Publication 360E

Crop Protection Guide for Tree Nuts

2021

Ministry of Agriculture,
Food and Rural Affairs

Ontario

Discard old editions of this publication. Each year a committee comprised of representatives from provincial government, industry, academia and grower organizations review the pesticides listed in the publication.

To the best knowledge of the committee, at the time of publishing, the pesticide products listed in this publication were federally registered.

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

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

THE PESTICIDE LABEL

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

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

REGISTRATION OF PESTICIDE PRODUCTS

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

1. Full Registration

Pesticide registrations are normally granted for a period of 5 years, subject to renewal.

2. Emergency Registration

An emergency registration is a temporary, time-limited registration of no more than 1 year, approved to deal with serious pest outbreaks. An emergency is generally deemed to exist when both of the following criteria are met:

A. An unexpected and unmanageable pest outbreak or pest situation occurs that can cause significant health, environmental or economic problems; and

B. Registered pesticides and cultural control methods or practices are insufficient to address the pest outbreak.

MAXIMUM RESIDUE LIMITS

The PMRA has established maximum residue limits (MRLs) for pesticides. An MRL is the maximum amount of pesticide residue that may remain on food after a pesticide is applied as per label directions and which can safely be consumed. 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/AMENDED LABELS

Supplemental/amended labels provide label directions for new approved uses for a registered pesticide that do not appear on the current label. These label directions MUST be followed when using the pesticide for these purposes.

Examples of when you must use a supplemental/amended label include:

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

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

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

REGULATION OF PESTICIDES IN ONTARIO

The Ontario Ministry of Environment, Conservation and Parks (MECP) is responsible for regulating pesticide sale, use, transportation, storage and disposal in Ontario.

Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the Pesticides Act and Regulation 63/09.

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

CLASSIFICATION OF PESTICIDES

As of May 1, 2020, Ontario's pesticides classes have been aligned with the federal government's pesticide categories to remove duplication and reduce complexity for the sale and use of pesticides in Ontario, while ensuring continued protection of human health and the environment.

MECP automatically classifies pesticides in Ontario as Class A, B, C, D or E. The Ontario pesticide classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario. For more information on the classification of pesticides, visit the MECP website at ontario.ca/pesticides.

CERTIFICATION AND LICENSING

Growers and Their Assistants

For information about farmer training and certification requirements, visit the MECP website at ontario.ca/pesticides and for information on courses check the Ontario Pesticide Education Program website at www.opep.ca or call 1-800-652-8573.

Pesticide Commercial Applicators (Exterminators) and Their Assisting Technicians

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

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

Publication 360E

Crop Protection Guide for Tree Nuts

2021

Ministry of Agriculture,
Food and Rural Affairs

Ontario

Acknowledgements

The information contained in this publication is printed following review by the Fruit Technical Working Group, comprised of representatives from provincial and federal governments, academia and industry.

If you need technical or business information

Contact the Agricultural Information Contact Centre at
1-877-424-1300
ag.info.omafra@ontario.ca

Looking for fruit production information on the Internet? Check out:

The OMAFRA website at ontario.ca/crops

The Ontario Specialty Crops Blog at onspecialtycrops.ca

The Ontario Fruit Blog at onfruit.ca

This publication contains pesticide control products that have been registered as of October 31, 2020, on fruit crops. Any updates to this information will be posted on the OMAFRA website at ontario.ca/crops

Cover Images

Top left: Gypsy moth on hazelnut
Top right: Husk fly on walnut
Bottom left: Chestnut blight on chestnut

COMING SOON!

For the 2022 growing season, you will be able to access the information currently listed in this publication through a new, digital application.

The application will replace OMAFRA's crop protection publications and provide you with information in one single location.

This one-stop tool for crop protection information will allow you to:

- ✔ customize and navigate through information based on your specific needs;
- ✔ access information when you need it to make important business decisions; and
- ✔ access information digitally, either through desktop, tablet or mobile.

