



CROP PROTECTION GUIDE

FOR NURSERY AND LANDSCAPE PLANTS

Publication 840

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 the Environment (MOE)

The information in this publication is general information only. The Ministry of Agriculture and Food (OMAF) and the Ministry of Rural Affairs (MRA) do not offer any warranty or guarantee, nor do they 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. It is against the law to use the product in any other way.

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 merit and 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 five 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, or the pesticide is used for emergency control of a serious pest outbreak.

Maximum Residue Limits

The PMRA has established maximum residue limits (MRLs) for pesticides. Processors or retailers may demand more restrictive limits. Growers should seek 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 OMAF, MRA or PMRA's Pest Management Information Service.

For more information on the federal registration status check the PMRA website at www.pmr-arfa.gc.ca or call 1-800-267-6315.

Regulation of Pesticides in Ontario

The MOE 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 www.e-laws.gov.on.ca 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 MOE, the classification of pesticide products before they can be sold or used in Ontario. Once approved by the MOE, classified products are posted on the MOE website: www.ene.gov.on.ca.

Certification and Licensing

Growers and Their Assistants

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

Commercial Applicators and Their Assistants

For more information about exterminator certification and licensing and technician training, check the Ontario Pesticide Training & Certification website at www.ontariopesticide.com/OPTC/default.htm or call 1-888-620-9999 or 519-674-1575.



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Publication 840

Introduction

Need technical or business information?
Contact the Agricultural Information Contact Centre at
1-877-424-1300
or
ag.info.omafra@ontario.ca

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

**If you are looking for timely information on the production and maintenance of outdoor ornamentals,
check out the Nursery and Landscape Report at www.ontario.ca/crops
It is updated weekly from April to October.
Sign up for a free subscription on the website.**

OMAF and MRA Publication 840, *Crop Protection Guide for Nursery and Landscape Plants 2013*,
and Publication 841, *Guide to Nursery and Landscape Plant Production and IPM*, together replace OMAF and
MRA Publication 383, *Nursery & Landscape Plant Production and IPM*.

OMAF and MRA Publication 840 contains information about pesticide products
that have been registered as of December 31, 2012 on outdoor ornamentals.
Any supplements to this publication will be posted at www.ontario.ca/crops.

OMAF and MRA Publication 840 is a companion to OMAF and MRA Publication 841, *Guide to Nursery
and Landscape Plant Production and IPM* (expected to be released in 2013). Publication 841 will contain more
comprehensive information on pest management, nutrition and water quality and includes colour photos
for many common pests.

Front Cover Images:

The cover shows a large image of a beautiful fall morning in a field production nursery that includes evergreen
trees growing in the field and large, mature sugar maples as a windbreak in the background.

Inset into the picture are three smaller pictures, the top one showing powdery mildew on Sedum, the middle
image showing a willow leaf beetle on willow and the lower image showing defoliation by spruce sawfly on spruce.

Contents

1. Using Pesticides in Ontario	1	General Precautions When Using Pesticides	12
Federal Registration of Pesticides	1	Protection When Using Pesticides	12
Regulations of Pesticides in Ontario	1	Protective Clothing and Equipment	13
Classification of Pesticides	1	When Working in Enclosed Areas	14
Certification and Licensing	2	Canister Respirators	14
Growers and Their Assistants	2	Self-Contained Breathing Apparatus	14
Commercial Applicators (Exterminators) and Their Assisting Technicians	2	Other Protective Clothing	14
Exception for Tree Care Specialists	2	Working Conditions	14
Pesticide Application Information	2	Safety Equipment Suppliers	14
Restricted Entry Intervals	3	Care of Protective Clothing and Equipment	16
Days to Harvest Intervals for Food Crops (Pre-Harvest, Pre-grazing and Feeding Intervals)	3	Respirators	16
Buffer Zones	3	Rubber, Vinyl or Plastic Boots and Gloves	16
Protect the Environment	4	How to Wash Clothes Used for Spraying	16
Protect Water Sources	4	Personal Hygiene	17
Bee Poisoning	4	3. Crop Protection: Insects, Mites and Diseases	19
Manage Drift	5	Using Pesticides	19
Pesticide Disposal	6	Classification of Pesticides for Sale and Use in Ontario	19
Empty Pesticide Containers Up to 23 L	6	Toxicity Information	19
Empty Pesticide Containers Greater Than 23 L	7	Prevent Bee Poisoning	19
Surplus Spray Mix	7	Chemical Families	20
Surplus Pesticide Disposal	7	Pesticide Application Restrictions	25
Storing Pesticides	7	A Compendium of Pests and Diseases with Recommended Management Practices — as of January 1, 2013	25
Pesticide Spills	8	ABIES — fir	26
2. Safe Use of Pesticides	9	ACER — maple	27
Human Health	9	AESCULUS — horsechestnut	30
Risks of Pesticide Use	9	AMELANCHIER — serviceberry	31
Cholinesterase Blood Tests	10	BETULA — birch	32
Read and Follow Pesticide Label Information	10	BUXUS — boxwood	33
Know the Hazard Symbols and Words	10	CARAGANA — pea shrub	33
First Aid	11	CARYA — hickory	34
		CHAENOMELES — quince	34
		CLEMATIS — clematis	35
		CORNUS — dogwood	35

CORYLUS — corkscrew hazel, filbert.....	36
COTONEASTER — cotoneaster.....	36
CRATAEGUS — hawthorn	37
EUONYMUS — euonymus.....	38
FAGUS — beech	40
FORSYTHIA — forsythia	40
FRAXINUS — ash	41
GLEDITSIA — honeylocust	43
HEDERA — ivy	44
HEMEROCALLIS — daylily.....	45
HERBACEOUS PERENNIALS — various	46
HYDRANGEA — hydrangea.....	48
JUGLANS — butternut, walnut.....	48
JUNIPERUS — juniper	49
LARIX — larch	50
LIGUSTRUM — privet	51
LIRIODENDRON — tuliptree	51
LONICERA — honeysuckle	52
MAGNOLIA — magnolia	52
MALUS — apple	53
ORNAMENTAL TREES AND SHRUBS — various	57
PACHYSANDRA — pachysandra	57
PHLOX — phlox	57
PICEA — spruce.....	58
PINUS — pine	62
PLATANUS — London plane, sycamore	67
POPULUS — poplar.....	67
POTENTILLA — potentilla.....	68
PRUNUS — black cherry, chokecherry, flowering cherry, pin cherry, peach, plum	69
PSEUDOTSUGA — Douglas fir	72
PYRACANTHA — firethorn	73
PYRUS — pear	74
QUERCUS — oak.....	75
RHODODENDRON — rhododendron, azalea ..	78
RIBES — currant	79
ROBINIA — locust	79
ROSA — rose	80
SALIX — willow	82
SORBUS — mountain ash	84
SYRINGA — lilac	85
TAXUS — yew	87
THUJA — eastern white cedar, arborvitae	88
TILIA — linden, basswood	90
TSUGA — hemlock	92
ULMUS — elm.....	93
VIBURNUM — viburnum.....	96

4. Crop Protection: Weeds 97

Chemical Weed Control 97

Herbicide Licensing Requirements..... 97

Applying Chemical Herbicides 97

Herbicide Drift 97

When to Use Herbicides 98

Application Technology 98

New Technologies 98

Sprayers for Small Areas..... 98

Field Sprayers 98

Air Blast or Mist Sprayers 98

Wiper Applicators for Selective Weed Control .. 98

Equipment Use and Care 99

Spraying Speeds 99

Using Water Correctly..... 99

Agitation 99

*Preparing a Wettable Powder and Oil or
Emulsifiable Concentrate Mix* 99

Pumps 99

Nozzles 100

Flat-Fan Nozzle Tips..... 100

Flooding-Fan Nozzle Tips 100

Broadcast Nozzle Tips..... 100

Full and Hollow Cone Nozzle Tips..... 100

Nozzle Screens 100

Cleaning the Sprayer 100

Environmental Issues When Cleaning 101

Sprayer Calibration 101

Determining Application Rates in L/ha 101

Method 1 101

Method 2 102

Determining the Number of Hectares
per Tankful 102

Calibrating Hand-Held and Backpack
Sprayers 103

Method 1 103

Method 2 103

Determining the Herbicide Quantity
Required 103

Materials, Mixing and Mixtures 103

Dry Formulations 103

Liquid Formulations 104

Mixing Herbicide Formulations 104

Application Indicators 104

A Compendium of Herbicides with Their Recommended Uses in Ontario — as of January 1, 2013 104

Notes on Herbicides 104

PREPLANTING TREATMENTS 106

Soil Fumigants 106

- ◆ *dazomet*
BASAMID
dithiocarbamate 106
- ◆ *metam sodium*
VAPAM
thiocarbamate..... 107
- ◆ *methyl bromide/chloropicrin*
TERR-O-GAS 67
organohalogen 107

PREEMERGENCE TREATMENTS 108

- ◆ *chlorthal dimethyl*
DACTHAL W-75
phthalate 108
- ◆ *dichlobenil*
CASORON G-4
nitriles 109
- ◆ *dimethenamid-p*
FRONTIER MAX
chloroacetamide 110
- ◆ *flumioxazin*
BROADSTAR G/SUREGUARD WDG
N-phenylphthalimide 111
- ◆ *isoxaben*
GALLERY 75 DF
benzamide 113
- ◆ *napropamide*
DEVIRINOL 2 G/DEVIRINOL 10 G/
DEVIRINOL 50 DF
amide 113
- ◆ *oxadiazon*
RONSTAR 2 G
oxadiazole 114
- ◆ *propyzamide*
KERB 50 WSP
amide 115
- ◆ *s-metolachlor*
DUAL II MAGNUM
acetanilide 116
- ◆ *simazine*
PRINCEP NINE-T/SIMADEX
S-triazine..... 116
- ◆ *trifluralin*
BONANZA 400 EC/RIVAL EC/TREFLAN EC
dinitroaniline..... 117

POSTEMERGENCE TREATMENTS 118

- ◆ *amitrole*
AMITROL 240
triazole 118
- ◆ *carfentrazone-ethyl*
AIM EC
triazolinone 119
- ◆ *clopyralid*
LONTREL 360
pyridine carboxylic acid 120
- ◆ *fluazifop-p-butyl*
VENTURE L
aryloxyphenoxy propionate 120
- ◆ *glyphosate*
various products
amino acid 121
- ◆ *oxyfluorfen*
GOAL 2XL
diphenyl-ether 122
- ◆ *paraquat*
GRAMOXONE
bipyridylum 123
- ◆ *triclopyr*
GARLON
carboxylic acid..... 123

Crop Tolerance and Efficacy of Herbicides Registered on Nursery Crops 124

5. Appendices 131

Appendix A. Nursery Crop Advisory Staff, Ministry of Agriculture and Food and the Ministry of Rural Affairs 131

Appendix B. Regional Contact Information, Ministry of the Environment 131

Appendix C. Other Contacts 132

Appendix D. Diagnostic Service 133

Appendix E. The Metric System 136

Appendix F. Pest Monitoring Record Sheet..... 139

Tables

1. Using Pesticides in Ontario

<i>Table 1–1. Requirements for Pesticide Storage Facilities</i>	<i>7</i>
---	----------

2. Safe Use of Pesticides

<i>Table 2–1. Label Hazard Symbols and Words</i>	<i>10</i>
<i>Table 2–2. Ontario Suppliers of Protective Clothing and Equipment.....</i>	<i>15</i>

3. Crop Protection: Insects, Mites and Diseases

<i>Table 3–1. Relative Toxicity of Pesticides to Honeybees</i>	<i>20</i>
<i>Table 3–2. Insecticides and Fungicides Used to Protect Ornamentals (as of January 1, 2013).....</i>	<i>21</i>

4. Crop Protection: Weeds

<i>Table 4–1. Herbicides Registered for Nursery Crops in Ontario (by Trade Name)</i>	<i>105</i>
<i>Table 4–2. Herbicides Registered for Nursery Crops in Ontario (by Common Name)</i>	<i>105</i>
<i>Table 4–3. Herbicides Registered for Use on Woody Plants</i>	<i>124</i>
<i>Table 4–4. Weed Susceptibility and Herbicides — Broadleaf Annuals</i>	<i>128</i>
<i>Table 4–5. Weed Susceptibility and Herbicides — Broadleaf Perennials</i>	<i>129</i>
<i>Table 4–6. Weed Susceptibility and Herbicides — Annual Grasses</i>	<i>130</i>

1. Using Pesticides in Ontario

The information in this chapter is updated regularly. For up-to-date information, visit www.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*.
Keep detailed spray records.

Federal Registration of Pesticides

Before a pesticide 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 the product has merit and value. It also ensures that any human health and environmental risks associated with its proposed uses are acceptable.

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. 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
- removal of the registration

The pesticide label is a legal document. It prescribes how the pesticide can be legally used. Labels for all registered pesticides are under "Search Pesticide Labels" on the PMRA website at www.pmra-arla.gc.ca. Ensure you have the most current label and are aware of any re-evaluation decisions.

Regulation of Pesticides in Ontario

The Ministry of the Environment (MOE) 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 www.e-laws.gov.on.ca 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 11 classes. Ontario's Pesticides Advisory Committee (OPAC) is responsible for assessing new pesticide products and recommending to the MOE 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 MOE, classified products are posted on the MOE website at www.ontario.ca/environment.

Certification and Licensing

Growers 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 use Class 4, 5, 6 or 7 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.

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/index.cfm/home-page or call 1-888-620-9999 or 519-674-1575
- the Pesticide Industry Council website at www.hort-trades.com or call 1-800-265-5656 or email pic@hort-trades.com
- the Pesticide Industry Regulatory Council (PIRC) at www.oipma.ca

Exception for Tree Care Specialists

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, see the Ministry of the Environment's website (www.ontario.ca/pesticideban). Click on "Industries and Institutions" and refer to the factsheet *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.pmr-arla.gc.ca
- PMRA Pest Management Information Service: 1-800-267-6315 (from within Canada) or 1-613-736-3799 (from outside Canada)

- Ontario Ministry of the Environment (MOE) website: www.ontario.ca/environment
- Regional MOE Pesticides Specialist (See Appendix B. *Regional Contact Information, Ministry of the Environment*, on page 131.)
- Ministry of Agriculture and Food (OMAF) website: www.ontario.ca/omafra
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) website: www.opep.ca
- Ontario Pesticide Training & Certification website: www.ontariopesticide.com/index.cfm/home-page
- Pesticide Industry Council website at www.hort-trades.com
- 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
- buffer zones
- precautionary statements
- steps to be taken in case of an accident
- disposal

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

For more information on pesticide application, see:

- OMAF and MRA Factsheet *Calibrating Airblast Sprayers*, Order No. 10-047
- OMAF and MRA Factsheet *Adjusting, Maintaining and Cleaning Airblast Sprayers*, Order No. 10-069
- OMAF and MRA Factsheet *How Weather Conditions Affect Spray Applications*, Order No. 09-037w (website only)
- OMAF and MRA Factsheet *Pesticide Drift from Ground Applications*, Order No. 11-001
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos at www.opep.ca/index.cfm/learning-resources/videos/
- OMAF and MRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- OMAF and MRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Cleanup and Responsibilities*, Order No. 10-097

Restricted Entry Intervals

The restricted entry interval, also referred to as re-entry interval (REI), is the period of time following a pesticide application during which workers must not enter the treatment area. This allows any pesticide residue and vapours to dissipate from the treatment location (e.g., field), preventing the possibility of inadvertent pesticide exposure.

The PMRA reviews each pesticide to determine whether the label should include a specific restricted entry interval. If the restricted entry interval is not stated on the label for agricultural crops, assume that the REI is 12 hours. For golf courses and residential turf applications, the spray solution must be dry before entry can occur. Some pesticides have labels that carry a warning about working in treated crops and provide specific PPE requirements. Follow the label recommendations.

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-hour 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.

Leave a suitable buffer zone between the treatment area and adjacent sensitive area. Buffer zones may vary depending on the method of application (e.g., aerial, field boom, air blast). Check the pesticide labels for buffer zone requirements.

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 allows 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. 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:

- OMAF and MRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Cleanup and Responsibilities*, Order No. 10-097
- OMAF and MRA Factsheet *Groundwater — An Important Rural Resource: Protecting the Quality of Groundwater Supplies*, Order No. 06-115
- OMAF and MRA/Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13

Bee Poisoning

Honeybees, native bee species 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. Under normal circumstances, spraying after 8 PM allows the spray to dry before the bees are exposed to it the next day. Early morning is the next best time, but 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 (e.g., dandelions) or flowering cover crops (e.g., clover) that have come in contact with an insecticide. 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 it or planting seeds treated with an insecticide. Take measures to reduce movement of dust from insecticide seed treatments to flowering weeds that are in or adjacent to the target field. Refer to OMAF and MRA's "Field Crop News" blog at fieldcropnews.com for current information on ways to reduce dust movement.
- Beekeepers should remove honeybee colonies as soon as pollination is complete in the crop and before any insecticides are applied post bloom. 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 hours 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.
- 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. See Table 3–1, *Relative Toxicity of Pesticides to Honeybees*, on page 19, which shows the relative toxicity of products to honeybees.
- Always read the most current label for guidance.
- Before applying a pesticide or planting with insecticide-treated seed, advise local beekeepers so they can move colonies out of the danger area, if this is an option. Contact information for the local beekeepers' association in your area can be found on the Ontario Beekeepers' Association website at <http://www.ontariobee.com/community/local-beekeepers-associations>. Other ways to find your local beekeepers are to contact the Provincial Apiarist at 1-888-466-2372, ext. 63595 or see

www.ontario.ca/crops and click "Apiculture" and then "Bee Inspectors" for a list of provincial bee inspectors who know the local beekeepers.

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 speeds are high or gusty. These conditions increase the potential for spray and vapour drift. Check pesticide labels for allowable wind speeds for spraying applications. However, not all labels provide this specific information.
- Constantly monitor wind conditions during spraying using a good-quality wind meter. Record the wind speed and direction. As wind conditions change, you may need to make adjustments to further reduce the drift potential, such as increasing water volume, minimizing nozzle-to-target distance, changing nozzle technology, changing fields because of surrounding influences or stopping spraying until conditions improve.
- Do not spray during periods of dead calm. Periods of dead calm may occur in early morning or late evening, at which time the temperature is usually cooler and the relative humidity is typically higher, which can result in the spray droplets remaining aloft, like fog. When the wind picks up, these spray droplets can move away from the target area, possibly causing injury to adjacent non-target areas. Off-target drift in calm conditions can occur hours after the spray event was completed.

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

- stay concentrated for long periods over the target
- move with the cool air over considerable distances when the breeze picks up
- move down slopes and concentrate in low-lying regions
- drift unpredictably as the inversion dissipates during the morning

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. Spray applicators can recognize a temperature inversion when:

- there is a big difference between the daytime and nighttime temperatures
- early evening and nighttime wind speeds are considerably less than during the day
- sounds seem to carry further
- odours seem more intense
- daytime cumulus clouds collapse toward evening
- overnight cloud cover is 25% or less
- mist, fog, dew or frost occur
- smoke or dust hangs in the air and/or moves laterally in a sheet.

Temperature inversions start to form 3 hours 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, then don't spray. Often, warnings for the risk of inversions are stated right on the product label.**

- Use the recommended sprayer output.
- Use a nozzle that will produce the droplet size specified on the pesticide label or delivers droplets appropriate for the job. Nozzles that produce fine droplets are rarely, if ever, required.
- Where practical, use air induction/venturi nozzles, which significantly reduce drift compared to conventional nozzles.
- Check the height of the boom to the target or distance from airblast boom to the target. Minimize the distance 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 spray plume protection where practical or available (hoods, shrouds, screens or air curtains).
- Use drift-reducing adjuvants in the spray tank as directed on the label. Mechanical or hydraulic agitations have been shown to reduce the effectiveness of certain drift-reducing adjuvants.

Be aware that certain combinations of anti-drift adjuvants and air-induction/venturi nozzles have been shown to increase the incidence of fine droplets that will drift.

- When possible, use non-volatile pesticide formulations or products.

For more information about spray drift, see:

- OMAF and MRA Factsheet *Pesticide Drift from Ground Applications*, Order No. 11-001
- OMAF and MRA/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 www.opep.ca/index.cfm/learning-resources/videos/chapter-19-drift-of-pesticides/

Pesticide Disposal

Empty Pesticide Containers Up to 23 L

Never re-use empty containers.

The Ontario Empty Pesticide 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 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.

Please note that starting in 2013 this program now includes liquid fertilizer containers up to 23 L in size.

Empty Pesticide Containers Greater Than 23 L

Growers and commercial applicators can return pesticide containers that are greater than 23 L in size. 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.

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 recommended 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 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 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 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 1–1, the storage requirements that must be followed are dependent on which classes of pesticides you store.

Table 1–1. Requirements for Pesticide Storage Facilities

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

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.

* Refer to MOE's website www.ene.gov.on.ca/en/land/pesticides for requirements for warning sign G. 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 MOE Spills Action Centre (1-800-268-6060) should also be readily available.

For more information about storing pesticides, see:

- OMAF and MRA Factsheet *Farm Pesticide Storage Facility*, Order No. 11-005
- OMAF and MRA/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 Spills Action Centre at 1-800-268-6060 (24 hours 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 cleanup 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.

For information on preventing spills, see:

- OMAF and MRA Factsheet *Ways to Avoid Pesticide Spills*, Order No. 96-025
- OMAF and MRA/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 the inside back cover.

2. Safe Use of Pesticides

For further information on the safe use of pesticides, refer to the *Grower Pesticide Safety Course Manual* found on the Ontario Pesticide Education Program's website at www.opecp.ca.

Human Health

Risks of Pesticide Use

Each time a pesticide is handled, there is some risk. The amount of risk depends on two things — the toxicity of that pesticide and the degree of exposure to it.

$$\text{Risk} = \text{Toxicity} \times \text{Exposure}$$

1. Toxicity is a measure of how harmful or poisonous the pesticide is. There are two types of toxicity:

Acute toxicity is the toxic response that results from a single exposure to the pesticide. The symbols and words on the front panel of a pesticide label give information about the acute toxicity (See Table 2–1, *Label Hazard Symbols and Words*, on page 10).

Lethal dose 50% (LD₅₀) is a measure of acute toxicity. It is the number of milligrams of product per kilogram of body weight that will kill 50% of test animals (usually female rats) within a stated period of time (24 hours to 7 days). This is commonly measured as the acute oral LD₅₀, which refers to the chemical ingested through the mouth or nose. Dermal LD₅₀ figures, which refer to penetration of the chemical through the skin, are also available.

The lower the LD₅₀ figure, the more toxic the product is to humans.

Examples of products with a high acute toxicity include:

Common (Active) Name	Trade Name
chlorpyrifos	Dursban, Pyrate
dichlorvos	DDVP
endosulfan	Endosulfan, Thiodan, Thionex
methomyl	Lannate

2. Chronic toxicity is the toxic response that results from repeated exposure to small doses of a pesticide over a longer period of time. These toxic effects may not appear for months or years after exposure to the pesticide. The symbols on the label do not give information about the chronic toxicity of the product. Use protective clothing and equipment to help reduce exposure and risk of chronic effects.

