, lilac, linden, locust, maple, mock orange, rhododendron, rose, spirea, willow and yew.

Use only on specific container woody nursery stock: *Juniperus chinensis*, *J. horizontalis* and *Thuja occidentalis* only.

Do not use on: ajuga, fir (*Abies* sp.), gladiolus, hemlock, *Ilex crenata*, *I. rotunda*, *I. vomitoria*, mugo pine or spruce.

Do not use on: herbaceous perennials (all plants that die down to the ground in the fall).

Use cautiously on: shallow-rooted ground covers (euonymus can be treated with this product).

Sensitive Weeds

Most weeds are susceptible to, or suppressed by, dichlobenil, including perennials, vetch and horsetail.

Uptake and Translocation
Absorbed by roots and rapidly translocated upward in the plant. Casoron inhibits cell growth at the growing points or meristematic tissues of the plant. Weed germination and growth initiation is strongly affected.

Basis of Selectivity
Selectivity is based on the physical separation between the dichlobenil vapour layer in the top 5 cm of soil and the established crop roots below this level.

Application Methods
Apply as a preemergence treatment to susceptible weeds, preferably in the fall or early spring. Apply to cool, moist soil.

Container nursery stock: Use only on containers growing outside. Apply at least 4 weeks after planting into containers with a weed-free surface. Do not use after September 15 or within 30 days of placing treated stock in overwintering structures.

Container bed preparation: Apply to bare soil before putting container pots onto the bed. For best results, apply to soils containing more than 2% organic matter. Dichlobenil provides inconsistent weed control on gravel or sandy soils. Apply in spring on a cool day and incorporate immediately using irrigation or mechanical methods. Do not cover polyhouses with plastic for 1 month after application. Do not apply in plastic-covered polyhouses or greenhouses. Do not transplant seedlings into treated soils until at least 1 year after application.

Residual Activity
May persist and provide weed control for 2–6 months. Higher rates and applications following use in previous years may cause soil residues to persist for more than 1 year.

Unique Characteristics
Although applied as a granular herbicide, it kills with a vapour layer in the topsoil profile. Weed roots take up the herbicide when entering this zone. Do not apply to very warm soils, since high temperatures volatilize the herbicide and prevent weed control.

Manufacturer: Chemtura Canada Co.

Common Name: dimethenamid-p

Trade Name: **FRONTIER MAX**
Chemical Family: **chloroacetamide**
Site of Action: **Group 15**

Rates of Application

dimethanamid-p	0.54–0.69 kg/ha
FRONTIER MAX	0.756–0.963 L/ha

Remarks
Frontier Max herbicide will control labelled annual grass weeds and certain broadleaf weeds in and around field, liner and container nurseries of commercial ornamental production. Frontier Max is used as preemergent or preplant incorporated herbicide. Frontier Max does not control weeds that have already emerged.

Established Container or Field-Grown Nursery Stock: Apply as a directed spray. Do not make over-the-top applications. Do not apply during bud swell, bud break or at time of first flush of new growth. If newly budded or grafted rootstock is to be sprayed, make an application using a shielded sprayer. Care must be taken to ensure there are no cracks in the soil where Frontier Max herbicide could come in contact with the roots.

Newly Transplanted Container or Field-Grown Nursery Stock: Apply as a directed spray. Do not make over-the-top applications. Use a shielded sprayer until plantings have been established for 1 year or more in the field. Do not apply until transplants have been watered and the soil has been thoroughly packed and settled around transplants. Care must be taken to ensure there are no cracks in the soil where Frontier Max herbicide could come in contact with the roots. For container-grown ornamentals, delay the first application of the product to bareroot liners or young seedlings (e.g., plugs) for 2 weeks after transplanting. Do not apply during bud swell, bud break or the first flush of new growth. Direct sprays away from grafted or budded tissue on transplants at all times.

Applications can be made to ornamental plant species such as: *Abies fraseri*, *Acer rubrum*, *Buxus sempervirens*, *Fraxinus pennsylvanica*, *Hydrangea macrophylla*, *Ilex cornuta*, *Ilex crenata*, *Juniperus* sp., *Lagerstroemia indica*, *Magnolia*

grandiflora, *Pseudotsuga menziesii*, *Rhododendron* sp., *Rosa* spp., *Spiraea vanhouttei*, *Taxus media*, *Thuja occidentalis*, *Thuja plicata.*

Do not apply Frontier Max herbicide during spring growth of conifers or injury to terminals may occur. Do not apply more than one application of Frontier Max herbicide per season. Before treating a large number of plants, spray a few plants and observe for 1–2 months for plant damage prior to full-scale application.

Sensitive Weeds
Barnyard grass, crabgrass (smooth, large), eastern black nightshade, fall panicum, foxtail (green, yellow, giant), old witchgrass and redroot pigweed. Use 963 mL/ha of Frontier Max herbicide for control of eastern nightshade and redroot pigweed.

Uptake and Translocation
Not readily translocated in the plant, so application placement and coverage are important.

Basis of Selectivity
Frontier Max inhibits the growth of seedling shoots (grasses) and roots (broadleaf). Susceptible grasses often fail to emerge from the soil. The mode of action is not well understood. This herbicide affects various biochemical processes in the plant and interferes with normal cell development.

Application Methods
Frontier Max is used as preemergent or preplant incorporated herbicide. Frontier Max herbicide will provide most effective weed control when applied and subsequently incorporated into soil by rainfall or mechanical tillage before weed seedlings emerge from the soil. Frontier Max herbicide treatments are most effective in controlling weeds when adequate rainfall or overhead irrigation is received. If Frontier Max herbicide is not activated by rainfall or irrigation within 30 days, erratic weed control may result.

Residual Activity
Provides season-long weed control. The length of residual activity depends upon soil and moisture factors, application rate and timing. Heavy rainfall following an incorporated treatment may reduce weed control.

Manufacturer: BASF Canada Inc.

Common Name: flazasulfuron

Trade Name: KATANA 25 WG
Chemical Family: sulfonylurea
Site of Action: Group 2

Rates of Application

flazasulfuron	37.5 to 50 g/ha
KATANA (25WG)	150 to 200 g/ha

Remarks
Katana 25WG Herbicide is a selective herbicide for preemergence and postemergence control of certain broadleaf weeds and grasses in conifer trees (ornamentals, Christmas trees, conifer release and forestry). Katana 25WG Herbicide may be applied to container and field grown Conifer Trees (ornamental production and Christmas trees) or for use in forestry for conifer release. Tolerant cultivars include: *Abies balsamea, A. concolor, A. fraseri, A. grandis, A. procera, A. nordmanniana, Cupressocyperis leylandii, Picea abies, P. pungens, Pinus resinosa, P. strobus, P. sylvestris and Pseudotsuga menziesii*.

Do not apply more than one application per year. Do not apply to conifer seedbeds. Do not apply to trees within 1 year of seeding. Directed sprays must not be made to conifers that have new growth or are not sufficiently hardened off.

Sensitive Weeds
Grasses, broadleaf weeds, yellow nutsedge.

Uptake and Translocation
Absorbed through the root and foliage of plants.

Basis of Selectivity
Best results are obtained when weeds are small and actively growing. Broadleaf weeds should be no larger than 5 to 10 cm and grasses should be no taller than 10 cm and prior to first tillering.

Application Methods
Weed growth stops within hours after the application, however progress from discoloration or chlorosis to necrosis generally requires from 2 to 4 weeks. Speed of control is generally a function of weather with faster action during warmer weather and actively growing weeds. The best control is obtained when Katana 25WG Herbicide is applied either to weeds just prior to germination or to young, actively growing weeds. For optimal

herbicidal activity, prior to application, the bed or soil surface should be reasonably even and clear of crop and weed residue. Before herbicide application, crop and weed residue can be mixed into the soil through cultivation, or removed by blowing the area to be treated. Any practices that cause disturbance of the soil surface after herbicide treatment will decrease herbicidal activity.

Residual Activity
Length of control is a function of environmental factors such as soil type, soil moisture, temperature and amount of moisture after the application.

Unique Characteristics
For preemergence application, rainfall or irrigation is needed for herbicide activation. If rainfall does not occur within 2 weeks after a preemergence application, then 0.5 to 1.25 cm of irrigation water should be applied. Do not apply more than 2.5 cm of irrigation water.

Manufacturer: ISK Biosciences Corporation

Common Name: flumioxazin

Trade Name: **BROADSTAR G, SUREGUARD WDG**

Chemical Family: **N-phenylphthalimide**

Site of Action: **Group 14**

Rates of Application

Field applications

flumioxazin	143–215 g/ha
SUREGUARD WDG	280–420 g/ha

Container applications

flumioxazin	0.21–0.42 kg/ha
BROADSTAR G	84–168 kg/ha

Remarks
Use BroadStar granular herbicide for preemergent weed control on outdoor, container-grown woody ornamentals. Apply BroadStar herbicide before target weeds germinate or immediately after disturbing the soil surface. BroadStar herbicide can be safely applied over the top of many species of woody ornamental shrubs and trees, providing the user follows the label directions. Apply to dry foliage only. Do not apply more than twice in a single year. See product label for more information. Use BroadStar on: *Acer ginnala*, *Acer palmatum*, *Buxus sempervirens*, *Juniperus horizontalis*, *Juniperus sabina*, *Picea glauca*, *Picea pungens*, *Quercus rubra*, *Taxus* x *media*, *Thuja occidentalis*.

Use SureGuard herbicide for preemergent weed control in field-grown ornamental deciduous and coniferous trees, including Christmas trees and trees produced for reforestation, and to maintain bare-ground non-crop areas in and around ornamental nurseries and field-grown ornamentals. SureGuard herbicide should be applied to tilled, weed-free and deciduous tree plantings. The deciduous trees species listed in the "Tolerant Deciduous Trees" section on the label have shown tolerance to applications of SureGuard herbicide only when applied to the soil and base of the plant. Tolerant ornamentals include: *Abies balsamea*, *Abies fraseri*, *Acer ginnala*, *Fraxinus pennsylvanica*, *Picea pungens*, *Pseudotsuga menzesii*, *Syringa reticulata*, *Thuja occidentalis*.

Do not use BroadStar on annual bedding plants and herbaceous perennials (e.g., hosta and daylily).

Do not use BroadStar on *Buddleia davidii*, *Clethra alnifolia*, *Deutzia gracilus* 'Nikko', *Hydrangea* spp., *Ilex verticillata*, *Myrica cerifera*, *Nandina domestica* 'Firepower', *Plumbago auriculata*, *Rhododendron* 'Delaware Valley', *Rosa* spp., *Spiraea japonica* or *Syringa* spp.

BroadStar herbicide can injure liners of several woody ornamental species that are tolerant when more mature.

Sensitive Weeds
Common lamb's-quarters (*Chenopodium album*), common ragweed (*Ambrosia artemisiifolia*), dandelion (*Taraxacum officinale*), eastern black nightshade (*Solanum ptycanthum*), green foxtail (*Setaria viridis*), green pigweed (*Amaranthus powellii*), hairy bittercress/snapweed (*Cardamine hirsuta*), hairy nightshade (*Solanum sarachoides*), liverwort (*Marchantia polymorpha*), redroot pigweed (*Amaranthus retroflexus*).

Suppression only: common chickweed (*Stellaria media*), common groundsel (*Senecio vulgaris*).

Uptake and Translocation
Root and shoot uptake.

Basis of Selectivity

BroadStar herbicide controls weeds by inhibiting protoporphyrinogen oxidase, an essential enzyme required by plants for chlorophyll biosynthesis. Seedling weeds are controlled when they start to emerge and are exposed to sunlight, following contact with the soil-applied herbicide. BroadStar herbicide is tightly bound to soil and does not inhibit or limit root growth under normal growing conditions.

Application Methods

Container-grown ornamentals: BroadStar herbicide can be safely applied over the top of many species of woody ornamental shrubs and trees, providing the user follows the label directions. BroadStar herbicide should be applied over dry foliage. Wait 7 days after treatment and apply 2.5 cm of irrigation before placing treated plants in an enclosed structure. See product label.

Field-grown coniferous trees: All over-the-top applications of SureGuard herbicide should be applied before bud swell in the spring or delayed until coniferous trees have sufficiently hardened off in the fall. For non-dormant coniferous ornamentals, applications may be made using a directed hooded or shielded spray.

Field-grown deciduous trees: For maximum safety of deciduous trees, directed applications of SureGuard herbicide should be made to the soil surface before bud swell in the spring or after dormancy has initiated in the fall. Direct the application of SureGuard herbicide to the soil surface and away from plant material.

Do not make more than 2 applications of SureGuard per season, and wait 8 weeks between applications.

Special Recommendations, Cautions or Restrictions

Apply BroadStar herbicide before weed seeds germinate. Disturbing the soil surface after application may reduce herbicide efficacy. Remove existing weeds, weed residues and trash before applying BroadStar herbicide. Apply to dry foliage only. To test for moisture, rub hands over plant foliage. Approximately 1–2 cm of rainfall, overhead sprinkler irrigation or hand irrigation is required to activate BroadStar herbicide. Irrigate plants within 1 hr after application with 1–2 cm of water to wash the particles off the plant foliage. Inadequate irrigation or rainfall following application may reduce the effectiveness of BroadStar herbicide. Drip irrigation cannot be relied on to activate BroadStar herbicide. If adequate soil moisture is maintained following application, BroadStar herbicide will provide residual control of the listed weeds, except under unusual environmental conditions (excessive rainfall, irrigation or temperature).