Updates can be found at:
ontario.ca/crops

Contents

Introduction **1**
Pest Control Products for Tree Nuts 1
Levels of Control for Fungicides and Insecticides/Miticides 2
Fungicides 2
Insecticides/Miticides 2

1. Using Pesticides in Ontario **3**
Federal Registration of Pesticides 3
Maximum Residue Limit (MRL) 3
Regulation of Pesticides in Ontario 4
Classification of Pesticides 4
Certification and Licensing 5
Certified Farmers and Their Assistants 5
Pesticide Commercial Applicators (Exterminators) and Their Assisting Technicians 6
Ontario's Cosmetic Pesticide Ban and Excepted Uses 6
Pesticide Application Information 7
Restricted Entry Intervals 7
Days to Harvest Intervals for Food Crops (Pre-harvest, Pre-grazing and Feeding Intervals) 8
Spray Buffer Zones 8
Vegetative Filter Strips 9
Protect the Environment 9
Protect Water Sources 9
Bee Poisoning 9
Manage Drift 10
Waste Management 12
Empty Pesticide and Fertilizer Containers up to 23 L 12
Empty Pesticide Containers Greater than 23 L (Totes and Drums) 12
Empty Seed and Pesticide Bags 12
Surplus Spray Mix 12
Surplus Pesticide Disposal 12
Storing Pesticides 13
Pesticide Spills 13

2. Pest Management **15**
Pest Management Tools 15
Cultural and Mechanical/Physical 15
Biological 15
Behavioural 16
Chemical 16
Degree-Day Modeling 17
Managing Pesticide Resistance 18
Resistance Management Strategies 19
Handling and Mixing Pesticides 23
Carrier Volume and Coverage 23
General Mixing Steps 24
Product Order by Formulation 24
Water Soluble Packaging 25
Compatibility of Spray Materials 25
Jar Test for Pesticide Compatibility 25
Adjuvants Used in Fruit Crops 26

3. Tree Nut Crop Protection **29**
Hazelnuts 29
Crop Nutrition 29
Pest Control Product Persistence 30
Hazelnut (Filbert) Calendar 31
Notes on Hazelnut Insect and Disease Control Products 41
Walnuts 44
Crop Nutrition 44
Pest Control Product Persistence 45
Walnut Calendar 46
Notes on Walnut Insect Control Products 61
Chestnuts and Pecans 63
Crop Nutrition 63
Pest Control Product Persistence 64
Chestnut and Pecan Calendar 65
Notes on Chestnut and Pecan Insect Control Products 77
Toxicity of Tree Nut Pest Control Products to Beneficial Insects 79

4. Soilborne Diseases and Nematodes 83
Soilborne Pathogens and Fumigants for Tree Fruit 83
Replant Disease in Perennial Crops 83
Nematodes 84
Soil Fumigation for Fruit Trees 85

5. Appendices 89
APPENDIX A: Additional Resources for Ontario Fruit Growers 89
APPENDIX B: Diagnostic Services 90
APPENDIX C: Ontario Ministry of Agriculture, Food and Rural Affairs – Fruit Crop Advisory Staff 92
APPENDIX D: Ontario Ministry of the Environment, Conservation and Parks – Regional Contact Information 93
APPENDIX E: The Metric System 94

List of Tables

Table 1–1. Federal and provincial classification 5
Table 1–2. Requirements for Pesticide Storage Facilities 13
Table 2–1. Fungicide/Bactericide Groups 21
Table 2–2. Insecticide/Miticide Groups 22
Table 2–3. Tank-mix Order for Pesticide Compatibility Test 26
Table 3–1. Hazelnut (Filbert) Calendar 31
Table 3–2. Products Used on Hazelnuts 39
Table 3–3. Activity of Insecticides and Miticides on Hazelnut Pests 41
Table 3–4. Activity of Fungicides on Eastern Filbert Blight (EFB) 43
Table 3–5. Walnut Calendar 46
Table 3–6. Products Used on Walnuts 59
Table 3–7. Activity of Insecticides and Miticides on Walnut Pests 61
Table 3–8. Chestnut and Pecan Calendar 65
Table 3–9. Products Used on Chestnuts and Pecan 75
Table 3–10. Activity of Insecticides and Miticides on Pecan and Chestnut Pests 77
Table 3–11. Toxicity of Pesticides to Honeybees and Mite/Aphid Predators 80
Table 4–1. Products for Management of Nematodes and Other Soil-borne Pests 86