Exposure is a measure of the contact with the pesticide. Workers can be exposed to the pesticide in three ways:

- 1. Dermal exposure** occurs through the skin or eyes. The amount and rate of pesticide that may be absorbed depends on several things, including:
 - Skin condition at time of exposure: If the skin is moist, or if a rash, broken skin or scratches are present, pesticides will be absorbed more easily.
 - Part of the body that is exposed: Eyes, genital area, scalp and ear canals absorb pesticides at a higher rate than hands or arms. Eyes absorb 100% of the pesticides they are exposed to.
- 2. Respiratory exposure (inhalation)** occurs when small spray particles, dust, gases or vapours are inhaled.
- 3. Oral exposure** occurs when a pesticide enters the mouth or is swallowed.

Cholinesterase Blood Tests

Organophosphorus and carbamate pesticides can affect the human nervous system. These pesticides can reduce the levels of the enzyme acetyl cholinesterase in the serum and red blood cells. The body uses this enzyme to transmit messages through the nervous system. If cholinesterase levels fall, individuals experience symptoms such as trembling, twitching, blurred vision, and breathing and heart difficulties.

People who use any organophosphorus or carbamate pesticides on a routine basis should have regular cholinesterase blood tests. A family doctor can arrange these tests, which are covered by the Ontario Health Insurance Plan (OHIP). Workers should have their first test before beginning to handle these pesticides to assess their normal (baseline) cholinesterase level.

During the spray season, workers who spray organophosphorus or carbamate insecticides regularly for several weeks should have a cholinesterase blood test every 7 to 10 days. If the worker's cholinesterase level drops to less than half of the baseline level, the worker is showing signs of pesticide poisoning and should not be exposed to these pesticides until cholinesterase levels return to normal.

Examples of products that contain organophosphorus or carbamate insecticides include:

Common (Active) Name	Trade Name
acephate	Orthene
bendiocarb	Trumpet
dichlorvos	DDVP
malathion	Malathion
naled	Dibrom

Read and Follow Pesticide Label Information

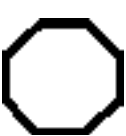
Know the Hazard Symbols and Words

Four important symbols and words show the potential hazards of pesticides.

Table 2-1. Label Hazard Symbols and Words

Hazard Symbol	Signal Word
	Poison
	Corrosive
	Flammable
	Explosive

The hazard symbol always appears inside one of the shapes shown on page 11. The shape and its signal word together indicate the degree of hazard of the pesticide. The greater the number of sides of the shape, the more hazardous the product.

Degree of Hazard	Warning Symbol	Signal Word
Triangular shape (3 sides) means low hazard		Caution
Diamond shape (4 sides) means moderate hazard		Warning
Octagonal shape (8 sides) means high hazard		Danger

**Learn these symbols and words —
they could save your life!**

Check the label for special warnings about eye hazards and skin hazards. **In addition**, the front panel of the pesticide label may contain warnings that indicate whether the product is corrosive to eyes or is a skin or eye irritant.

First Aid

If a serious accident occurs, call 911.

1. Rescuers should always protect themselves from injury. Protective clothing and equipment should always be worn before entering a contaminated area or handling a contaminated victim.

Symptoms of Pesticide Poisoning

Mild Symptoms

Headache, fatigue (feeling tired), loss of appetite, dizziness, weakness, nervousness, nausea, perspiration, diarrhoea, loss of weight, thirst, moodiness, irritation of the skin, eyes, nose or throat.

Moderate Symptoms

Nausea, trembling, loss of muscular co-ordination, excessive saliva, blurred vision, constricted throat or chest, laboured breathing, flushed or yellow skin, abdominal cramps, vomiting, diarrhoea, thirst, mental confusion, perspiration, rapid pulse, cough.

Severe Symptoms

Vomiting, loss of reflexes, inability to breathe or increased breathing rate, muscle twitching, tiny pupils, convulsions, unconsciousness, thirst, fever.

(Source: *Grower Pesticide Safety Course Manual*, University of Guelph Ridgetown Campus. Available online at www.opep.ca.)

If symptoms occur during or shortly after handling a pesticide, go to a hospital. Take the pesticide label, Material Data Safety Sheet (MSDS) or pesticide container. Do not transport the container in the passenger compartment. See the Emergency Procedures for Pesticide Poisoning on the inside back cover.

2. Check to see if the victim is breathing.

If the victim is not breathing:

- Straighten the victim's airway and check for breaths.
- If the victim does not begin to breathe, perform artificial respiration until the victim begins to breathe independently.
- Avoid becoming contaminated, especially if the victim has pesticide or vomit around the face or mouth. Use a face shield airway with a one-way valve. Do not breathe the exhaled air from the victim.
- If the victim's pulse disappears, perform CPR if qualified to do so.

If the victim is breathing, but unconscious:

- Place the victim in the recovery position (on the side with the head turned slightly down). If the victim vomits, try to keep the airway clear.
3. Stop the exposure to the pesticide. Move the victim away from the contaminated area. Remove all contaminated clothing. Use soap and water to wash any skin exposed to the pesticide.
 4. Check the four basic facts:
 - What? Identify the pesticide. Look for the label, container or leftover pesticide.
 - How much? How much product was the victim exposed to?
 - Where? How did the pesticide enter the body? Did it enter through the mouth, skin, eyes or lungs?
 - When? How much time has passed since the victim was exposed to the pesticide, and how long was the exposure? Were the symptoms immediate or did the poisoning occur as a result of using the pesticide over a longer period of time?

Don't waste time.

If you can't answer these questions quickly, be ready to tell emergency personnel whatever you can.

5. Call an ambulance or the poison information centre.
6. Start the first aid treatment appropriate for the contaminant and route of entry. First aid instructions can be found on most pesticide labels.
7. Make sure the patient gets medical attention. First aid is not a substitute for professional medical help.

General Precautions When Using Pesticides

Always read the label:

- before buying a pesticide
- before using a pesticide
- before storing or disposing of a pesticide

Always keep records of pesticide use.

Learn about the health hazards and toxic properties of the pesticide being used. Consult the product label, Material Safety Data Sheet (MSDS) or manufacturer for this information. Check the company's website for MSDS information.

Protection When Using Pesticides

Tell someone where the work is taking place, what pesticides are being handled and how long the job is expected to take.

Post emergency numbers, including the numbers for the Poison Information Centre and Spills Action Centre, near all telephones.

Keep a list of the names and the *Pest Control Products (PCP) Act* Registration Numbers of all the pesticides handled. It's a good idea to keep a file of the pesticide label booklets for all the products used. Ensure that co-workers and family members know where to find this list or file in case of an accident.

Have plenty of clean water, soap and paper towels — and an extra set of gloves and coveralls — nearby at all times in case a pesticide contaminates clothing or skin.

Wear the correct protective clothing and equipment and be sure that all items are clean and in good repair before wearing or using them.

Never smoke, chew tobacco, eat or drink when handling pesticides. Never carry tobacco or food in clothes, and never leave tobacco, food or beverages in areas where pesticides are handled or stored.

Change clothes and wash hands and face before eating, drinking or smoking.

Wash hands before using the toilet, as well as after. The skin in the groin area absorbs pesticides very easily.

Protective Clothing and Equipment

Choose and wear the appropriate protective clothing and equipment. Make sure protective clothing and equipment fit properly and are clean and in good repair. The protective clothing and equipment workers should wear depends on:

- **The pesticide being used** — read the precautions section of the label to find out what is required.
- **The job being done** — for example, use more protection when handling concentrated pesticide or when mixing and loading a sprayer.
- **The type of application** — enclosed space or air-blast sprayer applications made with open tractors require more protective equipment.

All persons who work with pesticides need their own set of protective clothing and equipment. Consult the product label to find out what protective clothing is required.

For all pesticides, always wear:

- a water-repellent hat, such as a hard hat or waterproof rain hat
 - Sometimes the entire head and neck must be protected: for example, if applying pesticides in a greenhouse, applying dusty formulations or using an air-blast sprayer. In these situations, wear a hood or hat that protects the ear canals.

Do not wear baseball-style or other cloth hats, which absorb pesticides and are not safe.

- long pants and a long-sleeved shirt or coveralls
 - Coveralls can be reusable or disposable.
 - If the reusable coveralls are cotton or polyester, they should be tightly woven. However, water-resistant coveralls are preferred because cotton, denim and cotton/polyester pants cling to the skin if they get wet, which increases the risk of dermal exposure.
 - Disposable coveralls should be designated for pesticide use.
- chemical-resistant gloves (unlined)
 - Use neoprene or nitrile PVC gloves, unless the label states otherwise. Do not wear rubber gloves, because many pesticides can break down the rubber material. Fold up the cuffs of the gloves and wear the gloves tucked under the shirt or jacket sleeves.
- chemical-resistant boots (unlined)
 - Wear pant legs over boots to prevent pesticide from running down inside the boots.

Read the label. It will describe what extra protective clothing and equipment to wear.

For some pesticides, workers should also wear:

- goggles
 - Use safety goggles with indirect vents so that splashes do not enter the eye. Regular eyeglasses do not provide complete protection. Never wear contact lenses when handling pesticides.
- face shield
- chemical-resistant apron
- respirator
 - A respirator is a unit that covers the mouth and nose to prevent spray droplets, small particles and vapours from entering the lungs. A dust mask is not a substitute for a pesticide respirator. Respirators and replacement cartridges should be NIOSH/MSHA-approved. Use cartridges and pre-filters that protect against organic vapours. For more information about respirators, see the *Grower Pesticide Safety Course Manual*, Ridgetown College, University of Guelph.

For fumigants:

- When handling methyl bromide, do not wear gloves because they will trap gas next to the skin. Wear a full-face respirator with organic vapour canister or positive-pressure breathing apparatus. Check the label. When using certain methyl bromide products, a self-contained breathing apparatus must be worn at all times while using the product.
- When handling aluminum phosphide, use cotton gloves and wear a NIOSH/MSHA-approved full-face mask respirator with an acid-gas canister. Always check the label to find the appropriate safety equipment requirements.

When Working in Enclosed Areas**Canister Respirators**

Canister gas masks offer effective protection against certain harmful gases, vapours and particulate matter. They are generally suitable for ventilated areas where conditions don't change rapidly. They should never be used in confined spaces where low oxygen levels or high gas concentrations may occur.

Self-Contained Breathing Apparatus

Air-purifying devices do not work in confined spaces where gas concentrations are unusually high and the lack of oxygen can be fatal. Under these conditions, use an air supply provided by a self-contained breathing apparatus (e.g., Scott Air Pack).

Substances that produce hydrogen cyanide, methyl bromide, chloropicrin or phosphine can produce high gas concentrations and reduce oxygen levels. A similar situation is caused by the use of smoke generators and foggers that use highly toxic pesticides and certain volatile sprays.

Other Protective Clothing

Wear other protective clothing listed on the pesticide label.

Working Conditions

Always check and follow the label for appropriate safety equipment requirements. Use the recommendations below as a guide only.

- Use canister respirators when the surrounding air contains low concentrations of toxic gases, vapours or particulate matter derived from soil-drench, granular, dust or foliar spray applications. Pesticides applied in this manner usually have moderate to low toxicity.
- Use a self-contained breathing apparatus (e.g., Scott Air Pack) when applying highly toxic pesticides. Pesticides can produce high concentrations of toxic gases, vapours or particulate matter, as well as reduce oxygen levels, especially in an enclosed space (e.g., when fumigating grain).
- Read the product label for recommendations and legal requirements. A list of safety supply companies can be found in Table 2–2, *Ontario Suppliers of Protective Clothing and Equipment*, on page 15.

Safety Equipment Suppliers

Read the label for safety equipment recommendations and requirements. Protective clothing and equipment can be purchased from the suppliers listed in Table 2–2.

TABLE 2-2. Ontario Suppliers of Protective Clothing and Equipment

3-M Canada Inc.	Occupational Health and Environmental Safety P.O. Box 5757 London, ON N6A 4T1 www.3m.ca/safety	Tel: 519-451-2500 Toll-free: 1-800-364-3577 Fax: 1-800-603-7758 Orders: 809-263-3489 OHS: 1-800-267-4414
Acklands Grainger	90 West Beaver Creek Road Richmond Hill, ON L4B 1E7 www.acklandsgrainger.com	Tel: 905-731-5516 Fax: 905-731-6053 Email: contact@agi.ca
Aearo Canada	6889 Rexwood Road Mississauga, ON L4V 1R2 www.aearo.com	Toll-free: 1-877-327-4332
DuPont Personal Protection	P.O. Box 2200 Streetsville, Mississauga, ON L5M 2H3 www.personalprotection.dupont.ca	Toll-free: 1-800-387-9326 Fax: 1-866-765-5357
HAMISCO	3392 Wonderland Road South London, ON N6L 1A8 www.hamisco.com	Tel: 519-652-9800 Toll-free: 1-800-668-9800 Fax: 519-652-9661
Huron Tractor	39995 Harvest Road Exeter, ON N0M 1S3 www.hurontractor.com	Tel: 519-235-1115 Fax: 519-235-1939
Levitt-Safety (Eastern) Limited	2872 Bristol Circle Oakville, ON L6H 5T5 www.levitt-safety.com	Tel: 905-829-3299 Toll-free: 1-888-453-8488 Fax: 905-829-2919
MGS Horticultural Inc.	50 Hazelton Street Leamington, ON N8H 1B8 www.mgshort.com	Tel: 519-326-9037 Fax: 519-326-5861 Email: info@mgshort.com
Mitt & Robe Co.	751 Norfolk Street North Simcoe, ON N3Y 3R6 www.mittrobe.ca	Tel: 519-428-4050 Toll-free: 1-877-893-6565 Fax: 519-428-5142
MSA Canada Inc.	5535 Eglinton Avenue West Unit 222 Toronto, ON M9C 5K5 www.msasafety.com	Tel: 416-620-4225 Toll-free: 1-800-267-0672 Fax: 416-620-9697
Plant Products Co. Ltd.	314 Orenda Road East Brampton, ON L6T 1G1 www.plantprod.com	Tel: 905-793-7000 Toll-free: 1-800-387-2449 Fax: 905-793-9157
Safety Express	4190 Sladeview Crescent Units 1 and 2 Mississauga, ON L5L 0A1 www.safetyexpress.com	Tel: 905-608-0111 Toll-free: 1-800-465-3898 Fax: 905-608-0091 Email: info@safetyexpress.com
The St. George Company (Suppliers of Kasco Helmets)	P.O. Box 430 20 Consolidated Drive Paris, ON N3L 3T5 www.thestgeorgeco.com	Tel: 519-442-2046 Toll-free: 1-800-461-4299 Fax: 519-442-7191 Email: sales@thestgeorgeco.com

Care of Protective Clothing and Equipment

After completing the spray operation, clean all protective clothing and equipment.

Never let children, pets or livestock come in contact with contaminated clothing or equipment. Also ensure that they cannot come into contact with the puddles of water created when cleaning equipment.

Wash gloves with soap and water and keep them on while removing other protective clothing and equipment and washing equipment.

Always remove protective clothing and equipment outdoors. If a granular pesticide was used, shake the clothing outdoors in a safe place. Be sure to empty pockets and cuffs.

Dispose of clothing that has been contaminated by spills of highly toxic or concentrated pesticide. Place contaminated clothing in a plastic bag and take it to a landfill site.

Continue to wear gloves while washing protective equipment. It is best to wash equipment outdoors. If the work area does not have a cleanup area outside, designate specific buckets just for equipment cleanup. Mark them and keep them in a designated place. Wash the inside and outside of goggles, hats, boots and any water-repellent clothing in warm soapy water, then rinse them well and let them air-dry.

Respirators

Record the date the cartridge is first used.

Remove the cartridges and prefilters from the respirator.

After each use, remove cartridges and filter pads from the face piece and store them in clean, sealed plastic bags.

Wash the face piece in warm soapy water, rinse it thoroughly and dry it in a well-ventilated area. Air-drying prevents damage to the inlet and outlet valves.

Never use alcohol or other solvents for cleaning because they will damage the rubber and plastic.

Discard cartridges, canisters and filter pads at the interval set by the manufacturer. Discard them earlier if breathing becomes difficult or a pesticide taste or odour is noticed.

Rubber, Vinyl or Plastic Boots and Gloves

To avoid contact with pesticides, wash the outside of boots and gloves with detergent and water before taking them off.

After removing boots and gloves, wash them inside and out with detergent and water, rinse them thoroughly and dry them in a well-ventilated area.

How to Wash Clothes Used for Spraying

Never mix spray clothing with household laundry. All clothing used for spraying must be stored and washed separately from other clothing. Wash spray clothing after each use. Remember to use chemical-resistant gloves to handle pesticide-contaminated clothing.

Presoak clothing before washing. Use one of the following methods:

- hose off garments outdoors
- soak in separate tub or pail
- use the prewash cycle in an automatic washer

Use hot water, a heavy-duty detergent and the highest water level and the longest cycle the washing machine offers. Follow the instructions that came with the machine for washing heavily soiled clothing.

Wash clothing twice.

After washing it, hang it outside (preferably in bright sunlight) until it is completely dry. Do not use a clothes dryer.

Clean the washing machine. Run the washing machine through one complete cycle using only detergent and hot water (no clothing).

When spray clothing is dry, place it in a plastic bag and keep it separate from other clothing.

Personal Hygiene

Always wash hands before eating, drinking or smoking.

When finished for the day, take a bath or shower as soon as possible. The longer a pesticide remains on the skin, the greater the risk that it will be absorbed into the body.

Wash hair and scrub under fingernails. Shower with a lot of soap and water.

Always change into clean clothes.

Wear clean work clothes every day. A small spill on the previous day's clothes may not seem important, but wearing the same clothing again without washing it prolongs exposure and increases risk.

3. Crop Protection: Insects, Mites and Diseases

Using Pesticides

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 11 different classes. It should be noted that agriculture, including nursery production, is excepted. For more information on the legislation, see the Ministry of the Environment's website at www.ontario.ca/pesticides.

Toxicity Information

The “relative toxicity” of a pesticide is expressed in the LD₅₀ value. The higher the LD₅₀ value of a pesticide, the less toxic the product is to humans.

LD₅₀ is the number of milligrams of a pesticide per kilogram of a test animal's body weight that will kill 50% of the test animals (usually female rats). LD₅₀ is commonly measured as the **Acute Oral LD₅₀**, which means the chemicals are ingested through the mouth or nose. In addition, toxicity values for penetration through the skin (**Dermal LD₅₀**) can usually be found on the Material Safety Data Sheet 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 4 of Chapter 1, Using Pesticides in Ontario. 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 3–1, *Relative Toxicity of Pesticides to Honeybees*.

Read each pesticide label for specific precautions regarding bees.

Table 3–1. Relative Toxicity of Pesticides to Honeybees

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.	
Trade Name	Active Ingredient
AceCap 97	acephate
Actara 25 WG	thiamethoxam
Admire 240	imidacloprid
Ambush 50 EC	permethrin
Avid 1.9% EC	abamectin
Confidor 200 SL	imidacloprid
Cygon 480	dimethoate
DeltaGard	deltamethrin
Diazinon	diazinon
Dursban T, Dursban WDG	chlorpyrifos
Dyno-Mite 75 W	pyridaben
Imidan 50 WP	phosmet
Lagon 480	dimethoate
Lorsban 4 E	chlorpyrifos
Malathion	malathion
Orthene 75 SP	acephate
Pounce 384 EC	permethrin
Pirate 480	chlorpyrifos
Scimitar CS	lambda-cyhalothrin
Sevin	carbaryl
Success 480 SC	spinosad

Table 3–1. Relative Toxicity of Pesticides to Honeybees *continued*

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.	
Trade Name	Active Ingredient
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
Thionex 50W WSP, Thionex EC, Thiodan 4E	endosulfan
Thionex 50 W, Thionex EC	endosulfan
TreeAzin	azadirachtin
Tristar 70 WSP	acetamiprid
Group 3 – Pesticides relatively non-toxic to bees.	
Actinovate SP	<i>Streptomyces lydicus</i>
Aliette T&O	fosetyl-Al
Apollo SC	clofentezine
BioProtec CAF	<i>Bacillus thuringiensis</i>
Botran 75 W	dicloran
Bravo 500	chlorothalonil
Confirm 240 F	tebufenozide
Daconil 2787, Daconil Ultrex	chlorothalonil
Decree 50 WDG	fenhexamid
Dipel 2X DF	<i>Bacillus thuringiensis</i>

Elevate 50WDG	fenhexamid
Folpan 50 WP, Folpan 80 WDG	folpet
Forbid 240 SC	spiromesifen
Funginex DC	triforine
Insecticidal soap	potassium salts of fatty acids
MilStop	potassium bicarbonate
Nova 40 W	myclobutanil
Pristine WG	boscalid + pyraclostrobin
Rhapsody ASO	<i>Bacillus subtilis</i>
Rovral 50 WP	iprodione
Senator 70 WP	thiophanate-methyl
Serenade	<i>Bacillus subtilis</i>
Shuttle 15 SC	acequinocyl
Subdue Maxx	metalaxyl

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

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 3–2, *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 3–2. Insecticides and Fungicides Used to Protect Ornamentals (as of January 1, 2013)

Product Name	Type*	Common Name	Oral LD ₅₀ (mg a.i./kg)	Chemical Family	Group**	Ontario Classification
AceCap 97	I	acephate	1,490	organophosphate	1B	3
Acrobat	F	dimethomorph	2,939	cinnamic acid amides	40	3
Actara	I	thiamethoxam	> 5,000	neonicotinoid	4A	3
Aliette	F	fosetyl-al	2,860	ethyl phosphonate	33	3
Apollo SC	A	chofentezine	> 5,000	tetrazine, mite growth inhibitor	10A	3
Arbotect 20-S	I	thiabendazole	> 5,000	benzimidazole	1	4
Banner MAXX	F	propiconazole	> 4,000	triazole	3	3
BGreen	I	<i>Heterohabditis bacteriophora</i>	non-toxic	biological		
BioProtec	I	<i>Bacillus thuringiensis</i>	> 15,000	biological		
BlightBan C9-1	F	<i>Pantoea agglomerans</i> (strain C9-1)	non-toxic	biological		
Bloomtime Biological	F	<i>Pantoea agglomerans</i> (strain E325)	non-toxic	biological		
Botran 75 W	F	dichloran	> 10,000	dicarboximide	14	4
Captan 50 WP	F	captan	> 5,000	phthalimide	M4	3
Compass 50 WG	F	trifloxystrobin	> 5,050	strobilurin	11	3
Confidor 200 SL	I	imidacloprid	1,858	neonicotinoid	4A	4
Confirm 240 F	I	tebufenozide	> 5,000	insect growth regulator	18	3
Copper	F	copper sulphate	472	inorganic	M1	3
Copper Spray	F	copper oxychloride	1,700	inorganic	M1	3
Daconil 2787	F	chlorothalonil	4,200	chloronitrile	M5	4
Daconil Ultrex	F	chlorothalonil	> 5,000	chloronitrile	M5	4
Deadline	M	metaldehyde	250			
Decree	F	fenhexamid	> 5,000	anilide	17	3

* I = Insecticide; F = Fungicide and/or bactericide; R = Rodenticide; A = Acaricide (miticide); M = Molluscicide

** 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 3–2. Insecticides and Fungicides Used to Protect Ornamentals (as of January 1, 2013)