SureGuard herbicide may be applied to established field-grown deciduous trees. Preemergence applications of SureGuard herbicide should be made to tilled, weed-free deciduous tree plantings.

For maximum safety of deciduous trees, directed applications of SureGuard herbicide should be made to the soil surface before bud swell in the spring or after dormancy has begun in the fall. Direct the application of SureGuard herbicide to the soil surface and away from plant material.

Avoid direct spray onto plant surfaces, flowers, foliage and green bark. SureGuard herbicide applications made after bud swell may result in plant injury if the herbicide contacts the tree foliage. Splashing of herbicide-treated soil onto foliage can result in plant injury and should be avoided. Do not apply to trees that have been established for less than 1 year, unless they are protected from spray contact by non-porous wraps, grow tubes or waxed containers. Newly established or transplanted trees should be sufficiently watered-in before application to settle soil around the plant.

Moisture is necessary to activate SureGuard herbicide in the soil for residual weed control. Dry weather following applications of SureGuard herbicide may reduce its effectiveness. However, when adequate moisture is received after dry conditions, SureGuard herbicide will control susceptible germinating weeds. SureGuard herbicide may not control weeds that germinate after application but before an activating rainfall or irrigation or weeds that germinate through cracks resulting from dry soil.

Residual Activity
The length of residual control depends on the application rate as well as on rainfall and temperature conditions. Length of residual control will decrease as temperature and precipitation increase. It will also decrease when there are high levels of organic matter and/or clay in the soil.

Manufacturer: Valent Canada Inc.

Common Name: Indaziflam

Trade Name: **SPECTICLE G**
Chemical Family: **Cellulose Biosynthesis Inhibitor (CBI)**
Site of Action: **Group 29**

Container applications

indaziflam	0.075 kg/ha
SPECTICLE G	336 kg/ha

Remarks
SPECTICLE G is a granular herbicide for pre-emergent weed control on outdoor, container-grown ornamentals. To avoid injury to ornamentals, irrigate with a sufficient amount of water within one hour to wash granules from leaf surfaces. Application of SPECTICLE G after bud swell may cause injury if granules remain on foliage. Avoid application under environmental conditions that favour possible adherence of the granule to non-targeted areas. Deep cultivation reduces the effectiveness of SPECTICLE G and should be avoided.

Use SPECITCLE G on: a wide range of ornamentals. See "ORNAMENTALS AND THEIR CULTIVARS TOLERANT TO SPECTICLE G Herbicide" on the Specticle G pesticide label.

DO NOT USE SPECTICLE G on *Aquilegia canadensis, Astilbe chinensis, Berberis thumbergii, Calamagrostis x acutiflora, Ceanothus x pallidus, Codiaeum variegatum, Coreopsis auriculata, Dianthus sp, Duranta erecta, Echinacea purpurea, Euonymus japonicus, Festuca glauca, Hydrangea macrophylla, Ixora coccinea, Kerri japonica, Lavandula angustifolia, Ligustrum japonicum, Liriope sp., Mandevilla sp., Mentha sp., Muhlenbergia capillaries, Ophiopogon japonicus, Pennisetum alopecuroides, Pennisetum setaceum, Plumbago spp., Salvia spp., Sambucus nigra, Spirea japonica* or *Viburnum odoratissimum*. Foliar symptoms include stunted, yellowed new growth. Stem girdling and swelling at the soil line may occur in some sensitive species.

Uptake and Translocation
Root and shoot uptake.

Basis of Selectivity
The active ingredient in Specticle G is indaziflam, which has a unique mode of action and is the only active ingredient in the Weed Science Society of America (WSSA) Group 29. Indaziflam prevents the emergence of seedlings by inhibiting crystalline cellulose deposition in the plant cell wall affecting cell wall formation, division and elongation. Indaziflam acts in plant cells and tissues where cellulose synthesis is actively taking place (germinating weed seeds and developing seedlings), for example, in actively growing meristematic tissues, dividing cells, expanding cells, as well as growing roots.

Application Methods
Container-grown ornamentals: SPECTICLE G Herbicide is a ready-to-use granular formulation and may be applied with a broadcast spreader or shaker can that is calibrated to deliver 336 kg/ha (3.36 kg/100 m^2 – 0.50 g/15 cm wide container). SPECTICLE G Herbicide is applied over-the-top to container-grown ornamentals using a clean, properly calibrated drop, rotary, hand-shaker or other spreader equipment according to manufacturer's directions. Check periodically to be certain that the equipment is working properly prior to each use. Uniform application is essential for satisfactory weed control.

Special Recommendations, Cautions or Restrictions
DO NOT USE SPECTICLE G on ornamentals where granules may become trapped in developing leaves or in meristematic areas (e.g. in whorls of grasses and perennials, such as hosta). Ornamentals should be established in the container for at least a week to allow the soil to settle and plants should be at least 12.7 cm (5 inches) tall prior to applying SPECTICLE G. Do not apply SPECTICLE G over-the-top of deciduous ornamentals at bud break. Do not apply SPECTICLE G

to unhealed budded grafts or other types of grafts. Care must be taken that the granules are evenly distributed and applied to dry foliage. Any granules adhering to the foliage must be removed prior to irrigation to prevent localized damage. Within one hour of application it is recommended to irrigate or water treated containers with at least 6 mm of water. Do not use SPECTICLE G on nursery seedbeds, rooted cuttings or young plants in liners. Do not apply SPECTICLE G Herbicide to plant types not listed as tolerant on the label. SPECTICLE G will not prevent shoot emergence from deeper weeds.

Residual Activity

Four months of residual weed control is expected. Under some environmental conditions, longer residual may be observed. In field sites, residual may last more than 6 months. Spring applications may interfere with establishment of fall-seeded cover crops; annual ryegrass is especially sensitive to indaziflam residues.

Manufacturer: Bayer CropScience Inc.

Common Name: isoxaben

Trade Name: GALLERY 75 DF
Chemical Family: benzamide
Site of Action: unknown

Rates of Application

isoxaben	0.75 kg/ha
GALLERY 75 DF	1.0 kg/ha

Remarks

To be used on bareroot and container-grown nursery stock grown for silvicultural purposes and containerized ornamentals grown in nurseries. Use on the following nursery stock 4 weeks after germination or crop emergence: *Picea abies*, *Picea glauca*, *Picea mariana*, *Pinus banksiana*, *Pinus contorta*, *Pinus resinosa*, *Pinus strobus.* Do not use on cut flowers. Germination of some sensitive crop species may be reduced in the year following treatment. Gallery is labelled for use on several container-grown ornamentals: *Acer*, *Clematis*, *Cornus*, *Euonymus*, *Hemerocallis*, *Heuchera*, *Hosta*, *Juniperus*, *Picea*, *Potentilla*, *Prunus*, *Pseudotsuga*, *Rhododendron*, *Rosa*, *Spiraea*, *Taxus* and *Thuja*. Gallery is UV-sensitive.

Sensitive Weeds

Common lamb's-quarters, common purslane, low cudweed, pineappleweed, purslane speedwell, shepherd's-purse, St. John's wort.

Uptake and Translocation

Absorbed by roots and translocated to the shoots of germinating weeds.

Basis of Selectivity

Root selectivity.

Application Methods

Do not use more than once per season. Apply in late summer to early fall, early spring or any time before germination of target weeds or immediately after cultivation. A single rainfall or sprinkler irrigation of 1 cm after application is necessary to activate Gallery 75 DF within 21 days after application. Apply Gallery 75 DF in 100–400 L of water carrier per hectare. For outdoor use only.

Residual Activity

Provides season-long control. Germination of some sensitive crop species may be reduced in the year following treatment.

Manufacturer: Dow AgroSciences

Common Name: napropamide

Trade Name: DEVRINOL 2 G, DEVRINOL 10 G, DEVRINOL 50 DF
Chemical Family: amide
Site of Action: Group 15

Rates of Application

napropamide	4.5 kg/ha
DEVRINOL 2 G	225 kg/ha
DEVRINOL 10 G (10 Gr)	45 kg/ha
DEVRINOL 50 DF (50 DF)	9 kg/ha

Remarks

Use on newly transplanted or established ornamentals, woody nursery stock, forest tree stock and container-grown ornamentals. Do not apply to species right after direct seeding. Devrinol is UV-sensitive.

Use on any of the following field-grown nursery stock:

Deciduous and evergreen trees: maple (*Acer* spp.), ash (*Fraxinus* spp.), birch (*Betula* spp.), black walnut (*Juglans nigra*), cedar (*Juniperus* spp.), cypress (*Cupressus* spp.), dogwood (*Cornus florida*), Douglas fir (*Pseudotsuga menziesii*), eucalyptus (*Eucalyptus* spp.), fir (*Abies* spp.), hawthorn (*Crataegus* spp.), hemlock (*Tsuga* spp.), honey-locust (*Gleditsia tricanthos*), Japanese larch (*Larix kaempferi*), laburnum (*Laburnum* spp.), flowering crab apple tree (*Malus* spp.), spruce (*Picea* spp.), pin oak (*Quercus palustris*), pine (*Pinus* spp.), pittosporum (*Pittosporum tobira*), podocarpus (*Podocarpus macrophyllus*), poplar, cottonwood, aspen (*Populus* spp.), cherry, peach, plum, apricot (*Prunus* spp.) and pear (*Pyrus* spp.).

Deciduous and evergreen shrubs: abelia (*Abelia* spp.), asparagus (*Sprengeri*) (*Asparagus densiflorus* and *A. Sarmentosus*), aucuba (*Aucuba japonica*), azalea (*Rhododendron* spp.), bottlebrush (*Callistemon* spp.), boxwood (*Buxus microphylla* or *B. sempervirens*), camellia (*Camellia* spp.), cotoneaster (*Cotoneaster* spp.), crepe myrtle (*Lagerstroemia* spp.), dogwood (*Cornus florida*), euonymus (*Euonymus* spp.), forsythia (*Forsythia* spp.), hibiscus (*Hibiscus* spp.), honeysuckle (*Lonicera* spp.), St. John's-wort (*Hypericum* spp.), holly, yaupon (*Ilex* spp.), juniper (*Juniperus* spp.), leucothoe (*Leucothoe* spp.), privet (*Ligustrum* spp.), heavenly bamboo, (*Nandina domestica*), osmanthus (*Osmanthus* spp.), chokecherry (*Photinia* spp.), pittosporum (*Pittosporum tobira*), podocarpus (*Podocarpus* spp.), firethorn (*Pyrancantha* spp.), Indian hawthorn (*Raphiolopsis indica*), rhododendron (*Rhododendron* spp.), rose (*Rosa* spp.), star jasmine (*Trachelospermum asiaticum*), yew (*Taxus* spp.) and viburnum (*Viburnum* spp.).

Fruit and nuts: filbert (*Corylus americana*), walnut (*Juglans nigra*) and grape (*Vitis* spp.).

Ground covers: Carpet bugleweed (*Ajuga* spp.), gazania (*Gazania* spp.), English ivy (*Hedera helix*), ivy (*Hedera* spp.), St. John's-wort (*Hypericum* spp.), lantana (*Lantana* spp.), liriope (*Liriope muscari* and *L. spicata*), pachysandra or spurge (*Pachysandra procumbens* and *P. Terminalis*), stonecrop (*Sedum* spp.), periwinkle (*Vinca major* or *V. minor*).

Flowers: Aster (*Aster* spp.), daisy (*Chrysanthemum* spp.), dahlia (*Dahlia* spp.), African daisy (*Dimorphotheca aurantiaca* and *D. sinuata*), geranium (*Geranium* spp.), plantain lily (hosta) (*Hosta* spp.), daffodils (*Narcissus* spp.), petunia (*Petunia hybrida*).

Use on the following container-grown nursery stock: Abelia (*Abelia* sp.), agapanthus (*Agapanthus* sp.), ageratum (*Ageratum houstonianum*), asparagus (*Asparagus* sp.), azalea (*Rhododendron* sp.), bottlebrush (*Callistemon* sp.), bougainvillea (Bougainvillea sp.), boxwood (*Buxus* sp.), camellia (*Camellia* sp.), cotoneaster (*Cotoneaster* sp.), crape myrtle (*Lagerstroemia* sp.), cypress (*Cupressus* sp.), dogwood (*Cornus florida*), Douglas fir (*Pseudotsuga menziesii*), ivy (*Hedera* sp.), eucalyptus (*Eucalyptus* sp.), euonymus (*Euonymus* sp.), fir (*Abies* sp.), firethorn (*Pyracantha* sp.), forsythia (*Forsythia* sp.), gardenia (*Gardenia jasminoides*), geranium (*Geranium* sp.), heather (*Erica* sp.), hibiscus (*Hibiscus* sp.), holly (*Ilex* sp.), juniper (*Juniperus* sp.), leucothoe (*Leucothoe* sp.), liriope (*Liriope muscari*, *L. spicata*), nandina (*Nandina domestica*), pachysandra (*Pachysandra procumbens*, *P. terminalis*), photinia (*Photinia* sp.), pine (*Pinus* sp.), raphoiolepis (*Raphiolopsis indica*), rhododendron (*Rhododendron* sp.), rose (*Rosa* sp.), sedum (*Sedum* sp.), star jasmine (*Trachelospermum asiaticum*), thuja (*Thuja occidentalis*) and vinca (*Vinca major* and *V. minor*).

Sensitive Weeds

Many annual weeds including annual bluegrass, barnyard grass, chickweed, crabgrass, foxtail, goose grass, groundsel, lamb's-quarters, pineappleweed, prickly lettuce, prostrate knotweed, purslane, redroot pigweed, sandbur and wild oats.