Introduction

Products Listed in This Publication

- Products listed in this publication are registered for use on tree nuts in Ontario as of October 31, 2020. The information contained in this publication is provided as a guideline only and has been prepared in consultation with the Fruit Technical Working Group, comprised of representatives from provincial and federal governments, academia and industry. Products are organized by tree nut crop and then by pest.
- Some tree nut products are under re-evaluation by Health Canada's Pest Management Regulatory Agency (PMRA) and their labels may change within the lifetime of this publication. Consult the most current version of each product label before you use a pest control product. Labels for registered pest control products are available at the Pest Management Regulatory Agency (PMRA) website at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php.

Pest Control Products for Tree Nuts

Tree nuts are a newer, small acreage crop in Ontario and have fewer registered products than larger acreage tree fruits grown in the province (e.g. apples) and tree nuts grown in other countries. Use of a product on a crop/pest combination that is not specifically listed on the Canadian label is not permitted. Use of non-permitted products can result in residues being left on the crop that can result in monetary fines, product recalls or other consequences. It is the grower and/or applicator's responsibility to ensure that they are applying a pest control product according to the Canadian label.

The registration of pest control products on lower acreage crops like tree nuts benefits from the use of crop groups. A crop group is a grouping of plant species based on botany and taxonomy (e.g. plant families), as well as on how the crops are produced. Crop groups are often subdivided into smaller and more closely related subgroups. A pest control product may be registered on a subgroup, rather than the entire group. Crop groups are used primarily to set maximum residue limits and establish a common preharvest interval (PHI) for a similar set of crops. It is important to remember that not all products have a crop group registration, and products registered on one crop group are not necessarily registered on all members of its crop group. There are some crops that do not belong in a crop group. A complete list of all crops included in both original and revised crop groups can be found by searching "Residue Chemistry Crop Groups" on the Government of Canada's website: www.canada.ca.

Tree nuts are included in the old Crop Group 14: Tree Nuts and the revised Crop Group 14-11: Tree Nuts. This publication only lists products registered on some members of this group — walnuts, chestnuts, pecans and hazelnuts. These products are not necessarily registered on all other tree nut species that might be grown in Ontario. Check each product label for a full list of registered tree nut crops.

Levels of Control for Fungicides and Insecticides/Miticides

The value of all insecticides, miticides and fungicides is evaluated by the Pest Management Regulatory Agency (PMRA) prior to registration, which includes an assessment of efficacy. Wording on the product label such as control, suppression or partial suppression is used to describe the level of pest management provided by these products. The definitions of "control" and "suppression" for insecticides have a somewhat different meaning than the same terms applied to fungicides, according to the PMRA's *Value Guidelines for New Plant Protection Products and Label Amendments.*

> **Note**: These guidelines are currently suggestions and are under review by the Pest Management Regulatory Agency. Current, approved Canadian labels may also include a statement "reduction in damage from" the target pest. This is an undefined level of control less than suppression, and this statement is still under review with the Pest Management Regulatory Agency

It is important to consider the level of control of a product and how it is incorporated into a pest management program. Together with cultural control, biological control or promoting natural enemies, products used for suppression might be enough to prevent significant crop damage. Products labelled for suppression may also play a role in resistance management. By alternating with products from different families, the risk of pest resistance to important products can be reduced. However, when using a new product for pest suppression, try to leave an untreated check and evaluate the benefits of using these products compared to the cost of application.

Fungicides

Control: A consistent level of disease management, as defined by commercial standards and expectations in the market. In general, disease control ratings would be between 80%–100%.

Suppression: A consistent level of disease management that is less than full control, as defined by commercial standards and expectations in the market. In general, disease control ratings would be between 60%–100%. Suppression is defined as consistent disease reduction to a level that is not optimal but is still of commercial benefit.

Partial suppression: A level of disease management that is less than suppression, as defined by the commercial standards and expectations in the market. This label claim will generally only be considered for non-conventional fungicides. In general, disease control ratings would be less than 60%.

Insecticides/Miticides

Control: The product, when applied in accordance with the label directions, consistently reduces pest numbers or pest damage to a commercially acceptable level.