Product Name	Type*	Common Name	Oral LD ₅₀ (mg a.i./kg)	Chemical Family	Group**	Ontario Classification
Diazinon	I	diazinon	300	organophosphate	1B	3
Dipel	I	<i>Bacillus thuringiensis</i>	> 15,000	biological	11	11
Dithane DG	F	mancozeb	> 5,000	dithiocarbamate	M3	4
Dithane M-45	F	mancozeb	> 5,000	dithiocarbamate	M3	4
Dragnet FT	I	permethrin	998	synthetic pyrethroid	3A	3
Dursban Turf	I	chlorpyrifos	135	organophosphate	1B	3
Dutch Trig	F	<i>Verticillium albo-atrum</i> strain WCS850		biological		11
Dygal	F	<i>Agrobacterium radiobacter</i>		biological		3
Dylox	I	trichlorfon	560	organophosphate	1B	4
Dyno-Mite	A, I	pyridaben	1,930	pyridazone	21A	4
Eagle	F	myclobutanil	1,600	triazole	3	3
Endeavor 50 WG	I	pymetrozine	> 5,000	pyridine azomethine	9B	4
Equal 65 WP	F	dodine	1,000	aliphatic nitrogenous compound	9B	4
Ferbam 76 WDG	F	ferbam	> 5,000	dithiocarbamate	M3	4
Floramite SC	A	bifenazate	> 5,000	carbazate	25	4
Folpan 50 WP	F	folpet	10,000	phthalimide	M4	4
Foray	I	<i>Bacillus thuringiensis</i>	> 15,000	biological	11A	11
Forbid	I	spiromesifen	> 2,000	lipid biosynthesis inhibitor	23	3
Funginex	F	triforine	> 16,000	piperazine	3	3
Ground Force	R	chlorophacinone	2	anticoagulant		
Heritage	F	azoxystrobin	> 5,000	strobilurin	11	3
Imidan 50 WP	I	phosmet	300	organophosphate	1B	3
Insecticidal soap	I	potassium salts of fatty acids	> 5,000	insecticidal soap and botanical		4, 11
Intercept 60 WP	I	imidacloprid	1,858	neonicotinoid	4A	4

3. CROP PROTECTION: INSECTS, MITES AND DISEASES

Kanemite 15 SC	I	acequinocyl	> 5,000	naphthaquinone derivative	20B	3
Lagon 480 E	I	dimethoate	215	organophosphate	1B	3
Landscape Oil	I	mineral oil	> 15,000	horticultural oil		11
Lannate	I	methomyl	17	carbamate	1A	2
Lorsban	I	chlorpyrifos	300	organophosphate	1B	4
Maestro 80 DF	F	captan	9,000	phthalimide	M4	4
Malathion	I	malathion	1,400	organophosphate	1B	4
Meltatox	F	dodemorph	4,500	morpholine	5	4
Met 52	I	<i>Metarhizium anisopliae</i> strain F52	> 2,000	biological		4
MilStop	F	potassium bicarbonate	2,700	inorganic		4
Mimic 240 LV	I	tebufenozide	> 5,000	insect growth regulator	18	3
Nemasys G	I	<i>Heterohabditis bacteriophora</i>	non-toxic	biological		
Nemasys H	I	<i>Heterohabditis megidis</i>		biological		
Nova	F	myclobutanil	1,600	triazole	3	3
Opal Insecticidal Soap	I	potassium salts of fatty acids	> 5,000	insecticidal soap and botanical		4, 11
Orthene	I	acephate	866	organophosphate	1B	3
Phostrol	F	phosphorous acid and salts	> 5,000	phosphonates	33	3
Polyram	F	metiram	> 10,000	dithiocarbamate	M3	4
Pounce	I	permethrin	> 4,000	pyrethroid	3A	4
Presidio	F	fluopicolide	> 2,000	unclassified	43	
Previcur	F	propimocarb	2,000	carbamates	28	3
Pristine WG	F	boscalid, pyraclostrobin	> 1,490	methoxy carbamate & pyridine carboxamide	7, 11	2
Purespray Green Spray Oil	I	mineral oil	> 15,000	horticultural oil		11
Pyrate	I	chlorpyrifos	135	organophosphate	1B	3

* I = Insecticide; F = Fungicide and/or bactericide; R = Rodenticide; A = Acaricide (miticide); M = Molluscicide

** 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 3–2. Insecticides and Fungicides Used to Protect Ornamentals (as of January 1, 2013)

Product Name	Type*	Common Name	Oral LD ₅₀ (mg a.i./kg)	Chemical Family	Group**	Ontario Classification
Ramik Brown, Ramik Green	R	diaphacinone	3	anticoagulant		
Ratak+	R	brodifacoum	0.27	anticoagulant		
Regalia Maxx	F	<i>Reynoutria sachalinensis</i>		biological		
Rhapsody	F, B	<i>Bacillus subtilis</i>		biological		11
Ripcord 400 EC	I	cypermethrin	242	pyrethroid	3A	3
Rodent Bait, Rodent Pellets	R	zinc phosphide	45	phosphide		
Rootshield	F	<i>Trichoderma harzianum</i>		biological		11
Rovral	F	iprodione	3,550	dicarboximide	2	3
Rozol	R	chlorophacinone		anticoagulant		
Scimitar CS	I	lambda-cyhalothrin	93	pyrethroid	3A	2
Senator 70 WP	F	thiophanate-methyl	7,500	benzimidazole	1	4
Serenade Max	F	<i>Bacillus subtilis</i>		biological	11	11
Sevin	I	carbaryl	560	carbamate	1A	3
Shuttle 15 SC	M	acequinocyl	> 5,000	naphthaquinone derivative	20B	3
Sluggo	M	ferric phosphate	> 5,000	mineral		11
Subdue MAXX	F	metalaxyl-M and S-isomer	3,436	phenylamide	4	3
Success 480 SC	I	spinosad	> 2,000	spinosin	5	3
Sulphur (various)	F	sulphur	> 5,000	inorganic	M2	4, 11
Supra Captan 80 WDG	F	captan	9,000	phthalimide	M4	4
Switch 62.5 WG	F	cyprodinil, fludioxonil	> 5,000	anilino pyrimidine and phenylpyrrole	9, 12	3
Thionex 50W WSP, Thionex EC, Thiodan 4E	I	endosulfan	110	organochlorine	2A	4
Thiram	F	thiram	780	dithiocarbamate	M	4
Thuricide	I	<i>Bacillus thuringiensis</i>	> 15,000	biological	11	4, 11

Tivano	F, B	citric acid, lactic acid	none known	biological		11
TreeAzin	I	azadirachtin	> 2,000	uncertain	UN	11
Tristar 70 WSP	I	acetimiprid	1,064	neonicotinoid	4A	3
Trounce	I	potassium salts of fatty acid and pyrethrin	> 5,000	insecticidal soap and botanical	3A	4, 11
Truban	F	etridiazole	1,077	thiadiazole	14	4
Vectobac	I	<i>Bacillus thuringiensis</i> subsp. <i>israelensis</i>	> 15,000	biological	11	4, 11
Vendex	A	fenbutatin oxide	2,631	organotin	12	4
Waxed Mouse Bait	R	zinc phosphide	45	phosphide		

* I = Insecticide; F = Fungicide and/or bactericide; R = Rodenticide; A = Acaricide (miticide); M = Molluscicide

** 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.

Pesticide Application Restrictions

According to Ontario's *Pesticides Act* and Regulation 63/09, pesticides cannot be used for cosmetic purposes on lawns, vegetable and ornamental gardens, patios, driveways or cemeteries or in parks and schoolyards. To learn more about the use and sale of pesticides in Ontario, visit the Ministry of the Environment's website at www.ontario.ca/pesticides. Search under "What you need to know" to find information for different users (homeowners, commercial operators, agriculture industry, etc.). Search under "Pesticide Classes and Database" to find the lists of pesticide products for each of the 11 pesticide classes.

A Compendium of Pests and Diseases with Recommended Management Practices — as of January 1, 2013

Listings begin on page 26 and appear alphabetically by plant genus. **Pesticide products listed appear alphabetically. The order in which products appear does not constitute a preference ranking.** See Table 3–2, *Insecticides and Fungicides Used to Protect Ornamentals* on page 21 for a list of pesticides registered on outdoor ornamentals and their chemical properties, such as toxicity. 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.

ABIES — fir**INSECT PESTS affecting *Abies***

Pest	Product/1,000 L Water	Notes
Balsam twig aphid (<i>Mindarus abietinus</i>)	Admire 240, 250 mL/ha DZN 600 EW, see label Endeavor 50 WG, 193 g/ha in 275 L water Malathion 500 EC, 1.25 L Tristar 70 WSP, 3 solupaks	The eggs overwinter on bark and hatch into first generation nymphs (“stem mothers”) in early spring when bud caps begin to loosen. Second-generation nymphs feed on newly developing needles, causing the needles to become distorted and discoloured. Treat when stem mothers first hatch. Second-generation nymphs are more difficult to manage due to their protective, waxy covering.
Cutworms (various species)	Confirm 240 F, 0.5 L/ha Dylox, 2.75–4 L/ha Pounce, 180 mL/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.
Spruce budworm (<i>Choristoneura fumiferana</i>)	Dragnet, 160 mL Foray 48 B, 1.6–2.4 L/ha Malathion 500 EC, 2.5 L Mimic 240 LV, 290 mL/ha Pounce, 45–90 mL Sevin 50 W, 1.1–2.2 kg	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 one 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.
Spruce spider mite (<i>Oligonychus ununguis</i>)	Cygon 480 E, 1.25 L Floramite SC, 625 mL horticultural oil, 20 L insecticidal soap, see label Kanemite 15 SC, 0.42–0.92 L Lagon 480, 1.25 L Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375–500 mL Vendex 50 W, 0.5–1.0 kg	Overwintered eggs hatch in early May, when <i>Amelanchier laevis</i> and <i>Magnolia x soulangiana</i> 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 <i>Juniperus</i> and <i>Picea</i> . 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.
Tarnished plant bug (<i>Lygus lineolaris</i>)	Ripcord 400 EC, 172 mL/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.

White grubs: European chafer (<i>Rhizotrogus majalis</i>) June beetle (<i>Phyllophaga sp.</i>)	Larval management: Lorsaban 4 E , 4.5 L (rescue treatment for shipping) Intercept 60 WP, 467 g/ha Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L	These beetle larvae are referred to as “white grubs.” They chew fibrous roots and girdle underground stems of many woody ornamentals (including <i>Cornus</i> sp.). Before planting, cultivate infested fields to expose grubs to natural predators. 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 hours after application; avoid overwatering.
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DISEASES affecting *Abies*

Disease	Product/1,000 L Water	Notes
Botrytis	Rovral 50 WP, 1.2–2 kg/ha	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 (<i>Phytophthora</i> , <i>Pythium</i>)	Presidio, 60–119 mL/380 L Subdue MAXX, 1.2 L/ha (drench)	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 <i>Pythium</i> and <i>Phytophthora</i>. Subdue MAXX can be used on conifer seedbeds, plugs and 2-0 transplants only. See product label.
Needlecast (various fungi)	Banner MAXX, 350 mL Copper Spray, 4 kg Daconil 2787 F, 2.5 L	This is principally a nursery disease. It is caused by several fungi with 2-year 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.

ACER — maple

INSECT PESTS affecting *Acer*

Pest	Product/1,000 L Water	Notes
Aphids (various)	insecticidal soap, see label Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	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. * <i>Thiodan and Thionex are toxic to fish.</i>

INSECT PESTS affecting *Acer* continued

Pest	Product/1,000 L Water	Notes
Cottony maple scale (<i>Pulvinaria innumerabilis</i>)	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg	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 <i>Philadelphus</i> and <i>Tilia cordata</i> 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.
Forest tent caterpillar (<i>Malacosoma disstria</i>)	Dipel, 0.5–1.0 L/ha Dragnet, 230 mL Foray, 1.0–1.6 L/ha Orthene 75 SP, 1 kg Pounce, 90 mL/ha Pyrate 480 EC, 500 mL Sevin 50 W, 2–3 kg Thuricide, 1.5–2.0 L	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.
Greenstriped mapleworm (<i>Dryocampa rubicunda</i>)	Sevin 50 W, 2–3 kg	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 (<i>Lymantria dispar</i>)	AceCap 97, see label Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).
Leafhopper (several species)	Imidan 50 WP, 1.25 kg Sevin 50 W, 2 kg Sevin T&O, 2.3–3.5 L Tristar 70 WSP, 5 solupaks	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.

Lecanium or European fruit lecanium (<i>Lecanium corni</i>)	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 kg Trounce, 50 L	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 <i>Sambucus canadensis</i> begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
Maple bladder gall mite (<i>Vasates quadripedes</i>) Maple spindle gall mite (<i>Vasates aceriscrumena</i>) Crimson erineum mite (<i>Eriophyes regulus</i>)	horticultural oil, 20 L Malathion 500 EC, 2.5 L	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.
Maple petiole borer (<i>Caulocampis acericaulis</i>)	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 lifecycle. 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 (<i>Oligonychus aceris</i>)	horticultural oil, 20 L	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 (<i>Epinotia aceriella</i>)	Sevin 50 W, 2–3 kg	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.
Sugar maple borer (<i>Glycobius speciosus</i>)	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, longhorned 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 (<i>Frankliniella occidentalis</i>)	Success 480 SC, 50 mL	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 three applications of Success 480 SC per year.
Whitemarked tussock moth (<i>Orgyia leucostigma</i>)	Dragnet, 160 mL Mimic 240 LV, 290 mL/ha	The caterpillars are large (up to 3 cm long), with a multicoloured 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.

DISEASES affecting *Acer*

Disease	Product/1,000 L Water	Notes
Anthraco <i>(Gloeosporium apocrytum)</i>	Banner MAXX, 280 mL	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.
Tar spot <i>(Rhytisma acerinum)</i>	Banner MAXX, 28 mL/100 L Compass 50 WG, 14–21 g/100 L	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.
Verticillium wilt <i>(Verticillium dahliae)</i>	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*

Disorder	Product/1,000 L Water	Notes
Leaf scorch	A pesticide application would not be effective.	Physiological leaf scorch is common symptom of desiccation on broadleaf deciduous 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**DISEASES affecting *Aesculus***

Disease	Product/1,000 L Water	Notes
Anthraco <i>(Glomerella cingulata)</i>	Daconil 2787 F, 2.5 L	Protect leaves with fungicides during cool, wet springs. Encourage good air circulation through the canopy. Do not crowd plants.
Leaf blotch <i>(Guignardia aesculi)</i> <i>(Botryosphaeria aesculi)</i>	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg	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*

Disorder	Product/1,000 L Water	Notes
Leaf scorch (physiological)	A pesticide application would not be effective.	Physiological leaf scorch is a common symptom of desiccation on broadleaf deciduous 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**INSECT PESTS affecting *Amelanchier***

Pest	Product/1,000 L Water	Notes
Western flower thrips (<i>Frankliniella occidentalis</i>)	Success 480 SC, 50 mL	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 three applications of Success 480 SC per year.

DISEASES affecting *Amelanchier*

Disease	Product/1,000 L Water	Notes
<i>Gymnosporangium</i> rusts	Nova 40 W, 250–340 g Pristine WG, 1–1.6 kg/ha	Spores from <i>Juniperus</i> hosts can infect rosaceous plants (<i>Malus</i> , <i>Crataegus</i> , <i>Amelanchier</i> , etc.). Treat when sporulation begins on the alternate host (<i>Juniperus</i>), in early- mid-spring when foliage is emerging and still tender. Repeat fungicidal application every 10–14 days if needed. Rotate registered fungicides with those other chemical families to avoid resistance.
Powdery mildew	Nova 40 W, 113 g	Fungal infection appears as white, powdery growth on the upper leaf surface. Use Nova 40 W at the first sign of powdery mildew to manage this disease on Saskatoonberry. Use Nova 40 W no more than three times per season.

BETULA — birch**INSECT PESTS affecting *Betula***

Pest	Product/1,000 L Water	Notes
Aphids (<i>Calaphis betulaecolens</i>) (<i>Euceraaphis punctipennis</i>) (<i>Hamamelistes spinosus</i>)	Cygon 480 E, 625 mL insecticidal soap, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	<i>Calaphis betulaecolens</i> , a large green aphid, feeds only on birch. <i>Euceraaphis punctipennis</i> , a black and green aphid, leaves a cottony-white wax on birch and alder. <i>Hamamelistes spinosus</i> feeds on birch and on <i>Hamamelis</i> (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).
Birch leafminer (<i>Fenusa pusilla</i> and many other species)	AceCap, see label Cygon 480 E, 500 mL DZN 600 EW, 830 mL Imidan 50 WP, 1.25 kg Lagon 480, 500 mL Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg	Larval mines look like a brown blotch sometimes covering half or more of each leaf. Foliage of heavily infested trees looks scorched. There are two 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 <i>Spiraea x vanhouttei</i> 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 applications must be made post-bloom as this product is toxic to bees and bee brood.
Birch skeletonizer (<i>Bucculatrix canadensisella</i>)	Sevin 50 W, 2–3 kg	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 (<i>Agrilus anxius</i>)	Confidor 200 SL, see label Pyrate 480 EC, 500 mL	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. Confidor is registered as a trunk-inject to suppress populations of bronze birch borer. Confidor 200 SL applications must be made post-bloom as this product is toxic to bees and bee brood.
Gypsy moth (<i>Lymantria dispar</i>)	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).

BUXUS — boxwood**INSECT PESTS affecting *Buxus***

Pest	Product/1,000 L Water	Notes
Boxwood leafminers (<i>Monarthropalpus buxi</i> , <i>M. flavus</i>)	Cygon 480 E, 1 L Diazinon 500 EC, 1 L DZN 600 EW, 830 mL Lagon 480, 1 L Malathion 50, 1.5 L Sevin 50 W, 2–3 kg	Larvae overwinter in leaves and pupate in spring. The adult is a gnat-like fly that lays eggs into new foliage. Second-generation larvae mine new leaves in spring and throughout the summer. Treat new foliage when the first mines begin to appear.
Boxwood psyllid (<i>Psylla buxi</i>)	insecticidal soap, see label Sevin 50W, 2–3 kg	Orange eggs overwinter next to buds. 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*

Disease	Product/1,000 L Water	Notes
Boxwood blight and canker (<i>Volutella buxi</i>)	Products registered for boxwood blight in Canada are temporary registrations only. Emergency uses for 2013 include Switch 62.5 WG and Daconil 2787. See labels for more information.	Black cankers appear on stems and leaves of <i>Buxus</i> . In high humidity, cankers may be accompanied by orange-white pustules (e.g., propagation). This blight can be a problem in propagation areas and sometimes in older plants. Always inspect cuttings and rooting beds for signs of canker. 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.

CARAGANA — pea shrub**INSECT PESTS affecting *Caragana***

Pest	Product/1,000 L Water	Notes
Leafhopper (several species)	Imidan 50 WP, 1.25 kg Sevin 50 W, 2 kg Sevin T&O, 2.3–3.5 L Tristar 70 WSP, 5 solupaks	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.

INSECT PESTS affecting *Caragana* continued

Pest	Product/1,000 L Water	Notes
Two-spotted spider mite (TSSM) <i>(Tetranychus urticae)</i>	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

CARYA — hickory**INSECT PESTS affecting *Carya***

Pest	Product/1,000 L Water	Notes
Hickory gall adelgid <i>(Phylloxera caryaecaulis)</i>	Malathion 500 EC, 1.25 L Pyrate 480 EC, 375 mL Tristar 70 WSP, 3 solupaks	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.
Walnut caterpillar <i>(Datana integerrima)</i>	Malathion 500 EC, 2.5 L Sevin 50 W, 1.0–1.5 kg	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**DISEASES affecting *Chaenomeles***

Disease	Product/1,000 L Water	Notes
Fire blight <i>(Erwinia amylovora)</i>	Serenade Max, 2.5–6 kg/ha	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.

CLEMATIS — clematis**INSECT PESTS affecting *Clematis***

Pest	Product/1,000 L Water	Notes
Two-spotted spider mite (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.
Western flower thrips (<i>Frankliniella occidentalis</i>)	Success 480 SC, 50 mL	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 three applications of Success 480 SC per year.

CORNUS — dogwood**INSECT PESTS affecting *Cornus***

Pest	Product/1,000 L Water	Notes
Aphids (various)	insecticidal soap, see label Trounce, 50 L	Aphids appear as new growth emerges in the spring. Repeated applications of insecticidal soap will be required to reduce aphid populations.
White grubs: European chafer (<i>Rhizotrogus majalis</i>) June beetle (<i>Phyllophaga sp.</i>)	Larval management: Intercept 60 WP, 467 g/ha Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L	These beetle larvae are referred to as “white grubs.” The larvae chew fibrous roots and girdle underground stems of many woody ornamentals (including <i>Cornus</i> 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 hours after application. Avoid overwatering.

DISEASES affecting *Cornus*

Disease	Product/1,000 L Water	Notes
Anthracnose (<i>Glomerella cingulata</i>) (<i>Colletotrichum gloeosporioides</i>)	Banner MAXX, 280 mL Nova 40 W, 340 g	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.
Leaf spot	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Nova 40 W, 340 g	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.
Powdery mildew	MilStop, 2.8–6.5 kg	This disease appears as a white, powdery fungal growth on the tops of leaves. MilStop will help suppress powdery mildew when applied preventively.
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**DISEASES affecting *Corylus***

Disease	Product/1,000 L Water	Notes
Eastern filbert blight (<i>Anisogramma anomala</i>)	Copper Spray, 3 kg/ha	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.

COTONEASTER — cotoneaster**DISEASES affecting *Cotoneaster***

Disease	Product/1,000 L Water	Notes
<i>Phytophthora</i> root rot	Presidio, 60–119 mL/380 L	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.

CRATAEGUS — hawthorn**INSECT PESTS affecting *Crataegus***

Pest	Product/1,000 L Water	Notes
Aphids (various)	Endeavor, 100–200 g Tristar 70 WSP, 3 solupaks Trounce, 50 L	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 three applications of Endeavor per year. Do not apply more than 3 kg of Endeavor per hectare per year.
Eastern tent caterpillar (<i>Malacosoma americanum</i>)	Diazinon 500 EC, 925 mL Dipel 132 ES, 0.5–1.0 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Malathion 500 EC, 2.5 L Orthene 75 WP, 1 kg Pounce, 90 mL Sevin 50 W, 2–3 kg Success 480 SC, 25 mL Thuricide, 1.5–2.0 L	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).
Hawthorn leafminer (<i>Profensua canadensis</i>)	Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.
Western flower thrips (<i>Frankliniella occidentalis</i>)	Success 480 SC, 50 mL	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 three applications of Success 480 SC per year.

DISEASES affecting *Crataegus*

Disease	Product/1,000 L Water	Notes
Fire blight (<i>Erwinia amylovora</i>)	Copper Spray, 1.25 kg Serenade Max, 2.5–6 kg/ha	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 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 (<i>Gymnosporangium globosum</i>) Quince rust (<i>G. clavipes</i>)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Nova 40 W, 340 g	Symptoms appear as orange spots on leaf surfaces in late spring. In the case of <i>G. globosum</i> , finger-like structures appear on leaf undersides by mid- to late summer. Infections of <i>G. clavipes</i> 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 (<i>Malus</i> , <i>Crataegus</i> , etc.).
Leaf blight (<i>Diplocarpon</i> sp.)	Dithane DG, M-45, 80 WP, 2.75–3.5 kg Manzate DF, 2.75–3.5 kg	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.
Leaf spot (<i>Fabraea</i> sp.)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg	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	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.