Uptake and Translocation

Absorbed through the roots of germinating weeds. Translocated upward through seedlings.

Basis of Selectivity

Metabolized by tolerant species. Inhibits root growth of germinating seedlings. Does not affect established plants due to placement selectivity.

Application Methods
Field nursery stock: Apply herbicide before planting, using water as the carrier. Incorporate uniformly to a depth of 2.5–5 cm, using irrigation or mechanical methods (e.g., tandem discs, field cultivator with sweep teeth). Follow with a levelling device.

Apply on established crops to a weed-free soil surface. Irrigate unless there is adequate rainfall within 7 days after spring/fall application or within 2 days after summer application. Soil must be wet to a depth of 5–10 cm.

Container nursery stock: Apply at any time of the year to a weed-free media surface. May be used on newly planted container stock once the potting media settles after the first watering. Incorporate by watering within 7 days after a spring or fall application. Water within 2 days after a summer application. Does not control bittercress.

Residual Activity
Provides season-long weed control if properly incorporated. Deep ploughing minimizes carry-over effects.

Unique Characteristics
Does not control germinated weeds. Resists leaching. To avoid crop injury, do not plant crops not registered for product use for 12 months after a napropamide application.

Manufacturer: United Phosphorus Inc.

Common Name: oxadiazon

Trade Name: **RONSTAR 2 G**
Chemical Family: **oxadiazole**
Site of Action: **Group 14**

Rates of Application

oxadiazon	2–4.5 kg/ha
RONSTAR 2G (2 Gr)	100–225 kg/ha

Remarks
Use in container nursery stock on: alpine currant, Colorado spruce, dogwood, emerald and gold euonymus, golden elder, juniper, lilac, mugo pine, Nanking cherry, potentilla, Scotch pine, Serbian spruce and vine maple.

The following plants are sensitive to Ronstar 2 G: *Andromeda* 'Temple Bell' (snowdrift); *Calluna* 'Mediterranean pink' (heath); *Cotoneaster* 'Eichholz', 'Himalayan', 'Shangri-la'; *Hibiscus* 'Red Heart'; *Picea abies* 'Primila' (Primila Norway spruce); *Picea glauca* 'Densena' (Densena white spruce); *Rhododendron* 'Everest', 'Girard Roberta', 'Hershey', 'Himo-Crimson', 'John Hearrens', 'Leuchtenfuer', 'Memoire', 'Nova Zimbela' (azalea), 'Pink Champagne', 'White Grandeur'; *Tsuga canadensis* 'Pendula' (weeping hemlock); *Viburum davidii*.

Sensitive Weeds
Annual weeds including annual bluegrass, barnyard grass, bittercress, black nightshade, common groundsel, crabgrass, green foxtail, lamb's-quarters, pigweed, purslane, redroot pigweed, shepherd's-purse, stinkweed, tumble and yellow foxtail.

Uptake and Translocation
Primarily through emerging shoots when they penetrate through the layer of treated soil.

Basis of Selectivity
Greater physiological tolerance relative to susceptible species and lack of contact with sensitive crop tissue.

Application Methods
Use on newly transplanted and established ornamentals and trees. Apply uniformly to soil. Apply at any time of the year before weed seeds germinate. Remove existing weed growth for satisfactory weed control. Do not apply to wet foliage or when granules can collect on leaves. Apply the herbicide at least 4 weeks before covering polyhouses in the fall.

Residual Activity
60–120 days.

Unique Characteristics
Because moisture activates the chemical, rainfall or overhead irrigation after application improves weed control. When the product is applied to soil, it is rapidly and strongly fixed by soil colloids. This adsorption to soil, along with the product's limited water solubility, mean the product is not easily leached.

Manufacturer: Bayer CropScience Inc.

Common Name: pendimethalin

Trade Name: PROWL H2O
Chemical Family: dinitroaniline
Site of Action: Group 3

Rates of Application

pendimethalin	1.68 kg/ha
PROWLS H2O	3.7 L/ha

Remarks

Prowl H2O herbicide will control annual grasses and certain broadleaf weeds in and around field, liner and container outdoor ornamentals and conifers for field production, including Christmas trees. For use on established container or field grown ornamentals and conifers for field production, including Christmas trees. Plant only those plant species for which tolerance has been confirmed into soil treated the previous season with Prowl H2O herbicide, or injury may occur.

Tolerant species include: Fraser fir (*Abies fraseri*), common yarrow (*Achillea millefolium*), columbine (*Aquilegia* sp. 'McKana'), river birch (*Betula nigra*), shasta daisy (*Chrysanthemum maximum*), lanceleaf tickseed (*Coreopsis lanceolata*), Leyland cypress (*Cupressocyparis leylandii*), foxglove (*Digitalis purpurea*), purple coneflower (*Echinacea purpurea*), forsythia (*Forsythia intermedia*), green ash (*Fraxinus pennsylvanica*), blanket flower (*Gaillardia aristata, Gaillardia pulchella*), avens (*Geum quellyon*, *Geum chiloense*), baby's breath (*Gypsophila paniculata*), daylily (*Hemerocallis* spp.), Andorra juniper (*Juniperus horizontalis*), crepe myrtle (*Lagerstroemia indica*), statice (*Limonium latifolium*), peony (*Paeonia* sp.), loblolly pine (*Pinus taeda*), water oaks (*Quercus nigra*), blood stonecrop (*Sedium spurium*), Stokes aster (*Stokesia laevis*), spreading yew (*Taxus cuspidate*), globe cedar (*Thuja occidentalis*), Canadian hemlock (*Tsuga canadensis*).

Do not apply PROWL H2O on the following:
Japanese holly fern (*Cyrtomium falcatum*), golden balsam (*Impatiens* sp.), petunia (*Petunia* hybrid), false dragonhead (*Physostegia virginiana*), white pine (*Pinus strobus*), black-eyed Susan (*Rudbeckia hirta*) and lamb's ear (*Stachys byzantine*).

Sensitive Weeds

Broadleaf Weeds: Lamb's-quarters and Redroot pigweed (suppression only).

Grasses: Barnyard grass, crabgrass (large and smooth), fall panicum and green foxtail.

Uptake and Translocation

Rapidly absorbed by primary roots of emerging/germinating seedlings as they penetrate through the layer of treated soil. Translocation with the plant is not significant and emerged weeds are not controlled.

Basis of Selectivity

Small-seeded grasses and broadleaf weeds. Weed seeds must germinate and grow within the treated soil layer to be affected.

Application Methods

Apply as a directed spray. Uniformly apply the recommended rate of Prowl H2O herbicide with properly calibrated ground equipment before weed emergence. PROWL H2O herbicide will not control emerged weeds. Do not make over-the-top applications. DO NOT apply during bud swell, bud break or at time of first flush of new growth. If newly budded or graphed rootstock, make an application using a shielded sprayer. Care must be taken to ensure there are no cracks in the soil where PROWL H2O herbicide could come in contact with the roots. Do not apply during bud swell, bud break or at time of first flush of new growth. Direct sprays away from graphed or budded tissue on transplants at all times. PROWL H2O herbicide treatments are most effective in controlling weeds when adequate rainfall or overhead irrigation is received. If PROWL H2O is not activated by rainfall or irrigation within 7 days, erratic weed control may result.

Residual Activity

Season-long control.

Manufacturer: BASF Canada Inc.

Common Name: propyzamide

Trade Name: KERB 50 WSP
Chemical Family: amide
Site of Action: Group 15

Rates of Application

propyzamide	1.5 kg/ha
KERB (50WG)	3 kg/ha

Remarks
Use on established ornamentals such as coniferous trees and shrubs, ground covers, iris and peony. Do not use on *Vinca minor*.

Sensitive Weeds
Perennial grasses including annual grasses, common chickweed, quackgrass and volunteer cereals.

Uptake and Translocation
Taken up by plant roots and translocated to foliage. Little foliar absorption.

Basis of Selectivity
Faster degradation in tolerant species.

Application Methods
Use as a preemergence treatment for annual weeds, or apply it in the fall for postemergence control of perennial grasses. Apply from late September to November when the soil temperature is low but above freezing and soil moisture is high.

Residual Activity
Persists 2–9 months, depending on soil type and climate. Decomposes slowly at temperatures below 1°C but accelerates at temperatures above this level. Persistence is greatest in sandy soils with low organic matter.

Unique Characteristics
Rainfall or irrigation is required after application. This moves the herbicide into the root zone for uptake by perennial grasses and germinating annual grasses.

Manufacturer: Dow AgroSciences Canada Inc.

Common Name: pyroxasulfone, sulfentrazone

Trade Name: AUTHORITY
Chemical Family: pyrazole, triazolinone
Site of Action: Group 15, 14

Rates of Application

pyroxasulfone	250 g/ha
sulfentrazone	250 g/ha
AUTHORITY	1.01 L/ha

Remarks
Pre-emergence to horsetail, applying as soon as the ground thaws annual grasses and annual broadleaf weeds in Christmas trees. Authority Supreme Herbicide may be applied to the soil as a preplant or pre-emergence (to weed and crop) surface application. Do not make fall applications to any crops.

Do not apply more than one application per year.

Sensitive Weeds
Horsetail.

Uptake and Translocation
Taken up by the plant roots and shoots.

Basis of Selectivity
Seedling root and shoot growth inhibitor.

Application Methods
The application is not recommended for an over-the-top broadcast spray and should be limited to directed sprays (banded application) ONLY.

Residual Activity
Sulfentrazone is persistent and will last in the soils (carryover) for one to two years. DO NOT APPLY AUTHORITY SUPREME HERBICIDE TO FIELDS TREATED WITH AUTHORITY 480 HERBICIDE or AUTHORITY SUPREME or ANY PRODUCT CONTAINING SULFENTRAZONE, IN THE PREVIOUS YEAR.

Unique Characteristics
All soil applications of Authority Supreme Herbicide require adequate rainfall for herbicidal activation. Authority Supreme Herbicide requires one (1) to two (2) cm of rain or irrigation water to be effective.

Manufacturer: FMC Corporation

Common Name: s-metolachlor

Trade Name: DUAL II MAGNUM
Chemical Family: acetanilide
Site of Action: Group 15

Rates of Application

s-metolachlor (915 g/L)	0.14–1.6 kg/ha
DUAL II MAGNUM	1.25–1.75 L/ha

Remarks

Use on white spruce 2 years or older, black spruce, Norway spruce, jack pine, red pine and white pine transplant or seedling stock. Also for use on poplar stoolbeds and second-year, non-bearing fruit trees. Use on outdoor ornamentals (woody and herbaceous): *Euonymus alata*, *Hemerocallis*, *Hosta*, *Juniperus*, *Rhododendron*, *Thuja*. May be used for field-grown conifers that are established: *Abies balsamea*, *Abies fraseri*, *Picea glauca*, *Pinus strobus*. Use on non-bearing stone fruit trees.

May be applied as a preemergent or early postemergent application to weeds before they pass the two-leaf stage. For poplar stoolbeds, apply to dormant and flushing stoolbeds.

Apply to soil before bud break. Do not apply Dual II Magnum within 4 weeks after bud burst or until the needles have hardened. Do not use on sandy soils with less than 2% organic matter. Make only one ground application per year, banded over top of trees. Apply in a minimum of 300 L water/ha.

Sensitive Weeds

Annual broadleaf weeds and grasses such as American nightshade, barnyard grass, eastern black nightshade, fall panicum, giant foxtail, green foxtail, hairy crabgrass, redroot pigweed (suppression only), smooth crabgrass, witch grass, yellow foxtail, yellow nut sedge.

Uptake and Translocation

Absorbed by germinating grasses mainly through the shoot, just above the seed. Absorbed by germinating broadleaf weeds through roots and shoots.

Basis of Selectivity

Metabolized by tolerant species.

Application Methods

Early preplant, preplant incorporated or preemergence. Set incorporation equipment to work the soil 10 cm deep with a disc operating at 6–10 km/h or a vibrating shank cultivator at 10–13 km/h. One incorporation is sufficient and need not be immediate. Rainfall within 10 days is required for maximum activity of the preemergence application.

Residual Activity

Activity will normally last for 10–14 weeks.

Unique Characteristics

The rate required depends on weed pressure (use a higher rate for heavier weed pressure). Yellow nut sedge control requires a preplant, incorporated application. Winter cereals may be planted 4–5 months after s-metolachlor application. Many tank mix combinations are registered for various crops. Do not use on muck soils or coarse-textured soils low in organic matter.

Manufacturer: Syngenta Canada Inc.

Common Name: simazine

Trade Name: PRINCEP NINE-T, SIMADEX
Chemical Family: S-triazine
Site of Action: Group 5

Rates of Application

Field applications

simazine	2.3–3.4 kg/ha
PRINCEP NINE-T (90 WG)	2.5–3.8 kg/ha
simazine	1.8–6.8 kg/ha
SIMADEX (500 g/L)	3.6–13.5 kg/ha

Container applications

simazine	2.3 kg/ha
PRINCEP NINE-T (90 WG)	2.5 kg/ha

Remarks

Use on new or established Christmas tree and woodland plantations (white pine 2 years or older and balsam fir). Use Princep Nine-T (only) for conifer site preparation before planting fir, pine or spruce.

Use on woody ornamentals and nursery stock established for at least 1 year: apple, barberry, black walnut, boxwood, cedar, chamaecyparis, cotoneaster, dogwood, flowering crabapple, hemlock, holly, juniper, mugo pine, multiflora rose, peony, rose, spruce, white ash and yew.