Suppression: The product, when applied in accordance with the label directions, does not reduce pest populations or damage to a level typically required to achieve commercially acceptable control. Under such situations, the level of performance offered by the product should still have value in a pest management program.

Source: Pest Management Regulatory Agency (PMRA), 2016.

1. Using Pesticides in Ontario

Visit www.ontario.ca/usingpesticides for up-to-date information on provincial pesticide use requirements. Some of the information provided 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 at https://www.opep.ca/courses/pick-up-a-gpsc-manual/

Keep detailed spray records.

Federal Registration of Pesticides

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

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

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

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

The pesticide label is a legal document. Follow all label directions. Labels for all registered pesticides are under "Search Pesticide Labels" on the PMRA website at www.healthcanada.gc.ca/pmra. Ensure you have the most current label and are aware of any re-evaluation decisions. Emergency registrations are temporary registrations (1 year or less) for pesticides needed by growers to manage a new invasive pest or pest outbreak. Know the expiration date for pesticides you are using under an emergency registration.

Maximum Residue Limit (MRL)

When you apply a pesticide to a crop, some residue may remain on the crop at harvest time. A Maximum Residue Limit (MRL) is the maximum amount of pesticide residue that may remain on food after a pesticide is applied as per label directions and which can safely be consumed. The PMRA sets the MRL well below a level that may cause harm to human health. The MRL is specific for every pesticide-crop combination.

The Canadian Food Inspection Agency (CFIA) is responsible for enforcing the MRLs established by the PMRA. OMAFRA's Food Inspection Branch conducts an annual Produce Food Safety Monitoring Program which involves collecting Ontario grown fresh fruits and vegetables and testing them for pesticide residues and pathogenic organisms (e.g., *Listeria monocytogenes, E. coli* O157:H7).

If you apply a pesticide at a higher rate, make too many applications or harvest a crop before the Pre- Harvest Interval has ended, there may be pesticide residues in excess of the MRLs set by PMRA.

When exporting your food product, it is important to confirm the importing country's MRLs because it may be different than ours. 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.

For more information on MRLs, see:

- PMRA's MRL database at http://pr-rp.hc-sc.gc.ca/ mrl-lrm/index-eng.php provides information on established Canadian MRLs. This database includes importing MRLs that may have pesticide- crop combinations that are not registered for use in Canada. Always check the current Canadian pesticide label for registered uses.
- Global MRL Database at www.globalmrl.com provides free access to U.S. MRL information.
- Agricultural Chemical Companies can provide MRL information for their products. Companies' contact information are found on the pesticide labels, company websites and in OMAFRA's crop protection publications.
- Summaries of OMAFRA's Food Safety Monitoring Program results can be found at www.ontario.ca/producesafety.
- CFIA's Chemical Residue Surveillance Program at https://www.inspection.gc.ca/food-safety-for-industry/food-chemistry-and-microbiology/food-safety-testing-bulletin-and-reports/eng/1453324778043/1453327843364

Regulation of Pesticides in Ontario

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

Classification of Pesticides

The PMRA classifies a pesticide into one of four classes – manufacturing, restricted, commercial and domestic. As of May 1, 2020, Ontario's pesticides classes have been aligned with the federal government's pesticide categories to remove duplication and reduce complexity for the sale and use of pesticides in Ontario, while ensuring continued protection of human health and the environment.

The MECP automatically classifies pesticides in Ontario as Class A, B, C or D based on the federal classification system plus one additional class (Class E) for regulating the sale and use of neonicotinoid-treated corn and soybean seed.

Table 1–1. Federal and provincial classification

Federal product class	Federal Class Description	Provincial Class
Manufacturing	The pesticide is only used to manufacture a pest control product.	Class A
Restricted	The pesticide is restricted by the federal government out of concern of environmental risk or human health. Additional information must be shown on the label regarding essential conditions for display, distribution and limitations on use. Specific qualifications may be required for a person to use this product.	Class B
Commercial	The pesticide can only be used in commercial activities that are specified on the label.	Class C
Domestic	The pesticide is primarily used by the general public for personal use and in and around their homes.	Class D
N/A	—	Class E* Corn and soybean seeds that are treated with imidacloprid, clothianidin or thiamethoxam neonicotinoids

* Class E pesticides do not apply to:
- popping corn
- sweet corn
- corn used for the production of seed
- soybean seed planted for the purpose of producing a soybean seed crop of certified status under contract
- corn seed and soybean seed treated only with fungicide

Each Ontario Class has specific certification, licensing and/or permit requirements and restriction on its use and sale.