EUONYMUS — euonymus**INSECT PESTS affecting *Euonymus***

Pest	Product/1,000 L Water	Notes
Black vine weevil Taxus weevil (<i>Otiorhynchus sulcatus</i>)	Actara 25G, 10.5–14 g/100 L BGreen, see label Met 52, see label Nemasys G, see label Scimitar SC, 36 mL/100 L *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. * <i>Thiodan and Thionex are toxic to fish.</i>

Euonymus scale (<i>Unaspis euonymi</i>)	Cygon 480 E, 2 L horticultural oil, 20 L Lagon 480 E, 2 L Orthene 75 SP, 1 kg	This greyish, pear-shaped scale also affects bittersweet (<i>Celastrus</i>) and <i>Pachysandra</i> . 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. <i>Catalpa speciosa</i> are beginning to bloom at this time; <i>Kolkwitzia</i> and <i>Philadelphus</i> 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.
Euonymus webworm (<i>Yponomeuta cagnagella</i>)	Dragnet, 230 mL Pounce, 90 mL	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.
Two-spotted spider mite (TSSM) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

DISEASES affecting *Euonymus*

Disease	Product/1,000 L Water	Notes
Anthrachnose (<i>Glomerella cingulata</i> , <i>Colletotrichum gloeosporioides</i>)	Daconil 2787, 2.5 L Daconil Ultrex, 1.5 kg	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 <i>Euonymus fortunei</i> 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.
Crown gall (<i>Agrobacterium tumefaciens</i>)	Dygal, 160 g/50 L	This gall appears as large, abnormal growths on stems and roots. Susceptible plants (<i>Euonymus</i> , <i>Rosa</i> , <i>Salix</i>) 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**INSECT PESTS affecting *Fagus***

Pest	Product/1,000 L Water	Notes
Aphids (various) Beech blight aphid (<i>Fagiphagus imbricator</i>, <i>Grylloprociphilus imbricator</i>) Woolly beech leaf aphid (<i>Phyllaphis fagi</i>)	insecticidal soap, see label Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	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. *Thiodan and Thionex are toxic to fish.
Cankerworm (<i>Alsophila pometaria</i> (<i>Paleacrita vernata</i>))	Dipel 132 ES, 1.6–2.4 L/ha Orthene 75 SP, 1 kg	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.
Gypsy moth (<i>Lymantria dispar</i>)	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).

FORSYTHIA — forsythia**DISEASES affecting *Forsythia***

Disease	Product/1,000 L Water	Notes
Bacterial blight (<i>Pseudomonas syringae</i>)	Clean Crop Copper Spray, 6 kg	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**INSECT PESTS affecting *Fraxinus***

Pest	Product/1,000 L Water	Notes
Ash flower gall mite (<i>Eriophyes fraxiniflora</i>)	horticultural oil, 20 L Malathion 25 WP, 2 kg	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.
Ash-lilac borer (<i>Podosesia syringae</i>)	Pyrate 480 EC, 500 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	Adults are dark brown, wasp-like moths, present from late May to late July (during <i>Syringa vulgaris</i> 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 <i>Syringa vulgaris</i> is in bloom. Repeat twice at 10-day intervals. Begin applications about 10 days after peak catch numbers. *Thiodan and Thionex are toxic to fish.
Ash plant bug (<i>Tropidosteptes amoenus</i>)	Dylox 420, 2.75–4.0 L Sevin T&O, 2.6 L	This plant bug feeds on <i>Fraxinus americana</i> and <i>F. pennsylvanica</i> . 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 (<i>Agrilus planipennis</i>)	AceCap 97, see label Confidor 200 SL, see label TreeAzin, see label	This exotic insect was first found in Essex County, Ontario, in 2002. Larvae bore into the cambium, 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 <i>Fraxinus pennsylvanica</i> . This is a regulated pest of quarantine significance to the Canadian Food Inspection Agency. It is difficult to detect infestations of emerald ash borer. Injectable insecticides are registered to combat this pest. However, trees with vascular damage due to boring larvae may not translocate insecticide as well as uninfested trees, so the efficacy may be lower. AceCap 97, Confidor 200 SL and TreeAzin applications must be made post-bloom as these products are toxic to bees and bee brood.
Fall webworm (<i>Hyphantria cunea</i>)	Dipel, see label Dragnet, 230 mL Dylox, 2.75–4 L/ha Orthene 75 SP, 1 kg Pounce, 90 mL	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.

INSECT PESTS affecting *Fraxinus* continued

Pest	Product/1,000 L Water	Notes
Gypsy moth <i>(Lymantria dispar)</i>	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).
Lecanium or European fruit lecanium <i>(Lecanium corni)</i>	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 kg Trounce, 50 L	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 <i>Sambucus canadensis</i> begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
Leopard moth <i>(Zeuzera pyrina)</i>	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 <i>(Lepidosaphes ulmi)</i>	Diazinon 500 EC, 1.5 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L	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 <i>Spiraea x vanhouttei</i> 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.
Sycamore lacebug <i>(Corythucha ciliata)</i>	Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg	Lacebugs are flat, rectangular insects, 4–6 mm long with broad, transparent, lacelike 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 two 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.

DISEASES affecting *Fraxinus*

Disease	Product/1,000 L Water	Notes
Anthraxnose (<i>Gloeosporium aridum</i>)	Dithane DG, M-45, 80 WP, 2.75–3.5 kg Manzate 200 DF, 2.75–3.50 kg	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.
Leaf spot (<i>Mycosphaerella</i> sp.)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg	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**INSECT PESTS affecting *Gleditsia***

Pest	Product/1,000 L Water	Notes
Cottony maple scale (<i>Pulvinaria innumerabilis</i>)	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg	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 <i>Philadelphus</i> and <i>Tilia cordata</i> 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.
Honeylocust plant bug (<i>Diaphnocoris chlorionis</i>)	Dylox 420, 2.75–4.0 L 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 (<i>Dasyneura gleditschiae</i>)	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.
Honeylocust spider mite (<i>Eotetranychus multigituli</i>)	horticultural oil, see label Orthene 75 SP, 1 kg	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.
Leafhopper (<i>Macropsis fumipennis</i>)	Orthene 75 SP, 1 kg Pyrate 480 EC, 1 L Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 kg Tristar 70 WSP, 5 solupaks	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.

INSECT PESTS affecting *Gleditsia* continued

Pest	Product/1,000 L Water	Notes
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 (<i>Lecanium corni</i>)	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 kg Trounce, 50 L	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 <i>Sambucus canadensis</i> begins blooming.

HEDERA — ivy**INSECT PESTS affecting *Hedera***

Pest	Product/1,000 L Water	Notes
Aphids (various)	insecticidal soap, see label	Aphids become numerous as new growth emerges in the spring. Repeated applications of insecticidal soap will help smother aphids.
Black vine weevil Taxus weevil (<i>Otiorhynchus sulcatus</i>)	Actara 25 G, 10.5–14 g/100 L BGreen, see label Met 52, see label Nemasys G, see label Scimitar SC, 36 mL/100 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. <i>*Thiodan and Thionex are toxic to fish.</i>

Two-spotted spider mite <i>(Tetranychus urticae)</i>	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.
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HEMEROCALLIS — daylily

INSECT PESTS affecting *Hemerocallis*

Pest	Product/1,000 L Water	Notes
Western flower thrips <i>(Frankliniella occidentalis)</i>	Success 480 SC, 50 mL	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 three applications of Success 480 SC per year.

DISEASES affecting *Hemerocallis*

Disease	Product/1,000 L Water	Notes
Daylily rust <i>(Puccinia hemerocallidis)</i>	Heritage EC, 282 g/ha (0.3 g/L)	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 OMAF and MRA Factsheet <i>Daylily Rust</i>, Order No. 04-089 at www.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 two applications per season.
Rhizoctonia stem blight <i>(Rhizoctonia sp.)</i>	Compass 50 WG, 3.8 g/100 L	Apply Compass as a drench at the time of propagation to help protect <i>Hemerocallis</i> from rhizoctonia stem blight.

HERBACEOUS PERENNIALS — various

INSECT PESTS affecting herbaceous perennials

Pest	Product/1,000 L Water	Notes
Aphids (various)	Endeavor, 100–200 g Tristar 70 WSP, 3 solupaks	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.
Black vine weevil Taxus weevil (<i>Otiorhynchus sulcatus</i>)	Actara 25G, 10.5–14 g/100 L BGreen, see label Met 52, see label Nemasys G, see label Scimitar SC, 36 mL/100 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. <i>*Thiodan and Thionex are toxic to fish.</i>
Two-spotted spider mite (TSSM) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.
Western flower thrips (<i>Frankliniella occidentalis</i>)	Success 480 SC, 50 mL	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 three applications of Success 480 SC per year.

DISEASES affecting herbaceous perennials

Disease	Product/1,000 L Water	Notes
Botrytis flower blight (<i>Botrytis cinerea</i>)	Captan 50 W, 2 kg Compass 50 WG, 7.5–30 g /100 L Daconil 2787, 2.5 L Daconil Ultrex, 1.5 kg Rhapsody, 10–20 L Rovral WP, 1 kg	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.
Crown and root rots	Rhapsody, 1–2 L/100 L Rootshield (<i>Trichoderma harzianum</i>), see label Senator 70 WP, 650–850 g	Various fungi cause root and crown rots on ornamentals. Many are a function of unsuitable environmental conditions and media properties. 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 <i>Pythium</i> , <i>Rhizoctonia</i> and <i>Fusarium</i> . It is registered for greenhouse ornamentals only.
Damping-off, bulb rots	Captan 50W, 6–15 kg Captan 80 WDG, 3.8–9.4 kg	Use Captan as a bulb dip before storage of bulbs. Allow the fungicide to dry on the bulbs prior to storage.
Damping-off, root and stem diseases (<i>Pythium</i> , <i>Phytophthora</i>)	Phostrol, see label Presidio, 60–119 mL/380 L Subdue MAXX, see label	<i>Pythium</i> and <i>Phytophthora</i> 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 <i>Phytophthora</i> root diseases only.
Downy mildew (<i>Peronospora</i> spp.)	Acrobat 50 WP, 48 L/100 L Presidio, 60–119 mL/380 L	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.
Leaf spot (various fungi)	Folpan 50 WP, 2 kg Rhapsody, 10–20 L	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.
Powdery mildew	Compass 50 WG, 15–20 g/100 L Folpan 50 WP, 2 kg MilStop, 0.28–0.56 kg/1,000 m ² Regalia Maxx, 0.5–1 L/400 L Rhapsody, 10–20 L Switch 62.5 WG, 100 g/100 L	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 applications at the first sign of disease. Regalia Maxx gives suppression of <i>Oidium</i> spp. powdery mildew only. Switch 62.5 WG gives suppression of <i>Sawadea</i> and <i>Erysiphe</i> powdery mildews only.
Rhizoctonia root and crown rot	Compass 50 WG, 3.8 g/100 L Rovral WP, 400 g Senator 70 WP, 650–850 g	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.

HYDRANGEA — hydrangea

DISEASES affecting *Hydrangea*

Disease	Product/1,000 L Water	Notes
Botrytis blight (<i>Botrytis cinerea</i>)	Botran 75 W, 1.75 kg	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.
<i>Cercospora hydrangeae</i> leaf spot	Daconil Ultrex, 1.5 kg	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 (<i>Erysiphe polygoni</i>)	MilStop, 2.8–5.6 kg Switch 62.5 WG, 100 g/100 L	Powdery mildew appears as a white, powdery fungal growth on the tops of leaves. Early signs include small, circular, whitish colonies. MilStop can be used for the suppression of powdery mildew. Start application of MilStop at the first sign of disease. Switch fungicide provides suppression of <i>Sawadea</i> and <i>Erysiphe</i> powdery mildews only.
Rust (<i>Pucciniastrum hydrangeae</i> and others)	Daconil Ultrex, 1.5 kg	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

INSECT PESTS affecting *Juglans*

Pest	Product/1,000 L Water	Notes
Walnut blister mite (<i>Eriophyes erinea</i> , <i>Aceria erinea</i>)	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 (<i>Datana integerrima</i>)	Malathion 500 EC, 2.5 L Sevin 50 W, 1.0–1.5 kg	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*

Disease	Product/1,000 L Water	Notes
Butternut canker (<i>Sirococcus clavignenti-juglandacearum</i>)	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

INSECT PESTS affecting *Juniperus*

Pest	Product/1,000 L Water	Notes
Juniper midge (<i>Contarinia juniperina</i>)	Cygon 480 E, 2.5 L	This midge is a problem on eastern red cedar, <i>Juniperus virginiana</i> . 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 (<i>Carulaspis juniperi</i>)	Diazinon 500 EC, 1.5 L DZN 600 EW, 1.25 L insecticidal soap, see label Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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 <i>Philadelphus</i> is in full bloom and <i>Catalpa</i> are beginning to bloom. Do not use Malathion on Savin or Canaertii junipers.
Juniper tip gall midge (<i>Rhopalicus</i> sp., <i>Oligotrophus betheli</i>)	There is no product registered at the time of this publication.	These midge larvae cause galls to form on the ends of shoots. The adult is a chalcid wasp. Prune out green galls and destroy them to reduce the number of next-generation adults that emerge.
Juniper webworm (<i>Dichomeris marginella</i>)	Cygon 480 E, 2.5 L Lagon 480, 2.5 L Sevin 50 W, 2–3 kg	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).

DISEASES affecting *Juniperus*

Disease	Product/1,000 L Water	Notes
Blight (dieback) (<i>Kabatina juniperi</i>)	Copper Spray, 4 kg Dithane M-45, 80 WP, 2.75–3.5 kg	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 <i>Phomopsis</i> , but <i>Kabatina</i> is most commonly found in Ontario. Laboratory diagnosis is needed to distinguish between <i>Kabatina</i> and <i>Phomopsis</i> . Spray when spring growth starts. Repeat at 10-day intervals until growth stops.
Cedar-apple rust (<i>Gymnosporangium juniperi-virginianae</i>) Hawthorn rust (<i>G. globosum</i>) Quince rust (<i>G. clavipes</i>)	Eagle WSP, 300 g (1 pouch in 280 L of water) Nova 40 W, 340 g	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. Eagle WSP and Nova 40 W have the same active ingredient. Starting in mid-summer, apply Eagle WSP or Nova 40 W every 10–14 days when infected alternate rosaceous hosts (<i>Malus</i> , <i>Crataegus</i> , <i>Amelanchier</i> , etc.) are sporulating. To avoid resistance, rotate Eagle or Nova with registered fungicides from other chemical families where possible. Eagle or Nova can also be tank-mixed with Dithane DG (3 kg/ha). Prune out dormant galls and cankers on infected branches before May. Separate rosaceous rust hosts from junipers. Plant resistant junipers where possible.

LARIX — larch**INSECT PESTS affecting *Larix***

Pest	Product/1,000 L Water	Notes
Cutworms (various species)	Confirm 240 F, 0.5 L/ha Dylox, 2.75–4 L/ha Pounce, 180 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-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.
Larch casebearer (<i>Coleophora laricella</i>)	Malathion 500 EC, 2.5 L	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 (<i>Pristiphora erichsonii</i>)	Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Sevin 50 W, 1.0–1.5 kg	Larvae are grey with black heads and can be up to 20 mm long. Larvae are active in mid- to late summer. 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 (<i>Lygus lineolaris</i>)	Ripcord 400 EC, 172 mL/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.
Woolly larch adelgid (<i>Adelges laricis</i>)	Malathion 500 EC, 1.25 L	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**INSECT PESTS affecting *Ligustrum***

Pest	Product/1,000 L Water	Notes
Privet rust mite (<i>Aculus ligustri</i>)	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 cooler weather.
Privet thrips (<i>Dendrothrips ornatus</i>)	Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 500 mL Sevin 50 W, 2–3 kg Success 480 SC, 50 mL	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.

DISEASES affecting *Ligustrum*

Disease	Product/1,000 L Water	Notes
Anthracnose and twig blight (<i>Glomerella</i> sp.)	Nova 40 W, 340 g	Leaves turn brown and remain attached to twigs. Prune and destroy infected branches during dry weather. Spray fungicides to protect emerging shoots in spring. <i>Ligustrum amurense</i> , <i>L. x ibolium</i> and <i>L. obtusifolium regelianum</i> do not appear susceptible to this fungal disease.
Leaf spot (several fungi)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Nova 40 W, 340 g	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.
Rhizoctonia root rot	Compass 50 WG, 3.8 g/100 L	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.

LIRIODENDRON — tuliptree**INSECT PESTS affecting *Liriodendron***

Pest	Product/1,000 L Water	Notes
Tuliptree aphid (<i>Macrosiphum liriodendri</i>)	insecticidal soap, see label Malathion 500 EC, 1.25 L *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	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. *Thiodan and Thionex are toxic to fish.
Tuliptree scale (<i>Toumeyella liriodendri</i>)	horticultural oil, 20 L Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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.

LONICERA — honeysuckle

INSECT PESTS affecting *Lonicera*

Pest	Product/1,000 L Water	Notes
Honeysuckle aphid (<i>Hyadaphis tataricae</i>)	horticultural oil, see label insecticidal soap, see label Malathion 500 EC, 1.25 L Tristar 70 WSP, 3 solupaks	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 <i>Lonicera x bella</i> 'Dropmore', <i>L. korolkowii</i> 'Zabelli', <i>L. tatarica</i> 'Grandiflora', 'Rosea', 'Hack's Red', and 'Red Giant'.

DISEASES affecting *Lonicera*

Disease	Product/1,000 L Water	Notes
Honeysuckle blight (<i>Herpobasidium deformans</i>)	Dithane DG, 2 kg	This is not a common disease in most of Ontario. Many species are susceptible. Symptoms appear as new leaves expand in spring. Infected leaves curl and turn brown. The veins tend to remain green at first. 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	Nova 40 W, 340 g Switch 62.5 WG, 100 g/100 L	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. Switch 62.5 WG gives suppression of <i>Sawadea</i> and <i>Erysiphe</i> powdery mildews only.

MAGNOLIA — magnolia

INSECT PESTS affecting *Magnolia*

Pest	Product/1,000 L Water	Notes
Magnolia scale (<i>Neolecanium cornuparvum</i>)	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 WP, 1.75 kg Sevin 50 W, 2–3 kg	Mature scales are large (up to 1 cm) and pinky-orange in colour. Feeding injury causes honeydew, sooty mould and twig dieback on <i>Magnolia acuminata</i> , <i>M. x soulangiana</i> and <i>M. stellata</i> . 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.

MALUS — apple**INSECT PESTS affecting *Malus***

Pest	Product/1,000 L Water	Notes
Aphids (various)	Cygon 480 E, 1.25 L Endeavor, 100–200 g insecticidal soap, see label Lagon 480, 1.25 L Malathion 500 EC, 1.25 L *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Apple rust mite (<i>Aculus schlechtendali</i>)	Dyno-Mite, 284 g/ha horticultural oil, see label	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.
Codling moth (<i>Cydia piononella</i>)	Confirm 240 F, 1 L/ha (330–600 mL/1,000 L water)	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.
Eastern tent caterpillar (<i>Malacosoma americanum</i>)	Diazinon 500 EC, 925 mL Dipel 132 ES, 0.5–1.0 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Malathion 500 EC, 2.5 L Pounce, 90 mL Sevin 50 W, 2–3 kg Success 480 SC, 25 mL Thuricide, 1.5–2.0 L	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.
European red mite (<i>Panonychus ulmi</i>)	Dyno-Mite, 284 g/ha horticultural oil, 20 L insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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.

INSECT PESTS affecting *Malus* continued

Pest	Product/1,000 L Water	Notes
Fall cankerworm <i>(Alsophila pometaria)</i> Spring cankerworm <i>(Paleacrita vernata)</i>	Dipel 132 ES, 0.5–1.7 L/ha Foray 48 B, 1.0–1.6 L/ha Malathion 500 EC, 2.5 L Pounce, 90 mL Sevin 50 W, 2–3 kg Thuricide, 1.5–2.0 L	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 <i>Acer platanoides</i> and <i>Magnolia x soulangiana</i> are blooming.
Gypsy moth <i>(Lymantria dispar)</i>	Dipel 132 ES, 1.6–2.4 L/ha Dagnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).
Japanese beetle <i>(Popillia japonica)</i>	Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin XLR PLUS, 2.3–3.5 L Larval management: Intercept 60 WP, 467 g/ha Lorsban 4 E, 4.5 L (rescue treatment for shipping)	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 <i>Yucca filamentosa</i> 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 hours after application; avoid overwatering.
Leafhopper <i>(several species)</i>	Imidan 50 WP, 1.25 kg Sevin 50 W, 2 kg Sevin T&O, 2.3–3.5 L Tristar 70 WSP, 5 solupaks	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.

Leafrollers: Fruit tree leafroller <i>(Archips argyrospila)</i> Redbanded leafroller <i>(Argyrotaenia velutinana)</i>	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.
Oystershell scale <i>(Lepidosaphes ulmi)</i>	Diazinon 500 EC, 1.25 L insecticidal soap, see label Malathion 500 EC, 2.5 L	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 <i>Spiraea x vanhouttei</i> is blooming. Ensure good coverage of trunk, branches and leaf bottoms.
Tentiform leafminer <i>(Phyllonorycter blancardella)</i>	Confirm 240 F, see label Tristar 70 WSP, 5 solupaks	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 three generations per year. Controlling the first generation is more effective than controlling subsequent generations.
Two-spotted spider mite (TSSM) <i>(Tetranychus urticae)</i>	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.
Western flower thrips <i>(Frankliniella occidentalis)</i>	Success 480 SC, 50 mL	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 three applications of Success 480 SC per year.

DISEASES affecting *Malus*

Disease	Product/1,000 L Water	Notes
Apple scab (<i>Venturia inaequalis</i>)	Banner MAXX, 140 mL Captan 50 WP, 2 kg Captan 80 WDG, 1.25 kg Compass 50 WG, 140–175 g Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Dithane DG, M-45, 80 WP, 2 kg Equal 65 WP, 1.08–2.25 kg/ha Maestro 80 DF, see label Manzate DF, 6 kg/ha Microscopic Sulphur, 6.5 kg Nova 40 W, 340 g Polyram 80 DF, see label Pristine WG, 1 kg/ha Serenade Max, 3–6 kg/ha Supra Captan 80 WDG, see label	Scab infection causes purplish blotches on leaves and lesions on fruit. Start fungicide applications when leaf buds begin to break. Repeat every 7–10 days during spring, especially in rainy weather. Nova is a triazole fungicide and should be rotated with fungicides of other chemical families to manage resistance. If disease spread stops after new leaves harden off, cease fungicide treatment. Clean up and remove/destroy fallen leaves. Prune to improve air circulation through the canopy. Try to use resistant cultivars (e.g., Sugar Tyme).
Cedar-apple rust (<i>Gymnosporangium juniperi-virginianae</i>)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Dithane DG, M-45, 80 WP, 2 kg Ferbam 76 WDG, 1.25–2.25 kg Manzate DF, 6 kg/ha Nova W, 340 g Polyram 80 DF, 2 kg	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 (<i>Juniperus</i>), in mid-spring. Spores from juniper can infect alternate rosaceous hosts (<i>Malus</i> , <i>Crataegus</i> , <i>Amelanchier</i> , etc.). Repeat fungicidal applications every 10–14 days if needed.
Fire blight (<i>Erwinia amylovora</i>)	Blightban, 370–500 g Bloomtime, 375–500 g Copper Spray, 1.25 kg Serenade Max, 2.5–6 kg/ha	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 suppress fire blight.
Powdery mildew (<i>Podosphaera leucotricha</i>)	Compass 50 WG, 140–175 g Funginex 190 DC, 2.5 L/ha Microscopic Sulphur, 6.5 kg Nova 40 W, 340 g Serenade Max, 3–6 kg/ha	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.