Use on container nursery stock: *Juniperus*, *Thuja* and *Taxus* only.

Sensitive Weeds

Annual broadleaf weeds such as clover (volunteer), groundsel, lady's-thumb, lamb's-quarters, pigweed, plantain, purslane, ragweed, smartweed and wild buckwheat. Annual grasses such as barnyard grass, crabgrass, wild oats and yellow foxtail. Most perennial species starting freshly from seed. Does not control triazine-resistant biotypes of foxtail, groundsel, lamb's-quarters or pigweed.

Uptake and Translocation

Absorbed by roots, but little or no foliar absorption. Translocated upwards in the xylem, accumulating in the apical meristem and leaves on new plantings of apples, apricots, cherries, peaches, pears and plums.

Basis of Selectivity

Some species, such as corn, metabolize simazine. In most crops, selectivity depends on crop-plant roots being deeper than the depth to which simazine leaches.

Application Methods

Remove any existing weeds from containers before application. Apply once per season: 1 month after planting, before weeds emerge.

Residual Activity

Persists longer than atrazine. Soil residues may persist for more than one season. Do not plant any crop but corn in the treated area for 1 year after a simazine application. If more than 2 kg/ha of product was applied, do not plant rotational crops the following year. If in any doubt, test the soil for excess residues.

Unique Characteristics

Apply only once per season. Needs sufficient moisture to activate. Rotate with non-triazine residual herbicides to avoid resistant weeds. Where rainfall causes erosion, soil containing simazine may wash to lower land and injure existing or subsequent crops.

Manufacturer: PRINCEP NINE-T: Syngenta Crop Protection Canada Inc.; SIMADEX: Bayer CropScience Inc.

Common Name: trifluralin

Trade Name: BONANZA 480 EC, RIVAL EC, TREFLAN EC
Chemical Family: dinitroaniline
Site of Action: Group 3

Rates of Application

trifluralin	0.6–1.15 kg/ha
BONANZA 480 (480 g/L)	1.25–1.7 L/ha
RIVAL EC	1.2–2.3 L/ha
TREFLAN EC (480 g/L)	1.2–1.7 L/ha

Remarks

Use with field-grown nursery stock, perennials (except *Ajuga*, *Pachysandra* and *Vinca*) and established shelterbelts.

Sensitive Weeds
Effective on most annual grasses. Provides good control of pigweed and lamb's-quarters, including the triazine-tolerant biotypes of these weeds.

Uptake and Translocation
No significant absorption or translocation in crops. Controls susceptible weeds as they germinate. Does not control established weeds.

Basis of Selectivity
Physiological growth processes associated with seed germination.

Application Methods
Preplant incorporated. Apply in 100–300 L water/ha. Use a lower rate of the chemical on sandy soils and a greater rate for loam-to-clay soils. Do not use on soils with a high organic content (muck, peat or black sands with more than 15% organic matter). Incorporate twice in crosswise directions using a tandem disc (7–10 km/h) or tine cultivator (10–13 km/h) set 8–10 cm deep. Incorporate immediately after application if possible, although a delay of up to 24 hr is acceptable, as per label directions. Incorporate again any time before planting. Trifluralin is activated upon incorporation. Irrigation is not required.

Residual Activity
Recommended application rates provide season-long weed control. Trifluralin does not injure succeeding crops under normal conditions. Fall-seeded grain crops will grow in soil treated with trifluralin the preceding spring.

Unique Characteristics
Strongly absorbs to soil particles and shows negligible leaching. Organic matter and clay content influence the application rate. Does not control ragweed, annual nightshades or mustards. Lady's-thumb may escape.

Manufacturer: BONANZA: Loveland Products Canada Inc.; RIVAL: NuFarm Agriculture Inc.; TREFLAN: Dow AgroSciences Canada

POSTEMERGENCE TREATMENTS
Postemergence treatments are applied after crops and weeds emerge.

- Selective chemicals kill weeds with little damage to desirable plants.
- Many postemergent treatments are non-selective and can damage desirable plants if used carelessly.
- The types of weeds controlled depend on weed susceptibility and crop tolerance to the chemical. Treatments must be applied at the correct stage of crop development. Since weed susceptibility is greatest when most weeds are young, early treatments need less herbicide and cause less crop damage.
- Some herbicides may be applied for preemergence weed action after the crop has emerged. For example, after a crop has been cultivated to ensure the soil is weed-free, a herbicide can be applied to control the weeds that subsequently germinate.

The following chemicals may be used as postemergence treatments.

Common Name: amitrole

Trade Name: **AMITROL 240**
Chemical Family: **triazole**
Site of Action: **Group 11**

Rates of Application

amitrole	0.39–0.69 kg/ha
AMITROL 240	1.7–3.0 L/ha

Remarks
To be applied only on spruce (*Picea* spp.).

Caution: Avoid application during the period of rapid shoot elongation in the spring. Applications can be made in the first year (1.7 L/ha), either in the seedbed or on transplants, but only after the seedlings have set bud. For actively growing seedlings or transplant bareroot spruce beyond the first year of growth, the rate may be increased to 3.0 L/ha. This product has activity against a wide range of plants (both evergreen and deciduous). Avoid spray drift into non-target areas.

Sensitive Weeds
Many annual and perennial broadleaf weeds and grasses, including ash, Canada thistle, cattail, dandelions, hoary cress, honeysuckle, horsetail, leafy spurge, locust, milkweed, poison-ivy, poison-oak, quack grass, sow-thistle, sumac and toadflax.

Uptake and Translocation
Absorbed by foliage and roots. Translocates well in the xylem and phloem. Accumulates in the growing regions of the plant.

Basis of Selectivity
Resistant plants metabolize amitrole more rapidly than sensitive plants and may have lower uptake as a result of leaf structure that reduces wetting and penetration.

Application Methods
Use foliar postemergence application for actively growing plants. Good coverage is essential. If weeds are mature, it is advisable to cut them and then spray the regrowth. Do not disturb treated plants for at least 2 weeks after application. Do not make postharvest applications after October 1. For control of quackgrass and Canada thistle, apply in spring or fall to actively growing plants 15–20 cm tall, then wait 10–14 days to plough or disk. Poor results may occur if heavy rain falls within 6 hr after application.

Residual Activity
Approximately 2–4 weeks in moist, warm soil.

Manufacturer: Nufarm Agriculture Inc.

Common Name: carfentrazone-ethyl

Trade Name: **AIM EC**
Chemical Family: **triazolinone**
Site of Action: **Group 14**

Rates of Application

carfentrazone-ethyl	36 g/ha
AIM EC	150 mL/ha

Remarks
To be applied on field-grown woody ornamental nurseries (genus such as *Malus*, *Prunus*, *Sorbus*). Aim EC herbicide can be applied a maximum of twice per growing season. Do not enter or allow workers to enter treated areas during the restricted entry interval (REI) of 12 hr.

Caution: This product contains aromatic petroleum distillates that are toxic to aquatic organisms.

Sensitive Weeds
Apply Aim EC to manage undesirable sucker growth from the base of vine or tree trunks or root sprouts. Treat when the tissue is young and not mature and/or hardened off.

Uptake and Translocation
Aim EC herbicide is a contact herbicide. Within a few hours following application, the foliage of susceptible weeds show signs of desiccation, and, in subsequent days, necrosis and death of the plant occur.

Basis of Selectivity
Aim EC herbicide is a selective, contact herbicide. It inhibits an enzyme of chlorophyll and heme biosynthesis.

Application Methods
Directed spray at the base of the tree for sucker control with special precaution not to get spray on fruit, foliage or tender growing parts. Use ground sprayers designed, calibrated and operated to deliver uniform spray droplets to the targeted plant or plant parts. Avoid using fine droplet nozzles that produce a droplet VMD of 300 microns or less (see the drift prevention section of the Aim label for more instructions). When using hooded sprayers or directed sprayer application: use drift-reducing nozzles, splash screens or a full screen to prevent drift from reaching other parts of the vine or tree (at least one method is required). Direct the spray toward the sucker zone.

Weed control is optimized when the product is applied to actively growing weeds up to 10 cm in height, or as specified. For conventional boom and nozzle sprayers, use nozzles that produce minimal amounts of fine spray droplets. Do not exceed 210 kPa spray pressure, unless otherwise required for optimal drift-reduction nozzle performance. Apply with an adjuvant such as Agral 90 or Ag-Surf at 0.25% v/v (0.25 L/100 L of spray solution) or use Merge at 1% v/v (1 L/100 L of spray solution).

Residual Activity
None.

Manufacturer: FMC Corporation

Common Name: clopyralid

Trade Name: LONTREL 360
Chemical Family: pyridine carboxylic acid
Site of Action: Group 4

Rates of Application

clopyralid	0.150–0.2 kg/ha
LONTREL 360 (360 g/L)	0.42–0.56 L/ha

Remarks

Use for established, field-grown conifers including Christmas trees (*Abies balsamea*, *Abies fraseri*, *Picea abies*, *Pinus strobus*) and for bearing and non-bearing apple trees.

Sensitive Weeds

Vetch (post-emergent).

Uptake and Translocation

Most growth regulator herbicides are readily absorbed through both roots and foliage and are translocated in both the xylem and phloem.

Basis of Selectivity

Growth regulator herbicide. Weeds cannot grow due to disruption of plant cell growth.

Application Methods

Postemergence.

Residual Activity

Half-life in soil is less than 30 days under conditions that are favourable for microbial degradation. Little to no residual activity.

Unique Characteristics

Clopyralid has little to no activity on woody vegetation, except woody species of the legume family.

Manufacturer: Dow AgroSciences Canada Inc.

Common Name: fluazifop-p-butyl

Trade Name: VENTURE L
Chemical Family: aryloxyphenoxy propionate
Site of Action: Group 1

Rates of Application

fluazifop-p-butyl	0.075–0.25 kg/ha
VENTURE L (125 g/L)	0.6–2.00 L/ha

Remarks

Use for field and container application. Good on non-grassy ornamental plants, shrubs, trees, non-bearing forest and ornamental nursery field stock and container-grown nursery stock. See list of tolerant species on label. Over-the-top application can injure some blue junipers (e.g., *Juniperus horizontalis* 'Bar Harbour,' 'Blue Acres' and 'Blue Rug').

Cultivars differ in sensitivity to Venture L. For example, *J. horizontalis* 'Blue Acres' is sensitive, while *J. horizontalis* 'Plumosa Compacta' is tolerant. Consult the label for tolerant species. Test samples of each cultivar not specifically listed on the label before using this product. Also for non-bearing apples and pears.

Sensitive Weeds

Annual grass species, quackgrass and volunteer corn, wheat and barley.

Uptake and Translocation

Absorbed primarily by leaves. Translocated to roots and rhizomes.

Basis of Selectivity

Metabolism by tolerant species.

Application Methods

Postemergence. Use a directed application in sensitive species to avoid contacting leaves and green tissue. Use higher application rates for quackgrass. Apply to actively growing grasses when annual grasses are in the 2–5-leaf stage and quackgrass is in the 3–5-leaf stage.

Residual Activity

Essentially none.

Unique Characteristics
Using preplant tillage to break up rhizomes improves quackgrass control. Do not cultivate for 5 days after application. Except as noted on the label, apply broadleaf herbicides separately at least 3 days after using this product. The product loses some effectiveness when used on stressed plants (e.g., when plants are suffering from lack of moisture, excessive humidity, low temperature or very low relative humidity). Weeds may regrow by tillering if the product is applied to stressed plants. A new flush of weeds may emerge after the first flush is controlled.

Manufacturer: Syngenta Canada Inc.

Common Name: glyphosate

Trade Name: **various products**
(see OMAFRA Publication 75, *Guide to Weed Control*, or contact a local supplier)
Chemical Family: **amino acid**
Site of Action: **Group 9**

Rates of Application

Emerged annual weeds

glyphosate	0.8–1.25 kg/ha

Emerged perennial weeds

glyphosate	1.7–4.3 kg/ha

Quackgrass & other perennial grasses

glyphosate	0.9–2.5 kg/ha

Perennial weeds (Canada thistle, dogbane, sow thistle)

glyphosate	0.9–2.5 kg/ha

Other perennial weeds (field bindweed, common milkweed)

glyphosate	2.5–4.3 kg/ha

Remarks
Apply to actively growing weeds. Spray must not contact leaves or green bark of trees or shrubs.

CROP AND/OR NON-CROP REGISTRATIONS
See OMAFRA Publication 75, *Guide to Weed Control*.

Sensitive Weeds
Annual grasses, perennial weeds (e.g., Canada thistle, cattails, field bindweed, milkweed, nut sedge, poison-ivy, quackgrass, sow thistle) and brush (e.g., alder, birch, maple, poplar, raspberry and willow).

Uptake and Translocation
Absorbed through foliage and translocated throughout the plant.

Basis of Selectivity
Non-selective for agricultural crops. Conifers may be tolerant at some stages for unknown reasons.

Application Methods
Use postemergence for perennial weed control. Apply at the bud-bloom growth stage to most perennial weeds. For Canada thistle or sow thistle, wait until they are at least in early flower bud. Apply to milkweed at flower bud. Apply to bindweed at full flower. Treat quackgrass in the spring or fall while it is actively growing, with at least three or four new leaves on each emerged shoot.

Remove crop refuse in the fall, but do not till before application. Fall or spring tillage before spring application may reduce weed control. Wait at least 3–5 days after application before working the area. For maximum quack grass control, till before the quack grass turns completely brown.

Glyphosate can be applied with boom equipment, knapsack sprayers or high-volume spray equipment for agricultural and non-crop uses. Use backpack mist blowers only for silvicultural site preparation and roadside brush control. Use aerial applications only for silvicultural site preparation and conifer release.

Glyphosate may be applied with selective equipment to non-crop areas, tree plantings, grapes and orchards. (See *Wiper Applicators for Selective Weed Control*, on page 95.) Regardless of the application method, do not allow the herbicide to contact green foliage or the green bark of crops or other desirable plants. Remove all suckers from the trunks of desirable trees before spraying.

Residual Activity
Crops may be planted or seeded directly into treated areas following application. Use other herbicides to control weeds emerging after the application.

Unique Characteristics
Rainfall within 6 hr after application can reduce control, as can a heavy frost.

Manufacturers: Cheminova Canada; Dow Agrosciences Canada Inc.; Interprovincial Cooperative Ltd.; Monsanto Canada Inc.; NuFarm Agriculture Inc.; Syngenta Canada Inc.

Common Name: oxyfluorfen

Trade Name: **GOAL 2XL**
Chemical Family: **diphenyl-ether**
Site of Action: **Group 14**

Rates of Application

oxyfluorfen	0.12–0.24 kg/ha
GOAL 2XL (see label)	0.5 or 1 L/ha

Remarks
Goal 2XL has some preemergent effects but is used mainly as a postemergent herbicide for broadleaf weeds in conifers (including Christmas trees). Goal 2XL has been tested on field-grown balsam fir, Fraser fir, white pine and white spruce. Goal 2XL may be applied to other non-listed conifer species, however, non-listed conifer species may vary in tolerance to herbicides, including Goal 2XL. Do not use handheld equipment to apply Goal 2XL to field-grown conifers. Goal 2XL applications should be made before bud break or after new foliage has hardened off (approximately 6 weeks after bud break). Some temporary needle burn may occur. Apply to healthy trees that are not under stress. Repeat applications as required to control late-germinating weeds. Do not apply more than 2 L of product per hectare per growing season.

For new and established plantings of *Populus* species (poplars and aspens) and their hybrids (including short-rotation intensive culture crops), Goal 2XL should only be applied to dormant, healthy plants. Make only 1 application per year, using a low-pressure sprayer with flat can nozzles. Do not apply more than 7 L per treated hectare per growing season.

Sensitive Weeds
Weed sensitivity depends on the rate used and application timing (see label). Sensitive weeds include: common purslane, cupped nightshade (potato weed), field pansy, lamb's-quarters, maple-leaved goosefoot, oak-leaved goosefoot, redroot pigweed, wild buckwheat, wood sorrel. (Dormant *Populus* tree crop: narrow-leaved hawk's beard, pale smartweed, shepherd's-purse, stinkweed.)

Uptake and Translocation
Goal 2XL is a contact herbicide with both foliar and soil activity. There is very little translocation within the plant.

Basis of Selectivity
Oxyfluorfen inhibits the production of a chlorophyll enzyme, which results in an accumulation of chemicals that disrupt cell membrane integrity in the presence of light.

Application Methods
To ensure effective post-emergence weed control, apply Goal 2XL when weeds are in the 2- to 4-leaf stage and actively growing. Heavy rainfall or heavy irrigation immediately following application to emerged weeds may reduce effectiveness. Apply in 200–500 L water/ha.

Do not apply to sandy soil. Goal 2XL enhances activity of glyphosate formulations and improves the weed spectrum and speed of kill.

Residual Activity
Can provide up to 6 months residual activity. Oxyfluorfen is not very soluble in water and can be expected to adhere strongly to all soil types.

Manufacturer: Dow AgroSciences Canada Inc.

Common Name: paraquat

Trade Name: GRAMOXONE-200 SL
Chemical Family: bipyridylium
Site of Action: Group 22

Rates of Application

paraquat	0.55–1.1 kg/ha
GRAMOXONE (200 g/L)	2.75–5.5 L/ha

Remarks

To control weed and grass between the rows of field and established nursery crops, apply after weed emergence. Use equipment and nozzles designed to prevent spray contact with the green foliage or other green parts of plants. Use for emerged annual weeds and to suppress top growth in perennial weeds.

Crop and/or Non-Crop Registrations

- stale seedbed technique
- inter-row directed chemical weeding for established nursery crops
- chemical mowing weed control in non-crop land

Sensitive Weeds

Non-selective action affects all green plants.

Uptake and Translocation

Absorbed by foliage and green bark. Little or no translocation.

Basis of Selectivity

All green plant tissue is sensitive. Paraquat is less effective on plants with a very waxy cuticle and linear leaf shape (e.g., nut sedge). It is safe on the mature (non-green) bark of woody plants.

Application Methods

Postemergence. Apply when weeds are under 15 cm high. Apply 2.75 to 5.5 L GRAMOXONE 200 SL in 300 to 550 L of water per hectare. Use 4.25 to 5.5 L when weeds are above 5 cm in height and higher volume of water on dense weed growth. Use as a chemical mower, applying it several times a year to actively growing vegetation. Aim the spray to avoid the leaves and green bark of nursery plants. Paraquat only controls emerged weeds. It suppresses perennial weeds. Paraquat can be broadcast if there is no danger to the leaves or bark of desirable plants. For best results, apply it on a dull or cloudy day or in the evening.

Residual Activity

Essentially no residual soil activity but persists in organic material (e.g., mulches, turf thatch). Do not reseed such areas for 5 days. Perennial weeds may need multiple applications per season.

Unique Characteristics

Inactivated by adsorption to soil particles.

Manufacturer: Syngenta Canada Inc.

Common Name: triclopyr

Trade Name: GARLON
Chemical Family: carboxylic acid
Site of Action: Group 4

Rates of Application

triclopyr	0.48 kg/ha
GARLON (755 g/L)	0.635 L/ha

Remarks

For the control of labelled weeds (woody and broadleaf weeds), including smooth bedstraw, in Christmas tree plantations. For best results, applications of Garlon XRT herbicide should be made when woody plants and weeds are actively growing. Apply Garlon XRT herbicide to trees at least 1.2 m tall, after the buds of the trees have hardened off and no lammas growth is present. Do not apply in the year of planting. Apply only once per year.

Sensitive Weeds

Woody and broadleaf plants. Sensitive weeds include alder, ash, birch, chokecherry, maples (red maple), poplar and smooth bedstraw.

Uptake and Translocation

Selective herbicide that mimics the effects of plant hormones (auxins). Triclopyr causes the growing tips of plants to elongate uncontrollably, resulting in death of the plant.

Basis of Selectivity

It is most effective on broadleaf plants. It has little or no impact on grasses.

Application Methods

Postemergence. Apply when target weeds are actively growing.

Residual Activity
Half-life in soil is approximately 30 days under conditions that are favourable for microbial decomposition.

Unique Characteristics
Apply only when there is little or no hazard from spray drift. Small quantities of spray drift may injure susceptible broadleaf plants.

Manufacturer: Dow AgroSciences Canada Inc.

CROP TOLERANCE AND EFFICACY OF HERBICIDES REGISTERED ON NURSERY CROPS

In this section:

Table 3–3. Herbicides Registered for Use on Woody Plants
Table 3–4. Weed Susceptibility and Herbicides — Broadleaf Annuals
Table 3–5. Weed Susceptibility and Herbicides — Broadleaf Perennials
Table 3–6. Weed Susceptibility and Herbicides — Annual Grasses

The following pages contain tables listing information about:

- herbicides registered in Ontario for use on nursery stock (agricultural use)
- the tolerance of specific nursery crops
- weed control ratings for herbicides registered on nursery stock

In April 2009, the Ministry of the Environment amended the Pesticides Act with the Cosmetic Pesticides Ban Act, 2008, and Ontario Regulation 63/09. Pesticides are now classified for sale and use under 12 different classes. Note that agriculture (including nursery production) is excepted. For more information on the legislation, see the Ministry of Environment, Conservation and Parks website at ontario.ca/pesticides.

Table 3–3. Herbicides Registered for Use on Woody Plants

LEGEND: C = container D = directed spray only F = field S = seedbed T = transplant
Not = labelled restriction — = insufficient information available to make a rating

	Herbicide							
Botanical Name	**CASORON**	**DEVRINOL**	**DUAL II MAGNUM**	**KERB**	**PROWL**	**RONSTAR**	**SIMADEX, PRINCEP NINE-T**	**VENTURE L**
Abelia	—	—	—	—	—	—	—	—
Abies balsamea	Not	—	—	F	—	—	F	—
Abies *fraseri*	—	—	—	—	F, C	—	—	—
Abies sp.	Not	—	—	F	—	—	—	TFC
Acer circinatum	—	—	—	—	—	C[2]	—	—
Acer sp.	T[1]F	TFC	—	—	—	—	—	TFC
Aesculus sp.								
Aesculus *glabra*	—	—	—	—	—	—	—	—
Amelanchier canadensis								
Aronia	—	—	—	—	—	—	—	—
Ajuga sp.	Not	—	—	—	—	—	—	—
Berberis	—	—	—	—	—	—	—	—
Berberis thumbergii								
Betula	—	—	—	—	—	—	—	—
Betula pendula 'Gracilis'	T[1]F	—	—	—	—	—	—	—
Betula nigra	—	—	—	—	F, C	—	—	—
Buddleia	—	—	—	—	—	—	—	—
Buxus sp.	T[1]F	TFC	—	—	—	—	F	TFC

[1] Apply 4 weeks after transplanting.
[2] Apply 30 days before covering polyhouses — no later than Sept. 30.
[3] Use directed spray from bud break to initial growth hardening.

Table 3–3. Herbicides Registered for Use on Woody Plants

LEGEND: C = container D = directed spray only F = field S = seedbed T = transplant
Not = labelled restriction — = insufficient information available to make a rating

	Herbicide							
Botanical Name	**CASORON**	**DEVRINOL**	**DUAL II MAGNUM**	**KERB**	**PROWL**	**RONSTAR**	**SIMADEX, PRINCEP NINE-T**	**VENTURE L**
Calluna sp.	T[1]F	—	—	—	—	—	—	TFC
Caragana sp.	T[1]F	—	—	—	—	—	F	TFC
Carpinus sp.	—	—	—	—	—	—	—	TFC
Carya sp.								
Caryopteris	—	—	—	—	—	—	—	—
Castanea sp.								
Catalpa	—	—	—	—	—	—	—	—
Cercis canadensis	—	—	—	—	—	—	—	—
Chaenomeles sp.	—	—	—	—	—	—	—	TFC
Chamaecyparis sp.	—	—	—	—	—	—	F	—
Cornus sp.	—	—	—	—	—	C[2]	F	TFCD
Cotinus coggygria	—	—	—	—	—	—	—	TFC
Cotoneaster sp.	—	—	—	—	—	—	F	TFC
Crataegus sp.	—	TFC	—	—	—	—	—	—
Cryptomeria japonica								
Cupressus								
Daphne	—	—	—	—	—	—	—	—
Deutzia								
Erica sp.	T[1]F	—	—	—	—	—	—	—
Euonymus alatus	—	—	—	—	—	—	—	—
Euonymus fortunei 'Emerald & Gold'	—	—	—	—	—	C[2]	—	—
Euonymus sp.	T[1]F	TFC	—	—	—	—	—	TFC
Forsythia sp.	T[1]F	—	—	—	F, C	—	—	TFC
Fothergilla gardenii								
Fagus sp.								
Fraxinus americana	—	—	—	—	—	—	F	—
Fraxinus sp.	T[1]F	—	—	—	F, C	—	—	TFC
Ginkgo biloba								
Gleditsia sp.	—	TF	—	—	—	—	—	TFC
Gleditsia triacanthos	—	—	—	—	—	—	—	T
Hedera sp.	—	C	—	—	—	—	—	TFC
Hibiscus sp.	—	TF	—	—	—	—	—	—
Hydrangea sp.	—	—	—	—	—	—	—	TFC
Hydrangea macrophylla								
Hypericum sp.	—	TF	—	—	—	—	—	—
Ilex sp.	T[1]F	TFC	—	—	—	—	F	TFC[3]
Itea virginica								

[1] Apply 4 weeks after transplanting.
[2] Apply 30 days before covering polyhouses — no later than Sept. 30.
[3] Use directed spray from bud break to initial growth hardening.