ORNAMENTAL TREES AND SHRUBS — various**INSECT PESTS affecting ornamental trees and shrubs**

Pest	Product/1,000 L Water	Notes
Brown marmorated stink bug (<i>Halyomorpha halys</i>)	Malathion 85E, 1.22 L/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., <i>Acer</i> , <i>Amelanchier</i> , <i>Buddleia</i> , <i>Catalpa</i> , <i>Cercis</i> , <i>Ilex</i> , <i>Juglans</i> , <i>Malus</i> , <i>Prunus</i> , <i>Pyrus</i> , <i>Rosa</i> , <i>Tilia</i> , <i>Viburnum</i>) 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, as a foliar treatment, provides suppression of brown marmorated stink bug.

PACHYSANDRA — pachysandra**INSECT PESTS affecting *Pachysandra***

Pest	Product/1,000 L Water	Notes
Euonymus scale (<i>Unaspis euonymi</i>)	Cygon 480 E, 2 L horticultural oil, 20 L insecticidal soap, see label Lagon 480 E, 2 L Orthene 75 SP, 1 kg	This greyish, pear-shaped scale found commonly on euonymus also affects bittersweet (<i>Celastrus</i>) and <i>Pachysandra</i> . 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. <i>Catalpa speciosa</i> are beginning to bloom at this time; <i>Kolkwitzia</i> and <i>Philadelphus</i> 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.

PHLOX — phlox**DISEASES affecting *Phlox***

Disease	Product/1,000 L Water	Notes
Powdery mildew	Folpan 50 WP, 2 kg MilStop, 2.8–5.6 kg Nova 40 W, 340 g Rhapsody, 10–20 L Switch 62.5 WG, 100 g/100 L	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. Switch fungicide provides suppression of <i>Sawadea</i> and <i>Erysiphe</i> powdery mildews only.
Rust (various)	Nova 40 W, 250–340 g	In this disease, orange-brown lesions form on leaves. Protect healthy tissue with fungicide applications, especially during warm, wet conditions.

PICEA — spruce**INSECT PESTS affecting *Picea***

Pest	Product/1,000 L Water	Notes
Bagworm (<i>Thyridopteryx</i> <i>ephemeraeformis</i>)	Dylox, 2.75–4 L/ha Lagon 480 E, 2 L Orthene 75 SP, see label Sevin 50 W, 2–3 kg	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 destroy bags by early spring. Insecticides may be effective on young larvae only.
Black vine weevil Taxus weevil (<i>Otiorhynchus sulcatus</i>)	Actara 25 G, 10.5–14 g/100 L BGreen, see label Met 52, see label Nemasys G, see label Scimitar SC, 36 mL/100 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. To test product safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. <i>*Thiodan and Thionex are toxic to fish.</i>
Cooley spruce gall adelgid (<i>Adelges cooleyi</i>)	Malathion 500 EC, 1.25 L Pyrate 480 EC, 375 mL Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Cutworms (various species)	Confirm 240 F, 0.5 L/ha Dylox, 2.75–4 L/ha Pounce, 180 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.

Eastern spruce gall adelgid <i>(Adelges abietis)</i>	horticultural oil, 20 L Malathion 500 EC, 1.25 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Gypsy moth <i>(Lymantria dispar)</i>	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).
Pine needle scale <i>(Chionaspis pinifoliae)</i>	Cygon 480 E, 1.5 L DZN 600 EW, 1.25 L horticultural oil, 20 L insecticidal soap, see label Lagon 480, 1.5 L Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg	Pine needle scale causes whitish flecks on pine and spruce needles. Reddish crawlers appear in late May, then turn yellowish. There are two 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 <i>Syringa vulgaris</i> and <i>Spiraea x vanhouttei</i> 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 <i>Pinus strobus</i> and blue cultivars of both <i>Juniperus</i> and <i>Picea</i> . See product label for rates and tolerant plants.
Spruce bud scale <i>(Physokermes piceae, P. hemieryphus)</i>	horticultural oil, 20 L insecticidal soap, see label Lagon 480 E, 1.5 L Malathion 500 EC, 2.5 L	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 <i>Juniperus</i> and <i>Picea</i> . See product label for rates and tolerant plants.
Spruce budworm <i>(Choristoneura fumiferana)</i> Also see under ABIES	Cygon 480 E, 1.5 L Dipel, see label Dragnet, 160 mL Foray 48 B, 1.6–2.4 L/ha Lagon 480, 1.5 L Lannate L, 1.25–1.75 L Malathion 500 EC, 2.5 L Mimic 240 LV, 290 mL/ha Pounce, 45–90 mL Sevin 50 W, 1.1–2.2 kg Thuricide, see label	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 one 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.

INSECT PESTS affecting *Picea* continued

Pest	Product/1,000 L Water	Notes
Spruce needleminer (<i>Taniva albolineana</i> , <i>Endothenia albolineana</i>)	Lagon 480 E, 1.5 L Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg	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.
Spruce spider mite (<i>Oligonychus ununguis</i>)	Cygon 480 E, 1.5 L Floramite SC, 625 mL horticultural oil, 20 L insecticidal soap, see label Kanemite 15 SC, 0.42–0.92 L Lagon 480, 1.25 L Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375–500 mL Vendex 50 W, 0.5–1.0 kg	Overwintered eggs hatch in early May, when <i>Amelanchier laevis</i> and <i>Magnolia x soulangiana</i> 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 <i>Juniperus</i> and <i>Picea</i> . 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 have less impact on these beneficials, such as Vendex and Floramite.
Strawberry root weevil (<i>Otiorhynchus ovatus</i>)	Met 52, see label Pounce, 45–90 mL	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 under 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 <i>Wiegela florida</i> and <i>Syringa reticulata</i> 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.
Tarnished plant bug (<i>Lygus lineolaris</i>)	Ripcord 400 EC, 172 mL/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.
White grubs: European chafer (<i>Rhizotrogus majalis</i>) June beetle (<i>Phyllophaga</i> sp.)	Larval management: Intercept 60 WP, 467 g/ha Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L	These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including <i>Cornus</i> 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 hours after application. Avoid overwatering.

White pine weevil (<i>Pissoides strobi</i>)	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 (<i>Pikonema alaskensis</i>)	Dragnet, 160 mL Dylox, 2.75–4 L/ha Pounce, 45–90 mL Success 480 SC, 25 mL	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.

DISEASES affecting *Picea*

Disease	Product/1,000 L Water	Notes
Botrytis (<i>Botrytis cinerea</i>)	Rovral WP, 1.5–2 kg	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 (<i>Cytospora valsa</i>)	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 (<i>Phytophthora</i> , <i>Pythium</i>)	Presidio, 60–119 mL/380 L Subdue MAXX, 1.2 L/ha (drench)	Stem rot and root rot cause rapid dieback and mortality and are often characterized by reddish-brown discoloration 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 <i>Pythium</i> and <i>Phytophthora</i> . Subdue MAXX is registered on conifer seedbeds, plugs and 2-0 transplants only. See product label for rates and application information.
Needlecast (<i>Rhizosphaera kalkhoffii</i>)	Banner MAXX, 350 mL Copper Spray, 4 kg Daconil 2787 F, 9.5 L Daconil Ultrex, 5.75 kg	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.
Needlecast (<i>Stigmina lautii</i>)	Banner MAXX, 350 mL	Needles infected with <i>Stigmina</i> 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 <i>Rhizosphaera</i> -infected needles are smooth and black. Banner MAXX gives preventative control of needlecast diseases when applied starting when new growth is 1–2 cm long.
Tip blight (<i>Sirococcus conigenus</i>)	Copper Spray, 4 kg Daconil 2787 F, 3.6–6 L Daconil Ultrex, 2.9–3.6 kg	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.

PINUS — pine

INSECT PESTS affecting *Pinus*

Pest	Product/1,000 L Water	Notes
Cutworms (various species)	Confirm 240 F, 0.5 L/ha Dylox, 2.75–4 L/ha Pounce, 180 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.
European pine shoot moth (<i>Rhyacionia buoliana</i>)	Cygon 480 E, 2 L Diazinon 500 EC, 1.5 L DZN 600 EW, 1.25 L Lagon 480 E, 2 L Sevin 50 W, 2–3 kg	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 <i>Catalpa speciosa</i>. There is one generation per year. In late April, apply spray to the area between buds on terminals and laterals. Do this when <i>Acer rubrum</i> and <i>Cornus mas</i> 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.
Northern pine weevil (<i>Pissoides approximatus</i>)	Sevin 50 W, 2–3 kg	This weevil can be a problem on all pines, especially nursery production. It is often found on <i>Pinus sylvestris</i>. 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 (<i>Hylobius pales</i>)	Sevin 50 W, 2–3 kg	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 (<i>Pineus strobi</i>)	horticultural oil, 20 L Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Tristar 70 WSP, 3 solupaks	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.

Pine false webworm (<i>Acantholyda erythrocephala</i>)	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 (<i>Chionaspis pinifoliae</i>)	Cygon 480 E, 1.5 L DZN 600 EW, 1.25 L horticultural oil, 20 L insecticidal soap, see label Lagon 480, 1.5 L Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg	Reddish crawlers appear in late May, then turn yellowish. Feeding injury causes yellow spots on pine and spruce needles. There are two 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 <i>Syringa vulgaris</i> and <i>Spiraea x vanhouttei</i> 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 <i>Pinus strobus</i> and blue cultivars of both <i>Juniperus</i> and <i>Picea</i>. See product label for rates and tolerant species.
Pine pitch mass borer (<i>Vespamima pini</i> , <i>Synanthedon pini</i>)	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 (<i>Hylobius radialis</i>)	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 (<i>Neodiprion sertifer</i>) Redheaded pine sawfly (<i>Neodiprion lecontei</i>)	Cygon 480 E, 1 L Dragnet, 160 mL Lagon 480, 1 L Malathion 500 EC, 2.5 L Orthene 75 SP, 1 g Pounce, 45–90 mL Pyrate 480 EC, 500 mL Sevin 50 W, 2–3 kg Success 480 SC, 25 mL Tristar 70 WSP, 3 solupaks	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.

INSECT PESTS affecting *Pinus* continued

Pest	Product/1,000 L Water	Notes
Pine shoot beetle (<i>Tomicus piniperda</i>)	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 <i>Plant Protection Act</i>. Pines from many areas of the province are subject to quarantine. The primary host is Scots pine, <i>Pinus sylvestris</i>. 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 <i>Pest Alert Factsheet</i> on pine shoot beetle.
Pine spittlebug (<i>Aphrophora cribrata</i>)	Malathion 500 EC, 2.5 L Pyrate 480 EC, 88–150 mL Sevin 50 W, 2–3 kg	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.
Pine tortoise scale (<i>Toumeyella numismaticum</i> , <i>T. parvicornis</i>)	DZN 600 EW, 1.25 L horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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 <i>Pinus strobus</i> and blue cultivars of both <i>Juniperus</i> and <i>Picea</i>. See product label for rates and tolerant plants.
Spruce spider mite (<i>Oligonychus ununguis</i>)	Cygon 480 E, 1.5 L Floramite SC, 625 mL horticultural oil, 20 L insecticidal soap, see label Kanemite 15 SC, 0.42–0.92 L Lagon 480, 1.25 L Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375–500 mL Vendex 50 W, 0.5–1.0 kg	Overwintered eggs hatch in early May, when <i>Amelanchier laevis</i> and <i>Magnolia x soulangiana</i> 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 <i>Juniperus</i> and <i>Picea</i>. 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.

Strawberry root weevil (<i>Otiorhynchus ovatus</i>)	Met 52, see label Pounce, 45–90 mL	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 under 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 <i>Wiegela florida</i> and <i>Syringa reticulata</i> 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.
Tarnished plant bug (<i>Lygus lineolaris</i>)	Ripcord 400 EC, 172 mL/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.
White grubs: European chafer (<i>Rhizotrogus majalis</i>) June beetle (<i>Phyllophaga</i> sp.)	Larval management: Intercept 60 WP, 467 g/ha Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin XLR PLUS, 2.3–3.5 L	These beetle larvae are referred to as "white grubs." They chew fibrous roots and girdle underground stems of many woody ornamentals (including <i>Cornus</i> sp.). To expose grubs to natural predators, cultivate infested fields before planting. Sevin 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 hours after application; avoid overwatering.
White pine aphid (<i>Cinara strobi</i>)	Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375 mL Tristar 70 WSP, 3 solupaks	These are black aphids that often cluster together on shoots. Look for honeydew and sooty mould on needles. Treat active stages in May.
White pine weevil (<i>Pissoides strobi</i>)	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.
Zimmerman pine moth (<i>Dioryctria zimmermani</i>)	Cygon 480 E, 2 L Lagon 480, 2 L	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 <i>Acer platanoides</i> is blooming). Treat again in mid-August when larvae hatch. Use pheromone traps to monitor adult activity.

DISEASES affecting *Pinus*

Disease	Product/1,000 L Water	Notes
Brown spot (<i>Scirrhia</i> or <i>Mycosphaerella</i>)	Daconil 2787 F, 9.5 L Daconil Ultrex, 5.75 kg	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 (<i>Ascochyta abietina</i> or <i>Sclerotinia abietina</i>)	Daconil 2787 F, 2.4–4.8 L Daconil Ultrex, 1.45–2.9 kg	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 (<i>Phytophthora</i> , <i>Pythium</i>)	Presidio, 60–119 mL/380 L Subdue MAXX, 1.2 L/ha (drench)	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 <i>Pythium</i> and <i>Phytophthora</i> . Subdue MAXX is registered for conifer seedbeds, plugs and 2-0 transplants only. See product label for rates and application information.
Diplodia tip blight (<i>Sphaeropsis sapinea</i> or <i>Diplodia pinea</i>)	Copper Spray, 4 kg	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 (<i>Lophodermium seditiosum</i>)	Copper Spray, 4 kg Daconil 2787 F, 2.4–4.8 L Daconil Ultrex, 1.45–2.9 kg Dithane DG, M-45, 80 WP, 2.5 kg Manzate DF, 2.5 kg	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.
Sweetfern blister rust (<i>Cronartium comptoniae</i>)	There is no product registered at the time of this publication.	This rust disease affects hard two- and three-needle pines, especially jack pine (<i>Pinus banksiana</i>). 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 (<i>Comptonia peregrina</i>) and sweet gale (<i>Myrica gale</i>) from plantations and from the immediate vicinity of pine nursery stock.
Tip blight (<i>Sirococcus</i>)	Copper Spray, 4 kg Daconil 2787 F, 3.6–6 L Daconil Ultrex, 2.9–3.6 kg	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.
White pine blister rust (<i>Cronartium ribicola</i>)	There is no product registered at the time of this publication.	This rust is a serious disease of five-needle pines, especially white pine, <i>Pinus strobus</i> . 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 <i>Ribes</i> sp. by at least 600 m.

PLATANUS — London plane, sycamore**DISEASES affecting *Platanus***

Disease	Product/1,000 L Water	Notes
Anthraxnose (<i>Apiognominia veneta</i>)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Dithane DG, M-45, 80 WP, 2.75–3.5 kg Manzate DF, 2.75–3.5 kg	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.

POPULUS — poplar**INSECT PESTS affecting *Populus***

Pest	Product/1,000 L Water	Notes
Forest tent caterpillar (<i>Malacosoma disstria</i>)	Dipel, 0.5–1.0 L/ha Foray, 1.0–1.6 L/ha Orthene 75 SP, 1 kg Pounce, 90 mL/ha Pyrate 480 EC, 500 mL Sevin 50 W, 2–3 kg Thuricide, 1.5–2.0 L	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.
Gypsy moth (<i>Lymantria dispar</i>)	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).
Poplar and willow borer (<i>Cryptorhynchus lapathi</i>)	Pyrate 480 EC, 500 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. *Thiodan and Thionex are toxic to fish.

DISEASES affecting *Populus*

Disease	Product/1,000 L Water	Notes
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 Daconil Ultrex, 1.5 kg Senator 70 WP, 1 kg	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.

POTENTILLA — potentilla**INSECT PESTS affecting *Potentilla***

Pest	Product/1,000 L Water	Notes
Two-spotted spider mite (TSSM) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

PRUNUS — black cherry, chokecherry, flowering cherry, pin cherry, peach, plum**INSECT PESTS affecting *Prunus***

Pest	Product/1,000 L Water	Notes
Aphids (various)	Endeavor, 100–200 g insecticidal soap, see label Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Eastern tent caterpillar (<i>Malacosoma americanum</i>)	AceCap 97, see label Diazinon 500 EC, 925 mL Dipel 132 ES, 0.5–1.0 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Malathion 500 EC, 2.5 L Pounce, 90 mL Sevin 50 W, 2–3 kg Success 480 SC, 25 mL Thuricide, 1.5–2.0 L	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.
European red mite (<i>Panonychus ulmi</i>)	Dyno-Mite, 284 g/ha horticultural oil, 20 L Vendex 50 W, 0.5–1.0 kg	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.
Gypsy moth (<i>Lymantria dispar</i>)	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).

INSECT PESTS affecting *Prunus* continued

Pest	Product/1,000 L Water	Notes
Japanese beetle <i>(Popillia japonica)</i>	Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin XLR PLUS, 2.3–3.5 L Larval management: Intercept 60 WP, 467 g/ha Lorsban 4 E, 4.5 L (rescue treatment for shipping)	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 <i>Yucca filamentosa</i> 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 hours after application; avoid overwatering.
Leafrollers: Fruit tree leafroller <i>(Archips argyrospila)</i> Redbanded leafroller <i>(Argyrotaenia velutinana)</i>	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.
Peachtree borer <i>(Synanthedon exitiosa)</i> Lesser peachtree borer <i>(Synanthedon pictipes)</i>	*Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	Peachtree borers attack tree/shrub bases of <i>Prunus</i> (e.g., <i>Prunus x cistena</i>) at the soil line. Lesser peachtree borers attack higher limbs and are found mainly on fruit tree species of <i>Prunus</i>. 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 <i>Philadelphus</i> 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. <i>*Thiodan and Thionex are toxic to fish.</i>
Pearslug <i>(Caliroa cerasi)</i>	insecticidal soap, see label Orthene 75 SP, 1 kg	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.

Two-spotted spider mite (TSSM) <i>(Tetranychus urticae)</i>	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.
Uglynest caterpillar <i>(Archips cerasivorana)</i>	Sevin 50 W, 2–3 kg Sevin XLR PLUS, 1.058 L 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.

DISEASES affecting *Prunus*

Disease	Product/1,000 L Water	Notes
Bacterial canker <i>(Pseudomonas syringae)</i>	Copper Spray, 6 kg (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 <i>(Apiosporina morbosa or Dibotryon morbosa)</i>	Maestro 80 DF, 3.75–4.5 kg	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 <i>Prunus</i> species from the area.
Blossom and twig blight <i>(Monilina fructicola)</i>	Captan 50 WP, 2 kg Captan 80 WDG, 1.25 kg Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Funginex 190 DC, 750 mL (or 2.5 L/ha)	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.
Peach leaf-curl <i>(Taphrina deformans)</i>	Ferbam 76 WDG, 1.75–3.5 kg	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.

DISEASES affecting *Prunus* continued

Disease	Product/1,000 L Water	Notes
Powdery mildew (various)	Compass 50 WG, 140–210 g Switch 62.5 WG, 100 g/100 L	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 <i>Sawadea</i> and <i>Erysiphe</i> powdery mildews only.
Shothole leaf spot (<i>Blumeriella jaapii</i>)	Captan 80 WP, 1.25–1.5 kg	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**INSECT PESTS affecting *Pseudotsuga***

Pest	Product/1,000 L Water	Notes
Cooley spruce gall adelgid (<i>Adelges cooleyi</i>)	Malathion 500 EC, 1.25 L Pyrate 480 EC, 375 mL Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Tarnished plant bug (<i>Lygus lineolaris</i>)	Ripcord 400 EC, 172 mL/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.

DISEASES affecting *Pseudotsuga*

Disease	Product/1,000 L Water	Notes
Needlecast (various fungi)	Daconil Ultrex, 1.45–2.9 kg Dithane DG, M-45, 80 WP, 2.75–3.5 kg	Various pathogens cause needlecast diseases on this host. Protect emerging needles in spring with fungicide to reduce fungal infections.

PYRACANTHA — firethorn**INSECT PESTS affecting *Pyracantha***

Pest	Product/1,000 L Water	Notes
Two-spotted spider mite (TSSM) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

DISEASES affecting *Pyracantha*

Disease	Product/1,000 L Water	Notes
Fire blight (<i>Erwinia amylovora</i>)	Copper Spray, 1.25 kg Serenade Max, 2.5–6 kg/ha	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.
Scab (<i>Spilocaea pyracanthae</i>)	Banner MAXX, 140 mL Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg	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 four applications of Banner per year. Stop treatments if no infection exists when foliage is hardened off.

PYRUS — pear**INSECT PESTS affecting *Pyrus***

Pest	Product/1,000 L Water	Notes
Aphids (various)	Endeavor, 100–200 g Tristar 70 WSP, 3 solupaks	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 three applications of Endeavor per year. Do not apply more than 3 kg/ha of Endeavor per year.
European red mite (<i>Panonychus ulmi</i>)	Dyno-Mite, 284 g/ha horticultural oil, 20 L Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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.
Pear rust mite (<i>Eritrimerus pyri</i>)	Dyno-Mite, 284 g/ha	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 russetting 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) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

DISEASES affecting *Pyrus*

Disease	Product/1,000 L Water	Notes
Fire blight (<i>Erwinia amylovora</i>)	Blightban, 370–500 g Bloomtime, 375–500 g Copper Spray, 1.25 kg Serenade Max, 2.5–6 kg/ha	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 suppress fire blight.

Pear trellis rust <i>((Gymnosporangium sabinae (G. fuscum))</i>	Nova 40 W, 340 g Pristine WG, 1–1.6 kg/ha	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, <i>Juniperus sabinae</i> (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.
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QUERCUS — oak

INSECT PESTS affecting *Quercus*

Pest	Product/1,000 L Water	Notes
Aphids (various)	insecticidal soap, see label Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Fall cankerworm <i>(Alsophila pometaria)</i> Spring cankerworm <i>(Paleacrita vernata)</i>	Dipel 132 ES, 0.5–1.7 L/ha Foray 48 B, 1.0–1.6 L/ha Malathion 500 EC, 2.5 L Pounce, 90 mL Sevin 50 W, 2–3 kg Thuricide, 1.5–2.0 L	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 <i>Acer platanooides</i> and <i>Magnolia x soulangiana</i> are blooming.
Golden oak scale <i>(Asterolecanium variolosum)</i>	Cygon 480 E, 2 L horticultural oil, 20 L insecticidal soap, see label Lagon 480, 2 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg	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.