Table 3–3. Herbicides Registered for Use on Woody Plants

LEGEND: C = container D = directed spray only F = field S = seedbed T = transplant
Not = labelled restriction — = insufficient information available to make a rating

	Herbicide							
Botanical Name	**CASORON**	**DEVRINOL**	**DUAL II MAGNUM**	**KERB**	**PROWL**	**RONSTAR**	**SIMADEX, PRINCEP NINE-T**	**VENTURE L**
Juglans nigra	—	—	—	—	—	—	F	—
Juniperus chinensis 'Pfitzeriana'	T[1]F, C[1,2]	—	—	F	—	—	—	TFCD
Juniperus horizontalis	—	—	—	—	F, C	—	—	—
Juniperus sabina	T[1]F, C[1,2]	—	—	F	—	—	—	—
Juniperus scopulorum	T[1]	—	—	F	—	—	—	—
Juniperus sp.	T[1]F	TFC	—	F	—	C[2]	FC	TFC[3]
Juniperus virginiana	T[1]F	—	—	F	—	—	—	—
Kerria japonica								
Kolkwitzia amabilis								
Laburnum sp.	—	TF	—	—	—	—	—	—
Lagerstroemia								
Ligustrum sp.	—	TFC	—	—	—	—	—	TFC
Ligustrum japonicum								
Lonicera sp.	T[1]F	—	—	—	—	—	—	TFC
Magnolia	—	—	—	—	—	—	—	—
Magnolia stellata								
Malus sp.	T[1]F	TF	—	—	—	—	F	TFC
Malus sylvestris	—	TFC	—	—	—	F	—	—
Metasequoia glyptostroboides	—	—	—	—	—	—	—	—
Nyssa sylvatica								
Parthenocissus quinquefolia	—	—	—	—	—	—	—	TFC
Philadelphus sp.	T[1]F	—	—	—	—	—	—	TFCD
Physocarpus opulifolius	—	—	—	—	—	—	—	—
Picea abies	Not	—	—	F	—	—	F	—
Picea abies 'Nidiformis'	Not	—	—	F	—	—	—	—
Picea glauca	Not	—	—	F	—	—	F	—
Picea glauca 'Conica'	Not	—	—	F	—	—	—	—
Picea marina	—	—	TF	—	—	—	—	—
Picea omorika	Not	—	—	—	—	C[2]	—	—
Picea pungens	Not	—	—	—	—	C[2]	—	—
Picea pungens 'Glauca'	Not	—	—	F	—	—	F	—
Picea pungens 'Glauca Globosa'	Not	—	—	F	—	—	F	—
Picea rubens	Not	—	—	F	—	—	F	—

[1] Apply 4 weeks after transplanting.
[2] Apply 30 days before covering polyhouses — no later than Sept. 30.
[3] Use directed spray from bud break to initial growth hardening.

Table 3–3. Herbicides Registered for Use on Woody Plants

LEGEND: C = container D = directed spray only F = field S = seedbed T = transplant
Not = labelled restriction — = insufficient information available to make a rating

	Herbicide							
Botanical Name	**CASORON**	**DEVRINOL**	**DUAL II MAGNUM**	**KERB**	**PROWL**	**RONSTAR**	**SIMADEX, PRINCEP NINE-T**	**VENTURE L**
Picea sp.	Not	TF	—	F	—	—	—	TFC[3]
Pieris sp.	—	—	—	—	—	—	—	TFC
Pinus banksiana	—	—	TF	—	—	—	—	—
Pinus mugo	Not	—	—	F	—	C[2]	F	—
Pinus nigra	—	—	—	F	—	—	—	—
Pinus resinosa	—	—	TF	—	—	—	—	—
Pinus sp.	—	TFC	—	F	—	—	—	TFC
Pinus strobus	—	—	TF	—	Not	F	—	F
Pinus sylvestris	—	—	—	—	—	C[2]	—	—
Pinus taeda	—	—	—	—	F, C	—	—	—
Pittosporum sp.	—	TF	—	—	—	—	—	—
Platanus sp.	—	—	—	—	—	—	—	TFC
Podocarpus sp.	—	TFC	—	—	—	—	—	—
Populus sp.	—	TF	stoolbed	—	—	—	—	—
Populus deltoides								
Populus tremuloides								
Potentilla sp.	—	—	—	—	—	C[2]	—	TFC
Prunus sp.	—	TF	—	—	—	—	—	—
Prunus tomentosa	—	—	—	—	—	C[2]	—	—
Pseudotsuga menzeisii	—	—	—	F	—	—	—	TFC[3]
Pyracantha sp.	—	TFC	—	—	—	—	—	TFC
Pyrus sp.	—	F	F	—	—	—	—	F
Quercus	—	—	—	—	—	—	—	—
Rhododendron sp.	T[1]F	TFC	—	—	—	—	—	TFC
Ribes alpinum	—	—	—	—	—	C[2]	—	—
Ribes sp.	—	—	—	—	—	—	—	TFC
Robinia sp.	T[1]F	—	—	—	—	—	—	—
Rosa multiflora	—	—	—	—	—	—	F	—
Rosa sp.	T[1]F	TFC	—	—	—	—	F	TFC
Salix sp.	T[1]F	—	—	—	—	—	—	TFC
Sambucus canadensis 'Aurea'	—	—	—	—	—	C[2]	—	—
Sambucus sp.	—	—	—	—	—	—	—	TFC
Sambucus nigra								
Spiraea sp.	T[1]F	—	—	—	—	—	—	TFC
Symphoricarpos rivularis	—	—	—	—	—	—	—	TFC
Syringa sp.	Not	—	—	—	—	C[2]	—	TFC

[1] Apply 4 weeks after transplanting.
[2] Apply 30 days before covering polyhouses — no later than Sept. 30.
[3] Use directed spray from bud break to initial growth hardening.

Table 3–3. Herbicides Registered for Use on Woody Plants

LEGEND: C = container D = directed spray only F = field S = seedbed T = transplant
Not = labelled restriction — = insufficient information available to make a rating

	Herbicide							
Botanical Name	**CASORON**	**DEVRINOL**	**DUAL II MAGNUM**	**KERB**	**PROWL**	**RONSTAR**	**SIMADEX, PRINCEP NINE-T**	**VENTURE L**
Taxodium	—	—	—	—	—	—	—	—
Taxus cuspidata	—	—	—	F	—	—	—	—
Taxus sp.	T[1]F, C[1,2]	TF	—	F	—	—	FC	TFC[3]
Thuja occidentalis	T[1]F, C[1,2]	—	—	F	—	—	—	—
Thuja sp.	T[1]F	C	—	F	—	—	FC	TFC
Tilia sp.	T[1]F	—	—	—	—	—	—	TFC
Tsuga sp.	Not	—	—	—	—	—	F	TFC[3]
Ulmus sp.	T[1]F	—	—	—	—	—	—	TFC
Viburnum sp.	—	—	—	—	—	—	—	TFC
Weigela sp.	—	—	—	—	—	—	—	TFC

[1] Apply 4 weeks after transplanting.
[2] Apply 30 days before covering polyhouses — no later than Sept. 30.
[3] Use directed spray from bud break to initial growth hardening.

Table 3–4. Weed Susceptibility and Herbicides — Broadleaf Annuals

LEGEND: S = susceptible MS = moderately susceptible — = insufficient information available to make a rating

Broadleaf Annuals	CASORON	DEVRINOL	DUAL II MAGNUM	KERB	PROWL	RONSTAR	SIMADEX, PRINCEP NINE-T	TREFLAN, RIVAL
bittercress	S	—	—	—	—	S	—	—
buckwheat, wild	S	—	—	—	—	—	S	MS
carpetweed	—	S	—	—	—	—	—	S
chickweed, common	S	S	—	S	—	—	—	S
clover, volunteer	—	—	—	—	—	—	S	—
groundsel, common	S	S	—	—	—	S	—	—
knotweed	S	—	—	—	—	—	—	—
knotweed, prostrate	—	S	—	—	—	—	—	S
kochia	S	—	—	—	—	—	—	—
lady's-thumb	—	—	—	—	—	—	S	—
lamb's-quarters	S	S	—	—	S	S	S	S
mustards	S	—	—	—	—	—	—	—
nightshade, black	—	—	MS	—	—	S	—	—
pigweed	S	S	—	—	—	S	—	S
pigweed, redroot	—	S	—	—	S	—	S	—
pineappleweed	—	S	—	—	—	—	—	—
plantain	S	—	—	—	—	—	—	—
prickly lettuce	—	S	—	—	—	—	—	—
purslane	S	S	—	—	—	S	S	S
ragweed, common	—	MS	—	—	—	—	S	—
Russian thistle	—	—	—	—	—	—	—	S
shepherd's-purse	S	—	—	—	—	S	—	—
smartweed	S	—	—	—	—	—	S	S
smartweed, green	—	—	—	—	—	—	S	—
sow thistle, annual	S	S	—	—	—	—	—	—
spurge	S	—	—	—	—	—	—	—
stinkweed	—	—	—	—	—	S	—	—
sweet clover, white	—	—	—	—	—	—	—	—

Table 3–5. Weed Susceptibility and Herbicides — Broadleaf Perennials

LEGEND: S = susceptible MS = moderately susceptible T = tolerant
— = insufficient information available to make a rating

Broadleaf Perennials	CASORON	DEVRINOL	DUAL II MAGNUM	KERB	PROWL	RONSTAR	ROUNDUP	SIMADEX	TREFLAN	VENTURE L
bindweed	T	—	—	—	—	—	S	—	T	—
chickweed, mouse eared	MS	—	—	—	—	—	S	—	MS	—
dandelion	MS	T	—	—	—	—	MS	—	—	—
grape, wild	T	—	—	—	—	—	MS	—	—	—
ground ivy (creeping Charlie)	MS	—	—	—	—	—	MS	—	—	—
horsetail	MS	—	—	—	—	—	MS	T	T	—
mallow	—	—	—	—	—	—	MS	—	—	—
milkweed	—	—	—	—	—	—	S	—	T	—
nut sedge	MS	MS	S	—	—	—	MS	T	T	T
plantain	MS	—	—	—	—	—	S	—	—	—
poison-ivy	—	—	—	—	—	—	—	—	—	S
quack grass	MS	T	—	MS	—	—	—	T	T	MS
sow thistle	MS	—	—	S	—	—	—	T	T	—
stinging nettle	—	—	—	—	—	—	—	—	—	S
thistle, Canada	MS	—	—	—	—	—	—	T	T	—
toadflax, yellow	—	—	—	S	—	—	S	—	—	S
vetches	MS	T	—	—	—	—	—	T	T	—

Table 3–6. Weed Susceptibility and Herbicides — Annual Grass

LEGEND: S = susceptible — = Insufficient information available to make a rating

Annual Grasses	CASORON	DEVRINOL	DUAL II MAGNUM	KERB	PROWL	RONSTAR	ROUNDUP	SIMADEX	TREFLAN	VENTURE L
barnyard grass	—	S	S	—	S	S	—	S	S	S
bluegrass, annual	S	S	—	—	—	S	S	—	S	—
brome grass	—	—	—	—	—	—	S	—	S	—
cheat grass	—	—	—	—	—	—	—	—	S	—
crabgrass	S	S	—	—	S	S	—	S	S	S
crabgrass, large	—	S	—	—	S	—	S	—	—	—
crabgrass, smooth	—	—	S	—	S	—	—	—	—	—
darnel, Persian	—	—	—	—	—	—	—	—	S	S
foxtail, giant	—	—	S	—	—	—	—	—	—	S
foxtail, green	S	S	S	—	S	S	S	—	S	S
foxtail, yellow	S	S	S	—	—	S	—	S	S	S
goose grass	—	S	—	—	—	—	—	—	S	—
grasses, annual	—	—	—	S	—	—	—	—	—	—
Johnson grass	—	—	—	—	—	—	—	—	—	S
love (stink) grass	—	—	—	—	—	—	—	—	S	—
oats, wild	—	S	—	S	—	—	S	S	S	S
panicum, fall	—	S	S	—	S	—	—	—	S	—
proso millet	—	—	—	—	—	—	—	—	—	S
ryegrass	—	S	—	—	—	—	—	—	—	—
witch grass	—	—	S	—	—	—	—	—	—	—

4. Appendices

APPENDIX A: Advisory Staff for Nursery and Landscape and Agricultural Information Contact Centre, Ontario Ministry of Agriculture, Food and Rural Affairs

Nursery and Landscape Specialist
Jennifer Llewellyn

E-mail: jennifer.llewellyn@ontario.ca

Tel: 519.826.4738

Agriculture Information Contact Centre

Providing province-wide, toll-free technical and business information to commercial farms, agri-businesses and rural businesses.

1 Stone Rd. West
Guelph, ON N1G 4Y2

Tel: 519-826-4047
Toll-free: 1-877-424-1300
Fax: 519-826-7610
E-mail: ag.info.omafra@ontario.ca

APPENDIX B: Additional Resources

Many factsheets, publications and other resources are available from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

These can be ordered from Service Ontario:

- Online at ServiceOntario Publications: ontario.ca/publications
- By phone through the ServiceOntario Contact Centre Monday–Friday, 8:30 am–5:00 pm

416-326-5300
416-325-3408 (TTY)
1-800-668-9938 Toll-free across Canada
1-800-268-7095 TTY Toll-free across Ontario

- In person at ServiceOntario Centres located throughout the province or at any OMAFRA Resource Centre. Many can also be found online at ontario.ca/omafra
- For a complete list of publications from OMAFRA: ontario.ca/omafra

OMAFRA Publications

- *Agronomy Guide for Field Crops* – Publication 811
- *Growing Strawberries in Ontario* – Publication 513
- *Growing Red Raspberries in Ontario* – Publication 105
- *Fruit Crop Protection Guide* – Publication 360
- *Guide to Weed Control* – Publication 75
- *Integrated Pest Management for Ontario Apples* – Publication 310
- *Ontario Field Vegetable Guide* – Publication 839
- *Soil Fertility Handbook* – Publication 611
- *Vegetable Crop Protection Guide* – Publication 838

Websites

Websites for technical information on pests and production in Ontario fruit crops:

- OMAFRA gateway to information on crops: ontario.ca/crops
- Spotted wing drosophila: ontario.ca/spottedwing
- Brown marmorated stink bug: ontario.ca/stinkbug
- Crop IPM (integrated pest management) modules: ontario.ca/cropipm
- Soil management, fertilizer use, crop nutrition and cover crops for fruit production: www.omafra.gov.on.ca/english/crops/hort/soil_fruit.htm
- Label Search Tool to find labels for pesticides and products registered for use in Canada: http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php
- Information on pesticide application technology: www.sprayers101.ca
- Specialty Cropportunities to find information on specialty berries and fruit: ontario.ca/crops (search on “cropportunities”)

Resources on Application Technology

- Ontario Pesticide Education Program: www.opep.ca

OMAFRA Factsheets:

- Plant Growth Regulators for Fruit
- Hand and Chemical Thinning in Tree Fruit
- Mating Disruption for Management of Insect Pests
- How Weather Conditions Affect Spray Applications
- Six Elements of Effective Spraying in Orchards and Vineyards
- Calibrating Airblast Sprayers
- Adjusting, Maintaining and Cleaning Airblast Sprayers
- Pesticide Drift from Ground Applications

Airblast 101 Course Materials: basic tools for applying pesticides and plant growth modifiers in an effective, economic and environmentally responsible manner. For more information, contact the ministry Application Technology Specialist.