INSECT PESTS affecting *Quercus* continued

Pest	Product/1,000 L Water	Notes
Gypsy moth <i>(Lymantria dispar)</i>	AceCap, see label Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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.
Lacebug <i>(Coruthuca arcuata)</i>	Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg	Lacebugs are flat, rectangular insects, 4–6 mm long with broad, transparent, lacelike 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 two 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.
Lecanium or European fruit lecanium <i>(Lecanium corni)</i>	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 kg Trounce, 50 L	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 <i>Sambucus canadensis</i> begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
Oak leaf gall <i>(several species)</i>	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 <i>(Profenusa lucifex)</i>	Diazinon 500 EC, 1 L DZN 600 EW, 830 mL Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg	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.
Oak leaftier <i>(Croesia semipurpurana)</i>	Sevin 50 W, 2–3 kg	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 red mite (<i>Oligonychus bicolor</i>)	horticultural oil, see label Orthene 75 SP, 1 kg	Feeding from mites causes bronzing and bleaching of oak leaves. Treat upper leaf surfaces from mid-June to mid-July. 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.
Oak skeletonizer (<i>Bucculatrix ainsliella</i>)	Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	Small yellowish-green larvae skeletonize the lower surface of oak leaves. There is one 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 (<i>Elaphidionoides villosus</i>)	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 (<i>Anisota senatoria</i>)	Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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.
Red oak clearwing moth (<i>Paranthrene simulans</i>)	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*

Disease	Product/1,000 L Water	Notes
Anthraxnose (<i>Gnomonia quercina</i> or <i>Apiognomonia quercina</i>)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Dithane DG, M-45, 80 WP, 2.75–3.5 kg Manzate DF, 2.75–3.5 kg	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.
Leaf spot (several fungi)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg	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*

Disorder	Product/1,000 L Water	Notes
Chlorosis or leaf yellowing	A pesticide application would not be effective.	This is a physiological problem for pin oak (<i>Quercus palustris</i>) and red oak (<i>Q. rubra</i>) 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**INSECT PESTS affecting *Rhododendron***

Pest	Product/1,000 L Water	Notes
Black vine weevil Taxus weevil <i>(Otiorhynchus sulcatus)</i>	Actara 25 G, 10.5–14 g/100 L BGreen, see label Met 52, see label Nemasys H, see label Scimitar SC, 36 mL/100 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. <i>*Thiodan and Thionex are toxic to fish.</i>

DISEASES affecting *Rhododendron*

Disease	Product/1,000 L Water	Notes
Dieback, canker <i>(Phytophthora)</i>	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Presidio, 60–119 mL/380 L Truban 25% EC, see label Truban 30% WP, see label	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.
Powdery mildew	Banner MAXX, 350 mL Nova 40 W, 340 g Switch 62.5 WG, 100 g/100 L	Symptoms appear as white, powdery growth on the tops of leaves, especially during hot days and cool nights. Apply Nova 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 four applications per year. Switch 62.5 WG gives suppression of <i>Sawadea</i> and <i>Erysiphe</i> powdery mildews only.
Stem rot of cuttings	Captan 50 W, 8–15 g/10 L Captan 80 WDG, 5–9.4 g/10 L	Various fungi will cause a stem rot on <i>Rhododendron</i>. 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.
Sudden oak death <i>(Phytophthora ramorum)</i>	Acrobat 50 WP, 450 g/ha Aliette WG, 5 kg/ha Presidio, 60–119 mL/380 L Subdue MAXX, 78–156 mL	Sudden oak death is a foliar blight and stem canker found on <i>Camellia</i>, <i>Rhododendron</i>, <i>Pieris</i>, <i>Kalmia</i>, <i>Viburnum</i> and <i>Syringa</i>. 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 per hectare.

RIBES — currant**INSECT PESTS affecting *Ribes***

Pest	Product/1,000 L Water	Notes
Two-spotted spider mite (TSSM) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

ROBINIA — locust**INSECT PESTS affecting *Robinia***

Pest	Product/1,000 L Water	Notes
Locust borer (<i>Megacyllene robiniae</i>)	Pyrate 480 EC, 500 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Locust leafminer (<i>Odontota dorsalis</i>)	Confidor 200 SL, see label Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg	In their adult and larval stages, leafminers feed on black locust leaves. Heavy infestations make trees unsightly. There are two 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. Confidor is registered as a trunk-inject to control this pest. Confidor 200 SL applications must be made post-bloom as this product is toxic to bees and bee brood.

ROSA — rose

INSECT PESTS affecting *Rosa*

Pest	Product/1,000 L Water	Notes
Aphids (various)	Cygon 480 E, 1.25 L Endeavor, 100–200 g insecticidal soap, see label Lagon 480 E, 1 L Tristar 70 WSP, 3 solupaks Trounce, 50 L	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 three applications of Endeavor per year. Do not apply more than 3 kg of Endeavor per hectare per year.
Japanese beetle (<i>Popillia japonica</i>)	Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin XLR PLUS, 2.3–3.5 L Larval management: Intercept 60 WP, 467 g/ha Lorsban 4 E, 4.5 L (rescue treatment for shipping)	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 <i>Yucca filamentosa</i> 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 hours after application; avoid overwatering.
Leafhopper (several species)	Imidan 50 WP, 1.25 kg Sevin 50 W, 2 kg Sevin T&O, 2.3–3.5 L Tristar 70 WSP, 5 solupaks	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.
Rose chafer (<i>Macrodactylus subspinosus</i>)	Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Roseslug (<i>Endelomyia aethiops</i> , <i>Allantus cinctus</i>)	insecticidal soap, see label Sevin 50 W, 2–3 kg Trounce, 50 L	These sawflies feed on the undersides of leaves from late May to mid-June. Treat both leaf surfaces with insecticides. <i>A. cinctus</i> may need a second treatment in mid- to late August.

Two-spotted spider mite (TSSM) <i>(Tetranychus urticae)</i>	Apollo SC, 80 mL/ha Cygon 480 E, 1.25 L Diazinon 500 EC, 1.25 L Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 0.42 L Lagon 480, 1.25 L Orthene 75 SP, 1 kg Vendex 50 W, 0.5–1.0 kg	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 one 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.
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DISEASES affecting *Rosa*

Disease	Product/1,000 L Water	Notes
Bacterial canker <i>(Pseudomonas syringae)</i>	Clean Crop Copper Spray, 6 kg	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.
Black spot <i>(Diplocarpon rosae)</i>	Banner MAXX, 330 mL Captan 50 W, Captan 50 WP, 2–2.5 kg Captan 80 WDG, 1.2–1.4 kg Clean Crop Copper 53 W, 6 kg Compass 50 WG, 15–20 g/100 L Daconil 2787, 1.8 L Daconil Ultrex, 1.1 kg Eagle WSP, 30 g/100 L (1 pouch in 280 L water) Funginex 190 DC, 1 L Nova 40 W, 340 g Senator 70 WP, 500–750 g Tivano, see label	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 Eagle and/or Senator every 10–14 days, and rotate with fungicides from other chemical families to avoid resistance. Eagle WSP and Nova 40 W have the same active ingredient. Reduce spray intervals in cool, wet weather. Avoid overhead irrigation, especially late in the day. A 6-hour 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.
Botrytis <i>(Botrytis cinerea)</i>	Botran 75, 1.75 kg Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg Senator 70 WP, 500–750 g	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.

DISEASES affecting *Rosa* continued

Disease	Product/1,000 L Water	Notes
Botrytis flower blight (<i>Botrytis cinerea</i>)	Captan 50 W, 2 kg Daconil 2787, 1.8 L Daconil Ultrex, 1.1 kg	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.
Crown gall (<i>Agrobacterium tumefaciens</i>)	Dygal, 160 g/50 L	This gall appears as large, abnormal growths on stems and roots. Susceptible plants (<i>Euonymus</i> , <i>Rosa</i> , <i>Salix</i>) 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 (<i>Peronospora sparsa</i>)	Acrobat 50 WP, 48 g/100 L Presidio, 60–119 mL/380 L	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.
Powdery mildew (<i>Sphaerotheca pannosa</i> var. <i>rosae</i>)	Banner MAXX, 350 mL Clean Crop Copper 53 W, 6 kg Eagle WSP, 30 g/100 L water (1 pouch in 280 L water) Folpan 50 WP, 2 kg Funginex 190 EC, 1 L Meltatox, 2.5 L MilStop, 2.8–5.6 kg Nova 40 W, 340 g Rhapsody, 10–20 L Senator 70 WP, 500–750 g sulphur, see label Tivano, see label	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 or Eagle 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. Meltatox is being phased out. The last date of use is April 2014.

SALIX — willow**INSECT PESTS affecting *Salix***

Pest	Product/1,000 L Water	Notes
Aphids (various)	Endeavor, 100–200 g insecticidal soap, see label Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	Aphids are small, soft-bodied 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 three applications of Endeavor per year. Do not apply more than 3 kg of Endeavor per hectare per year. *Thiodan and Thionex are toxic to fish.

Gypsy moth <i>(Lymantria dispar)</i>	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).
Imported willow leaf beetle <i>(Plagiodera versicolora)</i>	Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg Success 480 SC, 25 mL	Adults are small, oval, metallic-blue beetles. Adults and larvae skeletonize willow and Lombardy poplar leaves. There are two 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.
Poplar and willow borer <i>(Cryptorhynchus lapathi)</i>	Pyrate 480 EC, 500 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Spiny elm caterpillar <i>(Nymphalis antiopa)</i>	Malathion 500 EC, 2.5 L Sevin 50 WP, 2–3 kg	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) <i>(Tetranychus urticae)</i>	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

DISEASES affecting *Salix*

Disease	Product/1,000 L Water	Notes
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**INSECT PESTS affecting *Sorbus***

Pest	Product/1,000 L Water	Notes
European red mite (<i>Panonychus ulmi</i>)	horticultural oil, 20 L Kanemite 15 SC, 0.42–0.92 L Malathion 500 EC, 1.25 L	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.
Mountain ash sawfly (<i>Pristiphora geniculata</i>)	Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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 (<i>Eriophyes pyri</i> or <i>Phytoptus pyri</i>)	horticultural oil, see label Sevin 50 W, 2–3 kg	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. Apply Sevin as a foliar spray. Landscape Oil can be used when the plants are dormant and, in some cases, as a summer application. See product label.

DISEASES affecting *Sorbus*

Disease	Product/1,000 L Water	Notes
Fire blight (<i>Erwinia amylovora</i>)	Copper Spray, 1.25 kg Serenade Max, 2.5–6 kg/ha	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.

SYRINGA — lilac

INSECT PESTS affecting *Syringa*

Pest	Product/1,000 L Water	Notes
Japanese beetle <i>(Popillia japonica)</i>	Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin XLR PLUS, 2.3–3.5 L Larval management: Intercept 60 WP, 467 g/ha Lorsban 4 E, 4.5 L (rescue treatment for shipping)	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 <i>Yucca filamentosa</i> 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 hours after application; avoid overwatering.
Lilac borer <i>(Podosesia syringae</i> var. <i>syringae)</i>	Pyrate 480 EC, 500 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. <i>*Thiodan and Thionex are toxic to fish.</i>
Lilac leafminer <i>(Caloptilia syringella</i> or <i>Gracillaria syringella)</i>	Cygon 480 E, 1.25 L Lagon 480, 1.25 L Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg	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 (<i>Ligustrum</i>) is an alternate host.
Oystershell scale <i>(Lepidosaphes ulmi)</i>	Diazinon 500 EC, 1.5 L insecticidal soap, see label horticultural oil, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L	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 <i>Spiraea x vanhouttei</i> 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.
White grubs: European chafer <i>(Rhizotrogus majalis)</i> June beetle <i>(Phyllophaga</i> sp.)	Larval management: Intercept 60 WP, 467 g/ha Lorsban 4 E, 4.5 L (rescue treatment for shipping) Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin XLR PLUS, 2.3–3.5 L	These beetle larvae are referred to as “white grubs.” They chew fibrous roots and girdle underground stems of many woody ornamentals (including <i>Cornus</i> sp.). To expose grubs to natural predators, cultivate infested fields before planting. Sevin 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 hours after application; avoid overwatering.

DISEASES affecting *Syringa*

Disease	Product/1,000 L Water	Notes
Bacterial canker <i>(Pseudomonas syringae)</i>	Copper Spray, 6 kg (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 <i>(Microspheera alni)</i>	Nova 40 W, 340 g sulphur, see label	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.
Rhizoctonia root rot	Compass 50 WG, 3.8 g/100 L	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.

TAXUS — yew**DISEASES affecting *Taxus***

Disease	Product/1,000 L Water	Notes
Black vine weevil <i>Taxus</i> weevil (<i>Otiorhynchus sulcatus</i>)	Actara 25 G, 10.5–14 g/100 L BGreen, see label Met 52, see label Nemasys G, see label Scimitar SC, 36 mL/100 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. To test product safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. <i>*Thiodan and Thionex are toxic to fish.</i>
Fletcher scale (<i>Lecanium fletcheri</i>)	Cygon 480 E, 2 L Diazinon 500 EC, 1.25 L DZN 600 EW, 1.25 L horticultural oil, see label insecticidal soap, see label Lagon 480, 2 L Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg	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 <i>Yucca filamentosa</i> is blooming, or in September when the nymphs migrate. Repeat the application in about 10 days to catch all nymphs. Apply horticultural oils 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.
<i>Taxus</i> mealybug (<i>Pseudococcus</i> <i>cuspidatae</i> or <i>Dysmicoccus wistariae</i>)	Cygon 480 E, 2 L Diazinon 500 EC, 1.5 L horticultural oil, see label insecticidal soap, see label Lagon 480, 2 L Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg Trounce, 50 L	<i>Taxus</i> 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 <i>Aesculus hippocastanum</i> is blooming. Apply horticultural oils when plants are dormant. Apply Landscape Oil (horticultural oil) to target nymphs when new foliage is fully expanded and hardened off. See product label.

THUJA — eastern white cedar, arborvitae**INSECT PESTS affecting *Thuja***

Pest	Product/1,000 L Water	Notes
Black vine weevil Taxus weevil <i>(Otiorhynchus sulcatus)</i>	Actara 25 G, 10.5–14 g/100 L BGreen, see label Met 52, see label Nemasys G, see label Scimitar SC, 36 mL/100 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. <i>*Thiodan and Thionex are toxic to fish.</i>
Cedar leafminer Arborvitae leafminer <i>(Argyresthia thuiella and other species)</i>	Cygon 480 E, 2 L DZN 600 EW, 830 mL Lagon 480, 2 L Malathion 500 EC, 2.5 L	Four caterpillar species mine cedar foliage, but <i>A. thuiella</i> 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.
Fletcher scale <i>(Lecanium fletcheri)</i>	Cygon 480 E, 2 L Diazinon 500 EC, 1.25 L DZN 600 EW, 1.25 L insecticidal soap, see label Lagon 480, 2 L Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg Trounce, 50 L	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 <i>Yucca filamentosa</i> 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.
Juniper scale <i>(Carulaspis juniperi)</i>	Diazinon 500 EC, 1.25 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg	This small, circular, white scale with a yellow centre causes juniper and arborvitae needles to turn yellow. Treat crawlers in late June when <i>Philadelphus</i> is at full bloom and <i>Catalpa</i> are beginning to bloom. Repeat as needed about 10 days later.

Spruce spider mite <i>(Oligonychus ununguis)</i>	Cygon 480 E, 2 L Floramite SC, 625 mL horticultural oil, 20 L insecticidal soap, see label Kanemite 15 SC, 0.42–0.92 L Lagon 480, 2 L Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375–500 mL Vendex 50 W, 0.5–1.0 kg	Overwintered eggs hatch in early May, when <i>Amelanchier laevis</i> and <i>Magnolia x soulangiana</i> 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 in blue cultivars of both <i>Juniperus</i> and <i>Picea</i>. 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 have less impact on these beneficials, such as Vendex and Floramite.
Strawberry root weevil <i>(Otiorhynchus ovatus)</i>	Met 52, see label Pounce, 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 under 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 <i>Wiegela florida</i> and <i>Syringa reticulata</i> 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.
Tarnished plant bug <i>(Lygus lineolaris)</i>	Ripcord 400 EC, 172 mL/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.
White grubs: European chafer <i>(Rhizotrogus majalis)</i> June beetle <i>(Phyllophaga sp.)</i>	Larval management: Intercept 60 WP, 467 g/ha Adult management: Imidan 50 WP, 1.25 kg Sevin T&O, 2.3–3.5 L Sevin 50 W, 2–3 kg	These beetle larvae are referred to as “white grubs.” They chew fibrous roots and girdle underground stems of many woody ornamentals (including <i>Cornus</i> 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 hours after application; avoid overwatering.

DISEASES affecting *Thuja*

Disease	Product/1,000 L Water	Notes
Botrytis (<i>Botrytis cinerea</i>)	Rovral 50 WP, 1.2–2 kg/ha	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 (<i>Phytophthora</i> , <i>Pythium</i>)	Presidio, 60–119 mL/380 L Subdue MAXX, 1.2 L/ha (drench)	<i>Pythium</i> and <i>Phytophthora</i> 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 <i>Pythium</i> and <i>Phytophthora</i> . See product label.
Leaf blight (<i>Didymascella thujina</i>)	Copper Spray, 4 kg Dithane M-45, 80 WP, 2.75–3.5 kg Manzate 200 DF, 2.75–3.50 kg	This leaf blight mainly attacks western red cedar (<i>Thuja plicata</i>). Apply fungicides at 10–14-day intervals starting at bud break to protect new growth.

TILIA — linden, basswood**INSECT PESTS affecting *Tilia***

Pest	Product/1,000 L Water	Notes
Aphids (various)	Endeavor, 100–200 g Tristar 70 WSP, 3 solupaks Trounce, 50 L	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 three applications of Endeavor per year. Do not apply more than 3 kg of Endeavor per hectare per year.
Fall cankerworm (<i>Alsophila pometaria</i>) Spring cankerworm (<i>Paleacrita vernata</i>)	Dipel 132 ES, 1.6–2.4 L/ha Orthene 75 SP, 1 kg	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.
Gypsy moth (<i>Lymantria dispar</i>)	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).

Japanese beetle (<i>Popillia japonica</i>)	Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin XLR PLUS, 2.3–3.5 L Larval management: Intercept 60 WP, 467 g/ha Lorsban 4 E, 4.5 L (rescue treatment for shipping)	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 <i>Yucca filamentosa</i> 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 hours after application; avoid overwatering.
Linden looper (<i>Erannis tiliaria</i>)	Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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) (<i>Tetranychus urticae</i>)	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

TSUGA — hemlock**INSECT PESTS affecting Tsuga**

Pest	Product/1,000 L Water	Notes
Black vine weevil Taxus weevil <i>(Otiorhynchus sulcatus)</i>	Actara 25G, 10.5–14 g/100 L BGreen, see label Nemasys G, see label Scimitar SC, 36 mL/100 L Sevin 50 W, 2–3 kg *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label	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. Do not use Thiodan and Thionex on Anderson yew. To test treatment safety, treat some conifer seedlings, especially pine, before treating a larger area. Entomopathogenic nematodes (e.g., <i>Heterohabditis</i> 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, 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. * <i>Thiodan and Thionex are toxic to fish.</i>
Eastern hemlock looper <i>(Lambdina fiscelleria)</i>	Foray 48 B, 2.5–3.1 L/ha Mimic 240 LV, 290 mL/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.
Tarnished plant bug <i>(Lygus lineolaris)</i>	Ripcord 400 EC, 172 mL/ha	This plant bug is a small (5 mm), yellowish-brown insect. Adults have wings that form an X pattern when they are folded at rest. 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.
White grubs: European chafer <i>(Rhizotrogus majalis)</i> June beetle <i>(Phyllophaga sp.)</i>	Larval management: Intercept 60 WP, 467 g/ha Adult management: Imidan 50 WP, 1.25 kg Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L	These beetle larvae are referred to as “white grubs.” They chew fibrous roots and girdle underground stems of many woody ornamentals (including <i>Cornus</i> 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 hours after application; avoid overwatering.

ULMUS — elm**INSECT PESTS affecting *Ulmus***

Pest	Product/1,000 L Water	Notes
Aphids (various)	Endeavor, 100–200 g Tristar 70 WSP, 3 solupaks Trounce, 50 L	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 three applications of Endeavor per year. Do not apply more than 3 kg of Endeavor per hectare per year.
Elm bark beetle: European elm bark beetle (<i>Scolytus multistriatus</i>) Native elm bark beetle (<i>Hylurgopinus rufipes</i>)	Pyrate 480 EC, 10 L	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 (<i>Coleophora ulmifoliella</i>)	Malathion 500 EC, 2.5 L Sevin 50 W, 2–3 kg	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 (<i>Orchetes alni</i>)	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 (<i>Ulmus pumila</i>).
Elm leaf beetle (<i>Pyrhalta luteola</i>)	Orthene 75 SP, 1 kg Sevin 50 W, 2–3 kg Success 480 SC, 25 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, 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. *Thiodan and Thionex are toxic to fish.
Elm leafminer (<i>Fenusa ulmi</i>)	Confidor 200 SL, see label insecticidal soap, see label Sevin 50 W, 2–3 kg	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. Confidor is registered as a trunk-inject to control this pest. Confidor 200 SL applications must be made post-bloom as this product is toxic to bees and bee brood.
European elm scale (<i>Gossyparia spuria</i>)	Confidor 200 SL, see label horticultural oil, see label insecticidal soap, 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. Confidor 200 SL applications must be made post-bloom as this product is toxic to bees and bee brood.
European red mite (<i>Panonychus ulmi</i>)	Dyno-Mite, 284 g/ha horticultural oil, 20 L Malathion 500 EC, 1.25 L	These mites overwinter as eggs. Apply horticultural oils when plants are dormant. See product label for rates and tolerant plants.

INSECT PESTS affecting *Ulmus continued*

Pest	Product/1,000 L Water	Notes
Fall cankerworm <i>(Alsophila pometaria)</i> Spring cankerworm <i>(Paleacrita vernata)</i>	Dipel 132 ES, 1.6–2.4 L/ha Orthene 75 SP, 1 kg	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.
Gypsy moth <i>(Lymantria dispar)</i>	Dipel 132 ES, 1.6–2.4 L/ha Dragnet, 230 mL Foray 48 B, 1.0–1.6 L/ha Imidan 50 WP, 1.25 kg Orthene 75 SP, 850 g Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 L Success 480 SC, 25 mL Thuricide HPC, 1.6 L	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).
Leafhopper (several species)	Imidan 50 WP, 1.25 kg Sevin 50 W, 2 kg Sevin T&O, 2.3–3.5 L Tristar 70 WSP, 5 solupaks	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.
Lecanium or European fruit lecanium <i>(Lecanium corni)</i>	horticultural oil, 20 L insecticidal soap, see label Malathion 500 EC, 2.5 L Orthene 75 SP, 1 kg Pyrate 480 EC, 2 L Sevin 50 W, 2–3 kg Sevin T&O, 2.3–3.5 kg	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 <i>Sambucus canadensis</i> begins blooming. Do not use Malathion on Crimson King maple. Orthene may damage sugar maple leaves.
Two-spotted spider mite (TSSM) <i>(Tetranychus urticae)</i>	Apollo SC, 80 mL/ha Dyno-Mite, 284 g/ha Floramite SC, 333 mL Forbid, 300 mL insecticidal soap, see label Kanemite 15 SC, 2.1 L/ha Vendex 50 W, 0.5–1.0 kg	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 one 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.

DISEASES affecting *Ulmus*

Disease	Product/1,000 L Water	Notes
Dutch elm disease <i>(Ceratocystis ulmi)</i> <i>(Ophiostoma ulmi)</i>	Arbotect 20-S, see label Dutch Trig, 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 1) 20% or less of canopy is showing wilt symptoms; 2) infested branches are removed at the first sign of wilt; and 3) leaves have fully expanded and the plant is actively transpiring (late May, June and early July). Dutch Trig is a trunk-inject biocontrol treatment that introduces an organism that stimulates the tree's natural immune response, leaving it more resistant to Dutch elm disease ("induced resistance"). Dutch Trig is injected in the trunk of the elm in the early spring after bud break but before full leaf. Only inject if there is uptake of the liquid into the tree. Inject during the daytime. Do not inject when it is raining. Use the Dutch Trig tree inoculation tool to inject Dutch Trig. Dutch elm disease control is most effective when Dutch Trig is used in conjunction with other known cultural practices recommended for prevention of DED such as checking trees for symptoms during the growing season, removing dead and diseased elm trees and firewood and severing root grafts between healthy and infected trees.

VIBURNUM — viburnum**INSECT PESTS affecting *Viburnum***

Pest	Product/1,000 L Water	Notes
Snowball aphid (<i>Neoceruraphis viburnicola</i>)	insecticidal soap, see label Malathion 500 EC, 1.25 L Orthene 75 SP, 1 kg Pyrate 480 EC, 375 mL *Thionex 50W WSP, Thionex EC, Thiodan 4E, see label Tristar 70 WSP, 3 solupaks Trounce, 50 L	This aphid overwinters as eggs in <i>Viburnum opulus</i> 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. *Thiodan and Thionex are toxic to fish.
Viburnum crown borer (<i>Synanthedon viburni</i> , <i>S. fatifera</i>)	There is no product registered at the time of this publication.	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. 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 (<i>Pyrrhalta viburni</i>)	Actara 25 G, 280 g/ha Success 480 SC, 25 mL	Adults and larvae of this beetle skeletonize foliage of <i>Viburnum opulus</i> , 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. Actara 25 G is toxic to bees; avoid applications of Actara when <i>Viburnum</i> is blooming. Prune out and destroy terminal shoots (containing eggs) before May 1.

DISEASES affecting *Viburnum*

Disease	Product/1,000 L Water	Notes
Downy mildew (<i>Peronospora viburni</i>)	Acrobat 50 WP, 48 g/100 L Presidio, 60–119 mL/380 L	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.
Powdery mildew (<i>Microsphaera sparsa</i>)	Daconil 2787 F, 2.5 L Daconil Ultrex, 1.5 kg	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.

4. 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 the Environment, 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 **11 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 the Environment's website at www.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 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

Always take care to apply herbicides correctly. Incorrect application can waste pesticide, compromise control, damage neighbouring crops and contaminate the environment. New equipment and control systems can make herbicide application simpler and more precise.

New Technologies

Equipment manufacturers now work closely with

the crop protection industry to refine application systems. Computerized sprayer controllers and ground speed radar are available. These provide accurate monitoring and control during application. New developments in application technology include closed injection systems (which separate the herbicide concentrate from the water carrier) and drift reduction using air assists, air injection nozzles and electrostatic methods.

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's website at www.ontario.ca/pesticides.

Field Sprayers

Use boom-type sprayers for field herbicide applications. These sprayers apply herbicide evenly across the width of the boom. Always maintain:

- uniform spray pressure
- constant forward speed
- stable boom height (to ensure uniform overlap of the nozzle tip patterns)
- an application rate of 55–450 L/ha

Air Blast or Mist Sprayers

Never use air blast or mist sprayers to apply herbicides. They can cause herbicidal drift damage far from the target treatment area.

Wiper Applicators for Selective Weed Control

Wiper applicators (e.g., rope-wick applicators, roller applicators) are commonly used with glyphosate. Check the product labels for information about using this technique with other herbicides. Labels will list the crops for which wiper application is registered. To use wiper applicators, follow the manufacturer's directions. Contact enough of the

target weed to maximize the effectiveness of the herbicide. Keep the applicator tip above the desirable vegetation to avoid crop injury. Maintain a vehicle speed of 4–10 km/hr. Make a second pass, especially in heavy weed infestations or if using a higher vehicle speed. Avoid contact with sucker growth in orchards, vineyards and shelterbelts.

Equipment Use and Care

Spraying Speeds

Uniform application rates require a constant forward speed whenever spray nozzles deliver liquid. If a tractor's driving wheels slip on the soil surface, the tractor's speedometer or tachometer will not indicate a change in forward speed. To monitor forward speed despite wheel slippage on hills, use an independent speedometer with a ground-driven wheel. Install spray monitors and other electronic rate controllers. These automatically correct for tractor speed variations to maintain a constant application rate.

Using Water Correctly

Mix herbicides with clean water that does not contain debris, sand or mud. Never let the water intake screen rest on a pond bottom when filling a sprayer. The water intake line near the screen must, by law, have a check valve or backflow device. This prevents water-source contamination when the pump is shut off. Do not use a tank-refilling nozzle, volume-booster nozzle or injection pump when refilling sprayer tanks from ponds or streams. These tank-refilling aids may contaminate the water source. When using a farm water supply, install a frost-free water hydrant outside the building. Place a backflow valve/siphon on the discharge end of the hydrant.

Agitation

It is essential to return the spray solution to the sprayer tank to provide hydraulic agitation within the tank. To be effective, the return or bypass line from the pressure regulator must deliver liquid to the tank bottom. When applying chemical formulations in solution, return 2–14 L per minute to the tank. When spraying wettable powders, return 14–27 L per minute for each 450 L of tank capacity. The

appropriate rate depends on the wettable powder concentration and the size of the tank. Wettable powders need a special line from the pressure side of the pump (not the pressure regulator) to the tank for adequate hydraulic agitation using a venturi jet or sparge tube. Sparge tubes need more water than venturis to provide the same agitation. Reduce the flow rate if the sprayer tank has a mechanical agitator.

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 premixed slurry of wettable powder and water.
4. Agitate for 2–3 minutes before adding more water.
5. Add the oil or emulsifiable concentrate last.
6. Do not over-agitate the mixture. It may become a grease-like mass that settles to the tank bottom. In addition, over-agitation may cause the mixture to foam excessively.
7. After any break from spraying, agitate the tank thoroughly before resuming.
8. To prevent oil build-up in the sprayer, empty the tank completely before refilling.
9. Clean the tank and sprayer with a detergent or solvent immediately after use, and then flush thoroughly with clean water.

Pumps

Sprayer pumps must supply adequate capacity, pressure, volume and agitation for the task at hand. For wettable powder suspensions, use piston, diaphragm or centrifugal pumps. These, plus roller pumps, can be used for liquid herbicide applications. Pumps used for wettable powders and flowable formulations should have abrasion-resistant housings. For optimum pump performance, follow the manufacturer's care and storage instructions. Running a spray pump without water may cause premature wear or damage to the pump.

Nozzles

Accurate spray application requires high-quality nozzle tips. They must emit a uniform spray pattern at a predictable rate. Machined orifice and moulded orifice tips are available in materials ranging from brass, stainless steel and hardened stainless steel to non-metals such as plastics/polymers and ceramics. Choose an appropriate tip based on the descriptions that follow, and examine the tip's spray pattern before each use. Maintain a stable boom height to ensure uniform spray pattern overlap and to avoid missing weeds in the target area.

All herbicide formulations cause orifice wear. This is especially true of wettable powders. Replace nozzle tips when they deliver 10% more spray than when they were new. Worn nozzle tips spray unevenly and can produce streaks across a field by delivering too much herbicide to a given area. Clean nozzle tips and screens thoroughly. 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 nozzles.

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.

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

Consider the following recommendations when cleaning the sprayer:

- Clean sprayers immediately after spraying each day and whenever chemicals are changed. Delaying even overnight allows persistent deposits to form.

- Do not neglect any sprayer parts. Clean the spray tank, booms, hoses, nozzles, tips, screens, filters, strainers and pumps. Be sure to remove every trace of herbicide.
- Cleaning techniques depend on the herbicides applied. Many herbicides list tank-cleaning information on the label. Always follow these instructions. If necessary, contact the pesticide manufacturer to learn the best cleaning methods for a product. If specific cleaning instructions are not available, use a strong detergent or alkaline cleaner and then rinse thoroughly.
- Surfactants may remove some pesticide residues from spray equipment. Be sure tanks containing herbicide-surfactant (e.g., Agral 90) mixtures are scrupulously clean. Otherwise, the mixture may remove residues from the spray equipment, which may damage the crop.

Environmental Issues When Cleaning

Before cleaning the sprayer, dispose of any surplus tank mix safely. The Grower Pesticide Safety Course suggests diluting the remaining spray solution at least 1:10 with water. This diluted solution can be safely applied to the previously treated area if it does not exceed the maximum application rate on the product label. 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 www.ontario.ca/crops.

Sprayer Calibration

Calibrate sprayers frequently, especially when spraying wettable powders. Wettable powders erode the nozzle opening. As a nozzle wears, the quantity of herbicide delivered increases and distribution becomes uneven.

Determining Application Rates in L/ha

There are many ways to calibrate a sprayer or determine the amount of herbicide applied to 1 ha of land. Use one of the following two methods:

Method 1

This method requires a graduated cylinder calibrated in millilitres. See the OMAF website at www.ontario.ca/crops and click on the link to Pesticide Application and Safety for more detailed instructions.

1. Set 2 stakes 50 m apart in the field or along a fencerow beside the field.
2. Select the tractor gear and throttle setting that will be used while spraying. With the sprayer half full of water, do a test run to determine how many seconds it takes to travel the 50 m course. Repeat the trial at least three times to get an average time. Avoid previous wheel tracks in the field.
3. Mark or note the throttle setting and/or rpm's on the tachometer. Do not change the throttle setting when stopping for the next step.
4. Operate the sprayer while stationary. Use the desired pressure and the same throttle setting or rpm's used in the test runs. Spray for the length of time it took to travel 50 m. Collect the spray from each nozzle in a graduated cylinder.
5. Average the output per nozzle in millilitres. Clean or replace any nozzle more than 5% outside of the average nozzle output. Then reinstall all cleaned/new nozzles and recalibrate by repeating Steps 4 and 5.
6. Measure the boom's nozzle spacing in metres.

Application rate formula

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

For conversions to litres/acre or gallons/acre, see Appendix E on page 136.

Sample Calculation

Time to travel 50 metres:	24 seconds
Liquid collected/nozzle during 24 seconds:	525 mL
Nozzle spacing on the boom:	0.5 metres

$\frac{525 \text{ mL} \times 0.2}{0.5 \text{ m}} = 210 \text{ L/ha}$
--

Method 2

- Set 2 stakes 200 m apart in the field. Do not use a different distance. A different distance will not work because this method divides the number of square metres in one hectare by the distance travelled as follows:

$\frac{10,000 \text{ m}^2/\text{ha}}{200 \text{ m}} = 50 \text{ m/ha}$
--

- Add enough clean water to the sprayer to make the precalibration adjustments described in Steps 3 and 4.
- Adjust the boom height to obtain the sprayer manufacturer's recommended overlap for the nozzle tips and nozzle spacing used. For example, for a spray angle of 65°, the boom should be 53–58 cm above the surface to be sprayed. For a spray angle of 80°, the height should be 42–48 cm above the target surface.
- Operate the sprayer. Adjust the bypass relief valve to give the desired pressure with the nozzles operating. This also ensures that the sprayer lines are filled with water.
- Fill the tank and place it on a level surface. Measure the water level using the tank's sight gauge or a measuring stick. Record this number.
- Spray between the stakes in one direction, maintaining a set speed and pressure. Turn the boom "on" as the tractor nose passes the first stake and "off" as it passes the second. Mark the throttle setting.
- Return the sprayer to the same level surface used in Step 5. Refill the tank to the original mark on the sight gauge or measuring stick, carefully measuring the added water.
- Calculate the application rate in litres per

hectare using this formula:

$\frac{\text{litres of water added} \times 50 \text{ m/ha}}{\text{swath width in metres}^*} = \text{L/ha}$
--

* To determine swath width, see the Sample Calibration Calculations below.

Sample Calibration Calculations**Broadcast Spraying**

If the sprayer's swath width is 6.5 m and it takes 30 L of water to refill the tank, the application rate in litres per hectare is:

$\frac{30 \text{ L} \times 50 \text{ m/ha}}{6.5 \text{ m}} = 231 \text{ L/ha}$
--

Band Spraying

With band spraying, acreage sprayed is not the same as crop acreage. The herbicide rates given in this publication apply to the area actually sprayed.

If the sprayer has 10 nozzles and each nozzle covers a 36-cm (0.36-m) band, the swath width is:

$10 \times 0.36 \text{ m} = 3.6 \text{ m}$
--

If it takes 10 L of water to refill the tank, the application rate in L/ha, using Method 2, is:

$\frac{10 \text{ L} \times 50 \text{ m/ha}}{3.6 \text{ m}} = 139 \text{ L/ha}$
--

Determining the Number of Hectares per Tankful

Once the sprayer has been calibrated, determine the number of hectares that can be sprayed with a full tank as follows:

$\frac{\text{tank capacity (L)}}{\text{application rate (L/ha)}} = \text{ha/tank}$
--

Sample Calculation

400-litre tank	=	3.6 ha/tank
110 L/ha		

For conversion between litres and gallons, see Appendix E on page 136.

Calibrating Hand-Held and Backpack Sprayers

Many people use small hand-held or backpack sprayers to treat problem areas or spray areas that were missed. Like field sprayers, small sprayers must be calibrated accurately.

Method 1

1. Set 2 stakes 50 m apart in the field.
2. Fill the sprayer half full with water.
3. Walk the 50 m course 3 times at a uniform pace. Calculate the average time it takes to travel the course.
4. Measure the width (in metres) of the band sprayed by the nozzle at that pace.
5. Pump the sprayer, collecting liquid from the nozzle into a measuring device for the average time calculated in Step 3.
6. Determine the application rate using the following formula:

$\frac{(\text{L liquid per nozzle}) \times 0.2}{\text{band width in metres}}$	=	L/ha
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Method 2

1. Partially fill the sprayer. Pump the sprayer to the pressure to be used during the pesticide application.
2. Spray to determine the swath width (in metres).
3. Walk at a steady pace for 15 seconds. Measure the distance travelled (in metres) during that time.
4. To calculate the number of square metres sprayed in 15 seconds, multiply the swath width (determined in Step 2) by the distance travelled (determined in Step 3). This area is A.
5. Spray into a measuring device for 15 seconds. The number of litres sprayed in 15 seconds is B.

6. Determine the application rate using the following formula:

$\frac{B (\text{L/15 sec}) \times 1,000}{A (\text{m}^2)}$	=	L/ha
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Conversion factors

Convert any pesticide application rate to the amount needed for a small area:

Solids: 1 kg/ha = 10 g/100 m²

Liquids: 100 L/ha = 1 L/100 m²

Determining the Herbicide Quantity Required

It's important to distinguish between the amount of product required and the amount of active ingredient required. The common name (i.e., active ingredient) of each herbicide listed in this publication appears in lowercase letters (e.g., napropamide, oxidiazon, glyphosate). The first letter of a product trade name is typically capitalized (e.g., Devrinol). However, in the Herbicide Compendium and tables that follow, product trade names appear in all capital letters (e.g., DEVRINOL) for emphasis. Information on the total substance (e.g., liquid, powder) in the container is supplied by the manufacturer. Its formulation appears in brackets following the trade name. Herbicides in this publication are specified by quantity of active ingredient (i.e., common name) per hectare and by quantity of product trade name per hectare. If the specified rate is "product per hectare," simply use that amount. Always verify product labels before use to confirm the amount of active ingredient it contains.

Materials, Mixing and Mixtures**Dry Formulations**

Dry herbicide formulations come as granules, soluble powders and wettable powders. Granules do not require mixing; simply apply them as is. Many herbicides used for preemergent treatments come in granular formulations. Their performance usually equals that of the comparable liquid as long as the application equipment provides satisfactory distribution. Soluble powders should be dissolved in water. Wettable powders do not dissolve in water.

They form a suspension that must be constantly agitated to keep it mixed.

Liquid Formulations

Many liquid herbicide formulations form a solution when mixed with water. However, oil-based liquid herbicides form an emulsion that must be constantly agitated to keep it mixed. Emulsions appear milky.

Mixing Herbicide Formulations

Some herbicides can be combined with other chemicals in a single application. These combinations must be registered. Do not apply herbicide mixtures or herbicides mixed with other pesticides or foliar fertilizers unless the combination is registered for that specific use. Before mixing herbicides, consult package labels for compatibility information. Some combinations may react when mixed together, creating materials with new properties and activities. When using multiple herbicides together, mix one with the appropriate quantity of water, and then add the second. This reduces the formation of gums and precipitates that might clog nozzles and filters. Where water has a high salt content, test the compatibility of the water with the herbicide before spraying. Use the mixture at field strength in a small area and monitor the results. Do not use surfactants or detergents in spray solutions unless this is specifically recommended by the herbicide manufacturer.

Application Indicators

Colourants and foam markers are available from agricultural chemical dealers. These indicators make accurate applications easier. Foam marking systems help the applicator minimize overlap. Colourants added to a pesticide solution make the applied material more visible. For example, colouring a herbicide used on cut stumps of woody plants helps ensure thorough coverage without respraying, while water-soluble colourants make lawn spraying easier. Available colourants include:

- Bullsey Basal 55 Blue, oil soluble
- Blazon Blue, water soluble
- Bas-Oil Red, oil soluble

A Compendium of Herbicides with Their Recommended Uses in Ontario — as of January 1, 2013

All listed products are registered for the listed purpose. The order in which products appear does not constitute a preference ranking.

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 11 different classes. It should be noted that agriculture (including nursery production) is exempted. For more information on the legislation, see the Ministry of the Environment's website at www.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.pmr-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 4–1, *Herbicides Registered for Nursery Crops in Ontario (by Trade Name)* and Table 4–2, *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 4–1. Herbicides Registered for Nursery Crops in Ontario (by Trade Name)

Trade Name	Common Name
AIM	carfentrazone-ethyl
AMITROL	amitrole
BASAMID	dazomet
BONANZA	trifluralin
BROADSTAR	flumioxazin
CASORON	dichlobenil
DACTHAL	chlorthal dimethyl
DEVRIOL	napropamide
DUAL II MAGNUM	s-metolachlor
FRONTIER MAX	dimethenamid-p
GALLERY	isoxaben
GARLON	triclopyr
GOAL 2XL	oxyfluorfen
GRAMOXONE	paraquat
KERB	propyzamide
PRINCEP NINE-T	simazine
RIVAL	trifluralin
RONSTAR	oxadiazon
ROUNDUP	glyphosate
SIMADEX	simazine
SUREGUARD	flumioxazin
TERR-O-GAS	methyl bromide/chloropicrin
TREFLAN	trifluralin
VAPAM	metam sodium
Various products	glyphosate
VENTURE L	fluazifop-p-butyl

TABLE 4–2. Herbicides Registered for Nursery Crops in Ontario (by Common Name)

Common Name	Trade Name
amitrole	AMITROL
carfentrazone-ethyl	AIM
chlorthal dimethyl	DACTHAL
dazomet	BASAMID
dichlobenil	CASORON
dimethenamid-p	FRONTIER MAX
fluazifop-p-butyl	VENTURE L
flumioxazin	BROADSTAR, SUREGUARD
glyphosate	Various products (including ROUNDUP)
isoxaben	GALLERY
metam sodium	VAPAM
methyl bromide/chloropicrin	TERR-O-GAS
napropamide	DEVRIOL
oxadiazon	RONSTAR
oxyfluorfen	GOAL 2XL
paraquat	GRAMOXONE
propyzamide	KERB
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 D, Diagnostic Service, on page 133 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. See Chapter 2, Safe Use of Pesticides, for safety details.

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 quack grass. 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

10–40 days of residual activity can be expected, 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: **methyl bromide/
chloropicrin**

Trade Name: **TERR-O-GAS 67**
Chemical Family: **organohalogen**

Rates of Application

See product label.

Remarks

This product is registered for use as a preplant soil fumigant in ornamental and forest nurseries.

Caution: Methyl bromide is very poisonous to humans and livestock. Only experienced, licensed operators may use it.

Sensitive Weeds

Methyl bromide gas is toxic to germinating seedlings.

Application Methods

Methyl bromide is formulated as a pressurized liquid that, when released from its container, forms a gas. The product must be applied under a gas-proof cover, usually one made of plastic. The soil must be sealed with a plastic sheet since the gas is highly volatile. See the label for detailed directions.

Methyl bromide gas is very volatile and highly poisonous to humans and livestock. It can be absorbed through inhalation, ingestion and dermal contact. A permit from the Ontario Ministry of the Environment is required each time it is used.

The seedbed or greenhouse must be aired completely

after the treatment period. If there is any question, study the safety precautions in the *Pesticides Act* and follow the manufacturer's directions to the letter.

Unique Characteristics

Also controls soil insects, nematodes and fungal diseases.

Manufacturer: Great Lakes Chemical Corp.

PREEMERGENCE TREATMENTS

Some preemergence treatment chemicals control weeds by killing weed seedlings. Others function as a toxic chemical layer (in which germinating seeds and young seedlings cannot survive) on or near the soil surface. A herbicide may have either or both effects on a target weed.

- Apply preemergence treatments either:
 - after the seedling stage but before the specified weed or crop emerges, or
 - after planting new nursery stock.
- To avoid damage, make sure either:
 - the crops tolerate the chemical at the seedling stage, or
 - the chemical's toxicity will have disappeared before the crop emerges.
- For best results, apply the treatment to a smooth, well-prepared, clod-free seedbed.
- The surface soil should be moist and the temperature favourable for rapid weed-seed germination.

The following chemicals may be used as preemergence treatments.

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*, mugho 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

dimethenamid-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: 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 menziesii*, *Syringa reticulata* and *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 gracilis* ‘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 hour 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: **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: **DEVIRINOL 2 G**

DEVIRINOL 10 G

DEVIRINOL 50 DF

Chemical Family: **amide**

Site of Action: **Group 15**

Rates of Application

napropamide 4.5 kg/ha

DEVIRINOL 2 G 225 kg/ha

DEVIRINOL 10 G (10 Gr) 45 kg/ha

DEVIRINOL 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: apple, ash, azalea, birch, black walnut, boxwood, cedar, cherry, cypress, dogwood, Douglas fir, eucalyptus, euonymus, fir, firethorn, hawthorn, hemlock, hibiscus, holly, honeylocust, hypericum, Japanese larch, juniper, laburnum, maple, peach, pear, pin oak, pine, plum, poplar, privet, rhododendron, rose, spruce and yew.

Deciduous and evergreen shrubs: abelia, aucuba, azalea, bottlebrush, camellia, cotoneaster, crape myrtle, dogwood, forsythia, honeysuckle, leucothoe, nandina, osmanthus, photinia, raphiolepis, star jasmine and viburnum.

Fruit and nuts: filbert, grape and walnut.

Ground covers: ajuga, hederia, hypericum, ivy, lantana, liriopse, pachysandra, sedum and vinca.

Flowers: aster, dahlia, daisy, geranium, hosta, narcissus, osteospermum (African daisy) and petunia.