Best Management Practices

The Best Management Practices series of publications presents a practical, affordable approach to conserving a farm’s soil and water resources without sacrificing productivity.

A sampling of titles appears below. For a complete list of books in the BMP series, see: ontario.ca/omafra.

- BMP01E *Farm Forestry and Habitat Management*
- BMP06E *Soil Management*
- BMP07E *Water Management*
- BMP08E *Irrigation Management*
- BMP09E *Integrated Pest Management*
- BMP13E *Pesticide Storage, Handling and Application*
- BMP15E *Buffer Strips*
- BMP16E *Manure Management*
- BMP20E *Managing Crop Nutrients*
- BMP28E *Water and Fertilizer Use for Outdoor Container Production*

APPENDIX C: Suppliers of Pest Monitoring Equipment and Biological Control Agents

This list includes sources of weather monitoring equipment, pest monitoring supplies and biological control agents. For a more extensive list of beneficial insects and mite suppliers, see the OMAFRA website at ontario.ca/crops. This is a partial list and does not imply endorsement or recommendation by the Ontario Ministry of Agriculture, Food and Rural Affairs of the companies listed.

Company	Address	Telephone/Fax/Email	Products
Anatis Bioprotection www.anatisbioprotection.com	278 rang Saint-André Saint-Jacques-le-Mineur, QC J0J 1Z0	Toll-free: 1-800-305-7714 Email: info@anatisbioprotection.com	· beneficial insects and mites
Biobest Canada Ltd. www.biobestgroup.com	2020 Foxrun Rd. R.R. #4 Leamington, ON N8H 3V7	Tel: 519-322-2178 Fax: 519-322-1271 Email: info@biobest.ca	· beneficial insects, mites, nematodes · pheromone lures and traps · bumblebee hives for pollination
Contech Enterprises Inc. (Formerly Pherotech)	7572 Progress Way Delta, BC V4G 1E9	Tel: 1-800-767-8658 Fax: 604-940-9433 Email: sales@contech-inc.com	· pheromone lures and traps
Cooper Mill Ltd. www.coopermill.com	31 Hastings Road R.R. #3 Madoc, ON K0K 2K0	Tel: 613-473-4847 Fax: 613-473-5080 Email: ipm@coopermill.com	· pheromone lures and traps
Distributions Solida Inc. www.solida.ca	480 rang St-Antoine St. Ferreol-les-Neiges, QC G0A 3R0	Tel: 418-826-0900 Fax: 418-826-0901 Email: info@solida.ca	· pheromone lures and traps · tangle traps, insect trap coating · hand lens magnifiers · tally counters
Gempler's www.gemplers.com	P.O. Box 5175 Janesville, WI USA 53547	Toll-free: 1-800-382-8473 Fax: 1-800-551-1128 Email: customerservice@gempler.com	· weather monitoring equipment · pheromone lures and traps · tangle traps · hand lens magnifiers · tally counters
Great Lakes IPM, Inc. www.greatlakesipm.com	10220 Church Road NE Vestaburg, MI USA 48891	Tel: 989-268-5693 Toll-free: 1-800-235-0285 Fax: 989-268-5311 Email: glipm@greatlakesipm.com	· apple scab monitoring equipment · pheromone lures and traps · tangle traps · hand lens magnifiers · tally counters · insect sweep nets · field diagnostic equipment
Koppert Canada Ltd. www.koppertonline.ca	50 Ironside Cres. #2 Scarborough, ON M1X 1G4	Tel: 1-800-567-4195 Fax: 416-291-0902 Email: info@koppert.ca	· beneficial insects, mites · insect traps · BioWorks products

Company	Address	Telephone/Fax/Email	Products
Natural Insect Control www.naturalinsectcontrol.com	3737 Netherby Rd. Stevensville, ON L0S 1S0	Tel: 905-382-2904 Fax: 905-382-4418 Email: nic@niagara.com	· beneficial insects, mites and nematodes (Canadian strains) · pheromone lures and traps · mating disruption devices · bird houses
N.M. Bartlett Inc. www.bartlett.ca	4509 Bartlett Rd. Beamsville, ON L0R 1B1	Tel: 905-563-8261 Toll-free: 1-800-767-8658 Fax: 905-563-7882 Email: info@bartlett.ca	· pheromone lures and traps · mating disruption devices
Plant Products Inc. www.plantproducts.com	50 Hazelton Street Leamington, ON N8H 1B8	Tel: 519-326-9037 Toll-free: 1-800-387-2449 Fax: 519-326-9290 Email: info@plantproducts.com	· pheromone lures and traps · mating disruption devices · rodent traps · sticky tape and cards · tangle traps · beneficial insects
Warwick Orchards and Nursery	7056 Egremont Rd. R.R. #8 Watford, ON N0M 2S0	Tel: 519-849-6730 Fax: 519-849-6731 Email: warwickorchards@brktel.on.ca	· DeWitt leaf wetness sensor

APPENDIX D: Safety Supply Companies

This is a list of safety supply companies in Ontario providing protective clothing and personal protective equipment. Ask safety supply companies for help to select protective clothing and personal protective equipment. This is a partial list and does not imply endorsement or recommendation by the Ontario Ministry of Agriculture, Food and Rural Affairs of the companies listed.

Company	Address	Telephone/Fax/Email
3-M Canada Company www.3mcanada.ca	300 Tartan Drive London, ON N5V 4M9	Toll-free: 1-800-364-3577 Toll-free fax: 1-800-603-7758
Acklands Grainger www.acklandsgrainger.com	90 W. Beaver Creek Rd. Richmond Hill, ON L4B 1E7	Tel: 905-731-5516 Toll-free: 1-866-248-8801 Fax: 905-731-6053 Email: contact@agi.ca
Dupont Personal Protection Equipment www.personalprotection.dupont.ca	P.O. Box 2200 Streetsville Mississauga, ON L5M 2H3	Tel: 905-821-3300 Toll-free: 1-800-931-3456 Fax: 905-816-3059
Dutch Industries **"Protect-Air Cab Filter"** www.dutchopeners.com www.hurontractor.com	Huron Tractor 39995 Harvest Rd. Exeter, ON N0M 1S3	Tel: 519-235-1115 Fax: 519-235-1939
Hamisco Industrial Sales Inc. www.hamisco.com	3392 Wonderland Rd. S. London, ON N6L 1A8	Tel: 519-652-9800 Toll-free: 1-800-668-9800 Fax: 519-652-9661
Levitt-Safety (Eastern) Ltd. www.levitt-safety.com	2872 Bristol Circle Oakville, ON L6H 5T5	Tel: 905-829-3299 Toll-free: 1-888-453-8488 Fax: 905-829-2919 Email: csr@levitt-safety.com
The Mitt & Robe Company Ltd.	751 Norfolk St. N. Simcoe, ON N3Y 3R6	Tel: 519-428-4050 Toll-free: 1-877-893-6565 Fax: 519-428-5142 Email: sales@mittrobe.ca
MSA Canada www.msasafety.com	100 Westmore Dr., Unit 23 Toronto, ON M9V 5C3	Tel: 416-620-4225 Toll-free: 1-800-672-2222 Fax: 416-679-2875 Email: info@msasafety.com
Plant Products Inc. www.plantproducts.com	50 Hazelton St. Leamington, ON N8H 1B8	Tel: 519-326-9037 Toll-free: 1-800-387-2449 Fax: 519-326-9290 Email: info@plantproducts.com
Safety Express www.safetyexpress.com	4190 Sladeview Cres., Unit 1 & 2 Mississauga, ON L5L 0A1	Tel: 905-608-0111 Toll-free: 1-800-465-3898 Fax: 905-608-0091 Email: info@safetyexpress.com
The St. George Company Ltd. www.thestgeorgeco.com	20 Consolidated Dr. P.O. Box 430 Paris, ON N3L 3T5	Tel: 519-442-2046 Toll-free: 1-800-461-4299 Fax: 519-442-7191 Email: sales@thestgeorgeco.com

APPENDIX E: Diagnostic Services

Samples for disease diagnosis, insect or weed identification, nematode counts and Verticillium testing can be sent to:

Pest Diagnostic Clinic
Laboratory Services Division
University of Guelph
95 Stone Rd. W.
Guelph, ON N1H 8J7

Tel: 519-767-6299
Fax: 519-767-6240
Website: www.guelphlabservices.com
Email: aflinfo@uoguelph.ca

Payment must accompany samples at the time of submission. Submission forms are available at www.guelphlabservices.com/AFL/submit_samples.aspx

To obtain information on the fee schedule, visit www.guelphlabservices.com or phone the Pest Diagnostic Clinic.

How to Sample for Nematodes

Soil

When to sample
Soil and root samples can be taken at any time of the year that the soil is not frozen. In Ontario, nematode soil population levels are generally at their highest in May and June and again in September and October.

How to sample soil
Use a soil sampling tube, trowel or narrow-bladed shovel to take samples. Sample soil to a depth of 20–25 cm (8–10 in.). If the soil is bare, remove the top 2 cm (1 in.) prior to sampling. A sample should consist of 10 or more subsamples combined. Mix well, then take a sample of ½–1 L (1 pint–1 qt) from this. No single sample should represent more than 2.5 ha (6.25 acre). Mix subsamples in a clean pail or plastic bag.

Sampling pattern
If living crop plants are present in the sample area, take samples within the row and from the area of the feeder root zone (with trees, this is the drip line).

Number of subsamples
Based on the total area sampled:

500 m^2 (5,400 ft^2)	10 subsamples
500 m^2–0.5 ha (5,400 ft^2–1.25 acre)	25 subsamples
0.5 ha–2.5 ha (1.25–6.25 acre)	50 subsamples

Roots
From small plants, sample the entire root system plus adhering soil. For large plants, 10–20 g (½–1 oz.), dig fresh weight from the feeder root zone and submit.

Problem areas
Take soil and root samples from the margins of the problem area where the plants are still living. If possible, also take samples from healthy areas in the same field. If possible, take both soil and root samples from problem and healthy areas in the same field.

Sample handling

Soil samples
Place in plastic bags as soon as possible after collecting.

Root samples
Place in plastic bags and cover with moist soil from the sample area.

Storage
Store samples at 5°–10°C (40°–50°F) and do not expose them to direct sunlight or extreme heat or cold (freezing). Only living nematodes can be counted. Accurate counts depend on proper handling of samples.

Submitting Plant for Disease Diagnosis or Identification

Sample submission forms
Forms can be obtained from your local Ontario Ministry of Agriculture, Food and Rural Affairs office. Carefully fill in all of the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past three years and this year's pesticide use records.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system, or several plants showing a range of symptoms. If symptoms are general, collect the sample from an area where they are of intermediate severity. Completely dead material is usually inadequate for diagnosis.

With plant specimens submitted for identification, include at least a 20–25-cm sample of the top portion of the stem with lateral buds, leaves, flowers or fruits in identifiable condition. Wrap plants in newspaper and put in a plastic bag. Tie the root system off in a separate plastic bag to avoid drying out and contamination of the leaves by soil. Do not add moisture, as this encourages decay in transit. Cushion specimens and pack in a sturdy box to avoid damage during shipping. Avoid leaving specimens to bake or freeze in a vehicle or in a location where they could deteriorate.

Delivery

Deliver to the Pest Diagnostic Clinic as soon as possible by first class mail or by courier at the beginning of the week.

Submitting Insect Specimens for Identification

Collecting samples

Place dead, hard-bodied insects in vials or boxes and cushion with tissues or cotton. Place soft-bodied insects and caterpillars in vials containing rubbing alcohol. Do not use water, as this results in rot. Do not tape insects to paper or send them loose in an envelope.

Place live insects in a container with enough plant "food" to support them during transit. Be sure to write "live" on the outside of the container.

APPENDIX F: Ontario Ministry of the Environment, Conservation and Parks – Regional Contact Information

Region/County	Address	Telephone/Fax
Central Region Toronto, Halton, Peel, York, Durham, Muskoka, Simcoe	5775 Yonge St., 8th Floor Toronto, ON M2M 4J1	Tel: 416-326-6700 Toll-free: 1-800-810-8048 Fax: 416-325-6345
West-Central Region Haldimand, Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Ontario Government Building 119 King St. W., 9th Floor Hamilton, ON L8P 4Y7	Tel: 905-521-7640 Toll-free: 1-800-668-4557 Fax: 905-521-7820
Eastern Region Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry, Haliburton, Peterborough, Kawartha Lakes, Northumberland, Renfrew, Ottawa, Lanark, District of Nipissing (Twp. of South Algonquin)	1259 Gardiners Rd., Unit 3 PO Box 22032 Kingston, ON K7M 8S5	Tel: 613-549-4000 Toll-free: 1-800-267-0974 Fax: 613-548-6908
Southwestern Region Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth	733 Exeter Rd. London, ON N6E 1L3	Tel: 519-873-5000 Toll-free: 1-800-265-7672 Fax: 519-873-5020
Northern Region (East) Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma (East), Timiskaming, Sault Ste. Marie	199 Larch St., Ste. 1201 Sudbury, ON P3E 5P9	Tel: 705-564-3237 Toll-free: 1-800-890-8516 Fax: 705-564-4180
Northern Region (West) Algoma (West), Cochrane, Kenora, Rainy River, Timmins, Thunder Bay	435 James St. S., Ste. 331 Thunder Bay, ON P7E 6S7	Tel: 807-475-1205 Toll-free: 1-800-875-7772 Fax: 807-475-1745
Standards Development Branch	Pesticides Section 40 St. Clair Ave. W. 7th Floor Toronto, ON M4V 1L5	Tel: 416-327-5519 Fax: 416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Ave. W. 12A Floor Toronto, ON M4V 1L5	Tel: 416-314-8001 Toll-free: 1-800-461-6290 Fax: 416-314-8452

AGRICULTURE AND AGRI-FOOD CANADA RESEARCH CENTRES

www.agr.gc.ca/index_e.php

Eastern Cereals and Oilseeds Research Centre
960 Carling Ave.
Ottawa, ON K1A 0C6
Tel: 613-759-1858

Greenhouse and Processing Crops Centre
2585 County Road 20
Harrow, ON N0R 1G0
Tel: 519-738-2251

Southern Crop Protection and Food Research Centre
1391 Sandford St.
London, ON N5V 4T3
Tel: 519-457-1470

Vineland Research Farm
4902 Victoria Ave. N.
Vineland, ON L0R 2E0
Tel: 905-562-4113

Guelph Food Research Centre
93 Stone Road West
Guelph, N1G 5C9
Tel: 519-829-2400

CANADIAN FOOD INSPECTION AGENCY REGIONAL OFFICES (PLANT PROTECTION)

www.inspection.gc.ca

Belleville
345 College St. E.
Belleville, ON K8N 5S7
Tel: 613-969-3333

Brantford
625 Park Rd. N., Suite 6
Brantford, ON N3T 5P9
Tel: 519-753-3478

Hamilton
709 Main St. W., Ste. 101
Hamilton, ON L8S 1A2
Tel: 905-572-2201

London
19-100 Commissioners Rd. E.
London, ON N5Z 4R3
Tel: 519-691-1300

St. Catharines
395 Ontario St., PO Box 19
St. Catharines, ON L2N 7N6
Tel: 905-937-8232

Ottawa District
38 Auriga Dr., Unit 8
Ottawa, ON K2E 8A5
Tel: 613-274-7374, ext. 221

Toronto
1124 Finch Ave. W., Unit 2
Downsview, ON M3J 2E2
Tel: 416-665-5055

Guelph
174 Stone Rd W
Guelph, N1G 4T1
Tel: 519-837-9400

UNIVERSITY OF GUELPH

Main Campus
Guelph, ON N1G 2W1
Tel: 519-824-4120
www.uoguelph.ca

Ridgetown Campus
Ridgetown, ON N0P 2C0
Tel: 519-674-1500
www.ridgetownc.uoguelph.ca

Department of Plant Agriculture
www.plant.uoguelph.ca

Department of Plant Agriculture, Guelph
50 Stone Rd. W.
Guelph, ON N1G 2W1
Tel: 519-824-4120, ext. 56083
Fax: 519-763-8933

Department of Plant Agriculture, Simcoe
1283 Blueline Road, PO Box 587
Simcoe, ON N3Y 4N5
Tel: 519-426-7127
Fax: 519-426-1225

Department of Plant Agriculture, Vineland
4890 Victoria Ave. N., PO Box 7000
Vineland Station, ON L0R 2E0
Tel: 905-562-4141
Fax: 905-562-3413

Lab Services Division
95 Stone Rd. W., PO Box 3650
Guelph, ON N1H 8J7
Tel: 519-767-6299
www.uoguelph.ca/labserv

Trace Organics and Pesticides
Tel: 519-767-6485

Pest Diagnostic Clinic
Tel: 519-767-6256

VINELAND RESEARCH AND INNOVATION CENTRE

4890 Victoria Ave. N.
Vineland Station, ON L0R 2E0
Tel: 905-562-0320
Fax: 905-562-0084
www.vinelandresearch.com

APPENDIX H: The Metric System and Abbreviations

Metric Units

Linear Measures (length)
10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1,000 metres = 1 kilometre (km)
Square Measures (area)
100 m × 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)
Cubic Measures (volume)
Dry measure
1,000 cubic millimetres (mm^3)= 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)
Liquid Measure
1,000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)
Weight-Volume Equivalents (for water)
(1.00 kg) 1,000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)
Weight Measures
1,000 milligrams (mg) = 1 gram (g)
1,000 g = 1 kilogram (kg)
1,000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)
Dry–Liquid Equivalents
1 cm^3 = 1 mL
1 m^3 = 1,000 L
Approximate Metric Conversions
5 mL = 1 tsp
15 mL = 1 tbsp
28.5 mL = 1 Imp. fl. oz.

Application Rate Conversions

Metric to Imperial or U.S. (approximate)
litres per hectare × 0.09 = Imp. gallons per acre
litres per hectare × 0.11 = U.S. gallons per acre
litres per hectare × 0.36 = Imp. quarts per acre
litres per hectare × 0.43 = U.S. quarts per acre
litres per hectare × 0.71 = Imp. pints per acre
litres per hectare × 0.86 = U.S. pints per acre
millilitres per hectare × 0.014 = U.S. fluid ounces per acre
grams per hectare × 0.015 = ounces per acre
kilograms per hectare × 0.89 = pounds per acre
tonnes per hectare × 0.45 = tons per acre
Imperial or U.S. to Metric (approximate)
Imp. gallons per acre × 11.23 = litres per hectare (L/ha)
U.S. gallons per acre × 9.35 = litres per hectare (L/ha)
Imp. quarts per acre × 2.8 = litres per hectare (L/ha)
U.S. quarts per acre × 2.34 = litres per hectare (L/ha)
Imp. pints per acre × 1.4 = litres per hectare (L/ha)
U.S. pints per acre × 1.17 = litres per hectare (L/ha)
Imp. fluid ounces per acre × 70 = millilitres per hectare (mL/ha)
U.S. fluid ounces per acre × 73 = millilitres per hectare (mL/ha)
tons per acre × 2.24 = tonnes per hectare (t/ha)
pounds per acre × 1.12 = kilograms per hectare (kg/ha)
pounds per acre × 0.45 = kilograms per acre (kg/acre)
ounces per acre × 70 = grams per hectare (g/ha)

Liquid Equivalents

Litres/Hectare	Approximate Gallons/Acre
Imperial Gallons	U.S. Gallons
50 = 4.45	5.35
100 = 8.9	10.7
150 = 13.53	16.05
200 = 17.8	21.4
250 = 22.25	26.75
300 = 26.7	32.1

Application Rate Conversions (cont'd)

Approximate Dry Weight Equivalents

Grams/Hectare	Ounces/Acre
100	1½
200	3
300	4¼
500	7
700	10

Kilograms/Hectare	Pounds/Acre
1.10	1
1.50	1¼
2.00	1¾
2.50	2¼
3.25	3
4.00	3½
5.00	4½
6.00	5¼
7.50	6¾
9.00	8
11.00	10
13.00	11½
15.00	13½

Conversion Tables – Metric to Imperial (approximate)

Handy Metric Conversion Factor

Litres per hectare × 0.4 = litres per acre

Kilograms per hectare × 0.4 = kilograms per acre

Length
1 millimetre (mm) = 0.04 inch
1 centimetre (cm) = 0.4 inch
1 metre (m) = 39.4 inches
1 metre (m) = 3.28 feet
1 metre (m) = 1.09 yards
1 kilometre (km) = 0.62 mile
Area
1 square centimetre (cm^2) = 0.16 square inch
1 square metre (m^2) = 10.77 square feet
1 square metre (m^2) = 1.2 square yards
1 square kilometre (km^2) = 0.39 square mile
1 hectare (ha) = 107,636 square feet
1 hectare (ha) = 2.5 acres
Volume (dry)
1 cubic centimetre (cm^3) = 0.061 cubic inches
1 cubic metre (m^3) = 1.31 cubic yards
1 cubic metre (m^3) = 35.31 cubic feet
1,000 cubic metres (m^3) = 0.81 acre-foot
1 hectolitre (hL) = 2.8 bushels
Volume (liquid)
1 millilitre (mL) = 0.035 fluid ounce (Imp.)
1 litre (L) = 1.76 pints (Imp.)
1 litre (L) = 0.88 quart (Imp.)
1 litre (L) = 0.22 gallon (Imp.)
1 litre (L) = 0.26 gallon (U.S.)
Weight
1 gram (g) = 0.035 ounce
1 kilogram (kg) = 2.21 pounds
1 tonne (t) = 1.1 short tons
1 tonne (t) = 2,205 pounds
Pressure
1 kilopascal (kPa) = 0.15 $pounds/in.^2$
Speed
1 metre per second = 3.28 feet per second
1 metre per second = 2.24 miles per hour
1 kilometre per hour = 0.62 mile per hour
Temperature
°F = (°C × ⅘) + 32

Conversion Tables – Imperial to Metric (approximate)

Length
1 inch = 2.54 cm
1 foot = 0.3 m
1 yard = 0.91 m
1 mile = 1.61 km
Area
1 square foot = 0.09 m^2
1 square yard = 0.84 m^2
1 acre = 0.4 ha
Volume (dry)
1 cubic yard = 0.76 m^3
1 bushel = 36.37 L
Volume (liquid)
1 fluid ounce (Imp.) = 28.41 mL
1 pint (Imp.) = 0.57 L
1 gallon (Imp.) = 4.55 L
1 gallon (U.S.) = 3.79 L
Weight
1 ounce = 28.35 g
1 pound = 453.6 g
1 ton = 0.91 tonne
Pressure
1 pound per square inch = 6.90 kPa
Temperature
°C = (°F – 32) × 5⁄9

Abbreviations

%	= percent (by weight)	kPa	= kilopascal
ai	= active ingredient	L	= litre
cm	= centimetre	m	= metre
cm^2	= square centimetre	m/s	= metres per second
e.g.	= for example	m^2	= square metre
g	= gram	mL	= millilitre
ha	= hectare	mm	= millimetre
kg	= kilogram	t	= tonne
km/h	= kilometres per hour		

APPENDIX I: Pest Monitoring Record Sheet					
DATE (MM/DD/YY)	**LOCATION (Farm, Block, Landmarks, Direction)**	**HOST (Include Species 'Cultivar', Growth phase, Container vs. Field**	**PEST and/or SYMPTOMS (stage, population, % crop infestation)**	**GDD and/ or PLANT PHENOLOGY INDICATOR**	**ACTION TAKEN (Pesticide, Cultural measures)**

Emergency and First-Aid Procedures for Pesticide Poisoning

For pesticide poisonings and pesticide injuries, call the Poison Information Centre:
Toronto 1-800-268-9017
1-877-750-2233 (TTY)

PREVENT ACCIDENTS

- **Read the label.** Follow all the precautions the label recommends. Read the First Aid section of the label BEFORE you begin to handle any pesticide.
- **Make sure that someone knows** what pesticides you are working with and where you are.
- **Keep a file of labels and product Material Safety Data Sheets (MSDS) for the pesticides you use.**Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

If someone has been working with pesticides and you see any possible symptoms of pesticide poisoning or injury, take emergency action immediately.

IF AN ACCIDENT OR POISONING HAPPENS

- Protect yourself from injury first.
- Stop the exposure to the pesticide. Move the victim away from the contaminated area.
- Check the four basic facts — identify the pesticide, the quantity, the route of entry and time of exposure.
- Call an ambulance or the Poison Information Centre.
- Start first aid. This is not a substitute for professional medical help.
- **Provide the label, MSDS sheet or container to emergency personnel** at the scene — or take it with you to the hospital. Do not transport pesticide containers in the passenger compartment of the vehicle.

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FIRST AID

If a pesticide comes in contact with skin:

- remove all contaminated clothing; wash skin thoroughly with lots of soap and warm water
- dry skin well and cover with clean clothing or other clean material.

If pesticide comes in contact with eyes:

- hold eyelids open; wash the eyes with clean running water for 15 minutes or more.

If pesticide was inhaled:

- move the victim to fresh air and loosen tight clothing
- give artificial respiration if the victim is not breathing

Do not breathe in the exhaled air from the victim — you could also be poisoned.

If a pesticide was swallowed:

- call the Poison Information Centre IMMEDIATELY.

Emergency numbers are listed at the front of each Bell telephone directory.

To obtain copies of this or any other OMAFRA publication, please order:

- online at ontario.ca/publications
- by phone through the ServiceOntario Contact Centre, Monday to Friday, 8:30 AM to 5:00 PM ET
  - 416-326-5300
  - 416-326-3408 (TTY)
  - 1-800-668-9938, toll-free across Canada
  - 1-800-368-7095 (TTY), toll-free across Ontario
- in person at ServiceOntario Centres across Ontario

For a major spill, a theft or a fire involving a pesticide:

Call the Ministry of the Environment and Climate Change Spills Action Centre at
1-800-268-6060 (24 hr a day, 7 days a week).
Notify your municipality.

ontario.ca/crops

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