Use on the following container-grown nursery

stock: abelia, ageratum, azalea, bottlebrush, bougainvillea, boxwood, camellia, cedar, cotoneaster, crape myrtle, cypress, dogwood, Douglas fir, English ivy, eucalyptus, euonymus, fir, firethorn, forsythia, gardenia, geranium, heather, hibiscus, holly, juniper, leucothoe, liriopse, nandina, pachysandra, photinia, pine, privet, raphiolepis, rhododendron, rose, sedum, star jasmine and vinca.

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, mugho 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); *Viburnum 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: **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, quack grass 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: 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/hr or a vibrating shank cultivator at 10–13 km/hr. 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/hr) or tine cultivator (10–13 km/hr) set 8–10 cm deep. Incorporate immediately after application if possible, although a delay of up to 24 hours 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 quack grass 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 hours 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 hours.

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 litres per 100 litres of spray solution) or use Merge at 1% v/v (1 litre per 100 litres 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****Site of Action: 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, quack grass 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 quack grass. Apply to actively growing grasses when annual grasses are in the 2–5-leaf stage and quack grass is in the 3–5-leaf stage.

Residual Activity

Essentially none.

Unique Characteristics

Using preplant tillage to break up rhizomes improves quack grass 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 OMAF and MRA 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

Quack grass & 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 the OMAF and MRA Publication 75, *Guide to Weed Control*.

Sensitive Weeds

Annual grasses, perennial weeds (e.g., Canada thistle, cattails, field bindweed, milkweed, nut sedge, poison-ivy, quack grass, 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 quack grass 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 98.) 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 hours 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 litres 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 one application per year, using a low-pressure sprayer with flat fan nozzles. Do not apply more than 7 litres 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 litres of water per hectare.

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**

Chemical Family: **bipyridylum**

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. 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. For spot treatment, use 25 mL in 4 L of water. 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

The following pages contain charts listing information about herbicides registered in Ontario for use on nursery stock (agricultural use). The

following tables outline the tolerance of specific nursery crops and also provide weed control ratings for herbicides registered on nursery stock. See Table 4–3, *Herbicides Registered for Use on Woody Plants* on page 124; Table 4–4, *Weed Susceptibility and Herbicides — Broadleaf Annuals* on page 128; Table 4–5, *Weed Susceptibility and Herbicides — Broadleaf Perennials* on page 129; and Table 4–6, *Weed Susceptibility and Herbicides — Annual Grasses* on page 130.

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 11 different classes. Note that agriculture (including nursery production) is exempted. For more information on the legislation, see the Ministry of the Environment's website at www.ontario.ca/pesticides.

TABLE 4–3. Herbicides Registered for Use on Woody Plants

Botanical Name	Common Name	Herbicide						
		CASORON	DEVIRINOL	DUAL II MAGNUM	KERB	RONSTAR	SIMADEX, PRINCEP NINE-T	VENTURE L
<i>Abies balsamea</i>	balsam fir	Not			F		F	
<i>Abies</i> sp.	fir	Not			F			TFC
<i>Acer circinatum</i>	vine maple					C ²		
<i>Acer</i> sp.	maple	T ¹ F	TFC					TFC
<i>Ajuga</i> sp.	bugleweed	Not						
<i>Betula pendula</i> 'Gracilis'	cutleaf weeping birch	T ¹ F						
<i>Buxus</i> sp.	boxwood	T ¹ F	TFC				F	TFC
<i>Calluna</i> sp.	heather	T ¹ F						TFC
<i>Caragana</i> sp.	peashrub	T ¹ F					F	TFC
<i>Carpinus</i> sp.	blue beech							TFC
<i>Chaenomeles</i> sp.	flowering quince							TFC
<i>Chamaecyparis</i> sp.	false cypress						F	
<i>Cornus</i> sp.	dogwood					C ²	F	TFC

Botanical Name	Common Name	Herbicide						
		CASORON	DEVRIKOL	DUAL II MAGNUM	KERB	RONSTAR	SIMADEX, PRINCEP NINE-T	VENTURE L
<i>Cotinus coggygria</i>	smoke bush							TFC
<i>Cotoneaster</i> sp.	cotoneaster						F	TFC
<i>Crataegus</i> sp.	hawthorn		TFC					
<i>Erica</i> sp.	heath	T ¹ F						
<i>Euonymus fortunei</i> 'Emerald & Gold'	Emerald & Gold euonymus					C ²		
<i>Euonymus</i> sp.	euonymus	T ¹ F	TFC					TFC
<i>Forsythia</i> sp.	forsythia	T ¹ F						TFC
<i>Fraxinus americana</i>	white ash						F	
<i>Fraxinus</i> sp.	ash	T ¹ F						TFC
<i>Gleditsia</i> sp.	honeylocust		TF					TFC
<i>Gleditsia triacanthos</i>	honeylocust							T
<i>Hedera</i> sp.	English ivy		C					TFC
<i>Hibiscus</i> sp.	rose of Sharon		TF					
<i>Hydrangea</i> sp.	hydrangea							TFC
<i>Hypericum</i> sp.	hypericum		TF					
<i>Ilex</i> sp.	holly	T ¹ F	TFC				F	TFC ³
<i>Juglans nigra</i>	black walnut						F	
<i>Juniperus chinensis</i> 'Pfitzeriana'	Pfitzer juniper	T ¹ FC ^{1,2}			F			TFCD
<i>Juniperus sabina</i>	sabina juniper	T ¹ FC ^{1,2}			F			
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	T ¹			F			
<i>Juniperus</i> sp.	juniper	T ¹ F	TFC		F	C ²	FC	TFC ³
<i>Juniperus virginiana</i>	eastern red cedar	T ¹ F			F			
<i>Laburnum</i> sp.	golden chain tree		TF					
<i>Ligustrum</i> sp.	privet		TFC					TFC
<i>Lonicera</i> sp.	honeysuckle	T ¹ F						TFC
<i>Malus</i> sp.	flowering crabapple	T ¹ F	TF				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.

Not = Labelled restriction

S = Seedbed

T = Transplant

Blank = Insufficient information available to make a rating

C = Container

D = Directed spray only

F = Field

TABLE 4–3. Herbicides Registered for Use on Woody Plants *continued*

Botanical Name	Common Name	Herbicide						
		CASORON	DEVIRINOL	DUAL II MAGNUM	KERB	RONSTAR	SIMADEX, PRINCEP NINE-T	VENTURE L
<i>Malus sylvestris</i>	apple (non-fruiting)		TFC			F		
<i>Parthenocissus quinquefolia</i>	Virginia creeper							TFC
<i>Philadelphus</i> sp.	mock orange	T ¹ F						TFC ^D
<i>Picea abies</i>	Norway spruce	Not			F		F	
<i>Picea abies</i> 'Nidiformis'	nest spruce	Not			F			
<i>Picea glauca</i>	white spruce	Not			F		F	
<i>Picea glauca</i> 'Conica'	dwarf Alberta spruce	Not			F			
<i>Picea marina</i>	black spruce			TF				
<i>Picea omorika</i>	Serbian spruce	Not				C ²		
<i>Picea pungens</i>	Colorado spruce	Not				C ²		
<i>Picea pungens</i> 'Glaucá'	blue Colorado spruce	Not			F		F	
<i>Picea pungens</i> 'Glaucá Globosa'	globe blue spruce	Not			F		F	
<i>Picea rubens</i>	red spruce	Not			F		F	
<i>Picea</i> sp.	spruce	Not	TF		F			TFC ³
<i>Pieris</i> sp.	Japanese pieris							TFC
<i>Pinus banksiana</i>	jack pine			TF				
<i>Pinus mugo</i>	mugo pine	Not			F	C ²	F	
<i>Pinus nigra</i>	Austrian pine				F			
<i>Pinus resinosa</i>	red pine			TF				
<i>Pinus</i> sp.	pine		TFC		F			TFC
<i>Pinus strobus</i>	white pine 2 year			TF		F		F
<i>Pinus sylvestris</i>	Scots pine					C ²		
<i>Pittosporum</i> sp.	pittosporum		TF					
<i>Platanus</i> sp.	planetree							TFC
<i>Podocarpus</i> sp.	podocarpus		TFC					
<i>Populus</i> sp.	poplar		TF	stoolbed				
<i>Potentilla</i> sp.	cinquefoil					C ²		TFC
<i>Prunus</i> sp.	cherry (non- producing)		TF					
<i>Prunus tomentosa</i>	Nanking cherry					C ²		

Botanical Name	Common Name	Herbicide						
		CASORON	DEVRIOL	DUAL II MAGNUM	KERB	RONSTAR	SIMADEX, PRINCEP NINE-T	VENTURE L
<i>Pseudotsuga menzeisii</i>	Douglas fir				F			TFC ³
<i>Pyracantha</i> sp.	firethorn		TFC					TFC
<i>Pyrus</i> sp.	pear (non-producing)		F	F				F
<i>Rhododendron</i> sp.	rhododendron, azalea	T ¹ F	TFC					TFC
<i>Ribes alpinum</i>	alpine currant					C ²		
<i>Ribes</i> sp.	currant (non-producing)							TFC
<i>Robinia</i> sp.	locust	T ¹ F						
<i>Rosa multiflora</i>	multiflora rose						F	
<i>Rosa</i> sp.	rose	T ¹ F	TFC				F	TFC
<i>Salix</i> sp.	willow	T ¹ F						TFC
<i>Sambucus canadensis</i> 'Aurea'	golden elderberry					C ²		
<i>Sambucus</i> sp.	elderberry							TFC
<i>Spiraea</i> sp.	spirea	T ¹ F						TFC
<i>Symphoricarpos rivularis</i>	snowberry							TFC
<i>Syringa</i> sp.	lilac	Not				C ²		TFC
<i>Taxus cuspidata</i>	Japanese yew				F			
<i>Taxus</i> sp.	yew	T ¹ FC ^{1,2}	TF		F		FC	TFC ³
<i>Thuja occidentalis</i>	white cedar	T ¹ FC ^{1,2}			F			
<i>Thuja</i> sp.	cedar	T ¹ F	C		F		FC	TFC
<i>Tilia</i> sp.	linden, basswood	T ¹ F						TFC
<i>Tsuga</i> sp.	hemlock	Not					F	TFC ³
<i>Ulmus</i> sp.	elm	T ¹ F						TFC
<i>Viburnum</i> sp.	viburnum							TFC
<i>Weigela</i> sp.	weigela							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.

Not = Labelled restriction

S = Seedbed

T = Transplant

Blank = Insufficient information available to make a rating

C = Container

D = Directed spray only

F = Field

TABLE 4–4. Weed Susceptibility and Herbicides — Broadleaf Annuals

Broadleaf Annuals	CASORON	DEVRIOL	DUAL II MAGNUM	KERB	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
mustards	S						
nightshade, black			MS		S		
pigweed	S	S			S		S
pigweed, redroot		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		

S = Susceptible; MS = Moderately Susceptible; T = Tolerant; Blank = Insufficient information available to make a rating

TABLE 4–5. Weed Susceptibility and Herbicides — Broadleaf Perennials

Broadleaf Perennials	CASORON	DEVIRINOL	DUAL II MAGNUM	KERB	RONSTAR	ROUNDUP	SIMADIX	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	

S = Susceptible; MS = Moderately Susceptible; T = Tolerant; Blank = Insufficient information available to make a rating

TABLE 4–6. Weed Susceptibility and Herbicides — Annual Grasses

Annual Grasses	CASORON	DEVINOL	DUAL II MAGNUM	KERB	RONSTAR	ROUNDUP	SIMADEx	TREFLAN	VENTURE L
barnyard grass		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
crabgrass, large		S				S			
crabgrass, smooth			S						
darnel, Persian								S	S
foxtail, giant			S						S
foxtail, green	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	
proso millet									S
ryegrass		S							
witch grass			S						

S = Susceptible; MS = Moderately Susceptible; T = Tolerant; Blank = Insufficient information available to make a rating

5. Appendices

Appendix A. Nursery Crop Advisory Staff, Ministry of Agriculture and Food and the Ministry of Rural Affairs

Jen Llewellyn

Nursery Crops Specialist

Bovey Building

University of Guelph

Guelph, ON N1G 2W1

Tel: 519-824-4120, ext. 52671

E-mail: jennifer.llewellyn@ontario.ca

A complete list of advisory staff is available on the ministry website at www.ontario.ca/crops.

Agricultural Information Contact Centre

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

1 Stone Road West

Guelph ON N1G 4Y2

1-877-424-1300 or 519-826-4047

Fax: 519-826-7610

E-mail: ag.info.omafra@ontario.ca

Appendix B. Regional Contact Information, Ministry of the Environment

Region/County	Address	Telephone/Fax
Central Region Toronto, Halton, Peel, York, Durham, Muskoka, Simcoe	5775 Yonge Street 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 Street West 12th 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 Road 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 Road 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 Street Suite 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 Street South Suite 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 Avenue West 7th Floor Toronto, ON M4V 1L5	Tel: 416-327-5519 Fax: 416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Avenue West 12A Floor Toronto, ON M4V 1L5	Tel: 416-314-8001 Toll-Free: 1-800-461-6290 Fax: 416-314-8452

Appendix C. Other Contacts

Agriculture & Agri-Food Canada Research Centres

Eastern Cereals and Oilseeds Research Centre

960 Carling Avenue
Ottawa, ON K1A 0C6
Tel: 613-759-1952
Website: www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1180546650582&lang=e

Greenhouse and Processing Crops Centre

2585 County Road 20
Harrow, ON N0R 1G0
Tel: 519-738-2251
Website: www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1180624240102&lang=e

Southern Crop Protection and Food Research Centre

1391 Sandford Street
London, ON N5V 4T3
Tel: 519-457-1470
Website: www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1180640801098&lang=e

Vineland Research Farm

4902 Victoria Avenue North
Vineland, ON L0R 2E0
Tel: 905-562-4113

Canadian Food Inspection Agency Regional Offices (Plant Protection)

www.inspection.gc.ca/english/toce.shtml

Belleville

345 College Street East
Belleville, ON K8N 5S7
Tel: 613-969-3332

Brantford

625 Park Road North, Unit 6
Brantford, ON N3T 5L8
Tel: 519-753-3478

Hamilton

709 Main Street West, Suite 101
Hamilton, ON L8S 1A2
Tel: 905-570-8265

London

1200 Commissioners Road East
Unit 19
London, ON N5Z 4R3
Tel: 519-645-4021
Fax: 519-691-1315

Niagara Falls

P.O. Box 9, 350 Ontario Street
Unit 13
St. Catharines, ON L2R 5L8
Tel: 905-357-5981

Ottawa District

38 Auriga Drive, Room 8
Ottawa, ON K2E 8A5
Tel: 613-274-7374, ext. 221

Toronto

1124 Finch Avenue West, Unit 2
Downsview, ON M3J 2E2
Tel: 416-665-5055
Fax: 416-665-5069

University of Guelph

Main Campus

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

Alfred College

Alfred, ON K0B 1A0
Tel: 613-679-2218
Fax: 613-679-2423
Website: www.alfredc.uoguelph.ca

Kemptville College

Kemptville, ON K0G 1J0
Tel: 613-258-8336
Fax: 613-258-8384
Website: www.kemptvillec.uoguelph.ca

Ridgetown College

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

Department of Plant Agriculture

Website: www.plant.uoguelph.ca

Department of Plant Agriculture, Guelph

50 Stone Road East
Guelph, ON N1G 2W1
Tel: 519-824-4120, ext. 56083
Fax: 519-763-8933

Department of Plant Agriculture, Simcoe

P.O. Box 587, 1283 Blueline Road
Simcoe, ON N3Y 4N5
Tel: 519-426-7127
Fax: 519-426-1225

Department of Plant Agriculture, Vineland

P.O. Box 7000, 4890 Victoria
Avenue North
Vineland Station, ON L0R 2E0
Tel: 905-562-4141
Fax: 905-562-3413

Lab Services Division

Website: www.uoguelph.ca/labserv

Pesticide and Trace Contaminants

P.O. Box 3650,
95 Stone Road West
Guelph, ON N1H 8J7
Tel: 519-767-6200

Pest Diagnostic Clinic

Tel: 519-767-6256

Vineland Research and Innovation Centre

P.O. Box 4000,
4890 Victoria Avenue North
Vineland Station, ON L0R 2E0
Tel.: 905-562-0320
Fax: 905-562-0084
Website: www.vinelandontario.ca

APPENDIX D. Diagnostic Service

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 Road West
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

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 0.5–1 L (1 pint–1 quart) from this. No single sample should represent more than 2.5 ha (6.25 ac). 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 ac)	25 subsamples
0.5 ha–2.5 ha (1.25–6.25 ac)	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 plants for disease diagnosis or identification

Sample submission forms

Forms can be obtained from your local Ontario Ministry of Agriculture and Food/Ministry of 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 3 years and pesticide use records from this year.

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 (8–10 in.) 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 the soil drying out and contaminating the leaves. 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 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 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.

Sample Submission Form

Pest Diagnostic Clinic

LABORATORY USE ONLY: LS Form: SubP07/03/27 Pg. 1 of 1

Rec'd By: _____ Date Received: _____

Delivered By: ☐ Mail ☐ Courier ☐ In-Person

LS Sample No: _____ to _____

Payment Rec'd: \$ _____ Receipt #: _____

Submitted By:			Owner (if different from submitter):		
Business Name (if applicable):			Business Name (if applicable):		
Street:			Street:		
City:	Prov:	Postal Code:	City:	Prov:	Postal Code:
Tel: () -	Fax: () -		Tel: () -	Fax: () -	
Email:			Email:		

Report to: ☐ Submitter ☐ Owner Required Report Format: ☐ Fax ☐ E-Mail ☐ Mail

Invoice to: ☐ Submitter ☐ Owner Quotation #: Purchase Order / U of G G/L code:

Services Required: ☐ Nematode Count ☐ Nematode Count from Roots ☐ SCN Cyst & Egg Count
☐ Plant Disease Diagnosis ☐ Insect Identification ☐ Plant Identification ☐ DNA Multiscan

Is the purpose of the water test request to assess the quality of water for human consumption? ☐ YES ☐ NO

Date: _____ Signature: _____

Plant or Host Affected:		Cultivar/Variety:	Grower/Field sample #:
		Location of Plant (i.e. greenhouse, field, orchard, garden, etc.):	
Size of Planting:	% of Plants Affected:	Symptoms First Appeared in Past: ☐ Days ☐ Weeks ☐ Months ☐ Years	Degree of Injury: ☐ Severe ☐ Moderate ☐ Light
Cropping History:		Future Crop:	

Describe the problem in detail (i.e. symptoms, plant parts affected, distribution of symptoms)

Were chemicals applied? Please specify type of product(s) used and date(s) of application:

Additional comments and specific requests:

Additional Sheet(s) Attached: ☐

Appendix E. The Metric System

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

Metric conversions

5 mL	=	1 tsp
15 mL	=	1 tbsp
28.5 mL	=	1 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. quarter 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	
	Imp. Gallons	U.S. Gallons
50	= 4.45	5.35
100	= 8.90	10.70
150	= 13.35	16.05
200	= 17.80	21.40
250	= 22.25	26.75
300	= 26.70	32.10

Dry weight equivalents

<i>Metric</i>	<i>Imperial</i>
grams or kilograms/ hectare	ounces or pounds/acre
100 g/ha	= 1½ oz./acre
200 g/ha	= 3 oz./acre
300 g/ha	= 4¼ oz./acre
500 g/ha	= 7 oz./acre
700 g/ha	= 10 oz./acre
1.10 kg/ha	= 1 lb./acre
1.50 kg/ha	= 1¼ lb./acre
2.00 kg/ha	= 1¾ lb./acre
2.50 kg/ha	= 2¼ lb./acre
3.25 kg/ha	= 3 lb./acre
4.00 kg/ha	= 3½ lb./acre
5.00 kg/ha	= 4½ lb./acre
6.00 kg/ha	= 5¼ lb./acre
7.50 kg/ha	= 6¾ lb./acre
9.00 kg/ha	= 8 lb./acre
11.00 kg/ha	= 10 lb./acre
13.00 kg/ha	= 11½ lb./acre
15.0 kg/ha	= 13½ lb./acre

Conversion tables – metric to imperial (approximate)**Length**

1 millimetre (mm)	= 0.04 inches
1 centimetre (cm)	= 0.40 inches
1 metre (m)	= 39.40 inches
1 metre (m)	= 3.28 feet
1 metre (m)	= 1.09 yards
1 kilometre (km)	= 0.62 miles

Area

1 square centimetre (cm ²)	= 0.16 square inches
1 square metre (m ²)	= 10.77 square feet
1 square metre (m ²)	= 1.20 square yards
1 square kilometre (km ²)	= 0.39 square miles
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-feet
1 hectolitre (hL)	= 2.8 bushels

Volume (liquid)

1 millilitre (mL)	= 0.035 fluid ounces (Imp.)
1 litre (L)	= 1.76 pints (Imp.)
1 litre (L)	= 0.88 quarts (Imp.)
1 litre (L)	= 0.22 gallons (Imp.)
1 litre (L)	= 0.26 gallons (U.S.)

Weight

1 gram (g)	= 0.035 ounces
1 kilogram (kg)	= 2.21 pounds
1 tonne (t)	= 1.10 short tons
1 tonne (t)	= 2,205 pounds

Pressure

1 kilopascal (kPa)	= 0.15 pounds/in. ²
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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 miles per hour

Temperature

°F	= (°C × 9/5) + 32
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Conversion tables – imperial to metric (approximate)**Length**

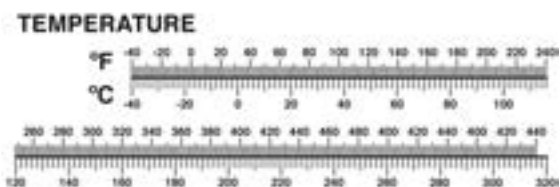
1 inch	= 2.54 cm
1 foot	= 0.30 m
1 yard	= 0.91 m
1 mile	= 1.61 km

Area

1 square foot	= 0.09 m ²
1 square yard	= 0.84 m ²
1 acre	= 0.40 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

Handy metric conversion factor
litres per hectare × 0.4 = litres per acre
kilograms per hectare × 0.4 = kilograms per acre



For exact values the formula is:
 Fahrenheit to Celsius: subtract 32 from number of °F, then multiply by 5/9.
 Celsius to Fahrenheit multiply °C by 9/5 then add 32.

Abbreviations

%	=	per cent (by weight)
ai	=	active ingredient
AP	=	agricultural powder
cm	=	centimetre
cm ²	=	square centimetre
CS	=	capsule suspension
DF	=	dry flowable
DG	=	dispersible granular
DP	=	dispersible powder
E	=	emulsifiable
EC	=	electrical conductivity
e.g.	=	for example
F	=	flowable
g	=	gram
Gr	=	granules, granular
ha	=	hectare
kg	=	kilogram
km/h	=	kilometres per hour
kPa	=	kilopascal
L	=	litre
m	=	metre
m ²	=	square metre
mL	=	millilitre
mm	=	millimetre
m/s	=	metres per second
SC	=	sprayable concentrate
SP	=	soluble powder
t	=	tonne
W	=	wettable (powder)
WDG	=	water dispersible granular
WG	=	wettable granule
WP	=	wettable powder

Appendix F. Pest Monitoring Record Sheet

[illegible]

Appendix F. Pest Monitoring Record Sheet *continued*

[illegible]

Emergency and First-Aid Procedures for Pesticide Poisoning

For a major spill, a theft or a fire involving a pesticide, call the Ministry of the Environment at
1-800-268-6060.

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.

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.

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