Certification and Licensing

Certified Farmers and Their Assistants

Farmers must be certified through the Grower Pesticide Safety Course (GPSC) in order to buy and use Class B and C pesticides on their farms. Certification is not required to buy and use Class D pesticides for agricultural purposes.

Farmers become certified by successfully completing one of the following certification options:

- one-day in-person course and pass an open book certification test with a mark of at least 75%, or
- online course and successfully complete quizzes and case studies to become certified.

Farmer assistants and supervised farmers using Class B or C pesticides must complete training and assist or be supervised by a certified farmer. Farmer assistants and supervised farmers must complete one of the two training options:

- participate in a GPSC (assessment is not required) or
- participate in an On-Farm training session given by an On-Farm Instructor.

For information about farmer training and certification requirements visit the MECP website at ontario.ca/pesticides and for information on courses visit the University of Guelph's Ontario Pesticide Education Program website at www.opep.ca or call 1-800-652-8573.

To buy and use Class E pesticides, farmers are required to:

1. Complete the Integrated Pest Management (IPM) Course for Corn and Soybean
2. Complete a pest risk assessment and a pest risk assessment report
3. Sign an IPM Written Declaration Form stating that you considered IPM principles to decrease the risk of early season insect damage.

Farmers must provide these pieces of information to a vendor sales representative or custom-seed treater in order to purchase Class E pesticides. They must retain these records for at least two years.

Farmers must also carry with them or have readily available at the field when they are planting a copy of their certificate of completion of the Integrated Pest Management (IPM) Course for Corn and Soybean and pest risk assessment report.

For information on the requirements for Class E pesticides visit the MECP website ontario.ca/pesticides. For information on the IPM Course visit the University of Guelph's website at IPMCertified.ca.

Pesticide Commercial Applicators (Exterminators) and Their Assisting Technicians

All applicants for a pesticide exterminator licence must first become certified by passing an examination. Once certified, you can apply to the MECP for an exterminator licence.

For more information on how to become certified, refer to Ontario Pesticide Training and Certification

University of Guelph, Ridgetown Campus
1-888-620-9999

Email: rcoptc@uoguelph.ca
Website: www.ontariopesticide.com

For further information on pesticide licensing please refer to the document Guide to Pesticide Licensing available at ontario.ca/pesticides.

For information on technician training, visit:

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

Ontario's Cosmetic Pesticide Ban and Excepted Uses

Ontario prohibits the use of certain pesticides for cosmetic (non-essential) purposes.

Only low risk pesticides and biopesticides may be used for cosmetic purposes such as in lawns and gardens, and these are listed in the publication "List of Active Ingredients Authorized for Cosmetic Uses (Allowable List)"

Under the ban, the use of an active ingredient that is not on the Allowable List is permitted for appropriately licensed individuals if the use falls under one of the exceptions to the ban. There are exceptions for public health and safety (including for public works, buildings and other structures that are not a public work, and to control poisonous plants), golf courses, specialty turf, specified sports fields, arboriculture and the protection of natural resources, if certain conditions are met. There are also exceptions for agriculture, forestry, research and scientific purposes, uses of pesticides for structural exterminations (e.g., in and around homes to control insects), and uses of pesticides required by other legislation.

To locate your local MECP District Office:
https://www.ontario.ca/environment-and-energy/ministry-environment-district-locator

To speak with your local MECP Pesticide Specialist:

South West Region – 519-668-9292

West Central Region – 905-512-0981

Central Region – 416-990-1694

Eastern Region – 613-540-6874

Northern Region – 705-562-0853

Pesticide Application Information

When you decide to use a pesticide, choose the least toxic and least volatile option for your situation. Use an appropriate application method and ensure equipment is properly maintained and calibrated. Take all possible precautions to prevent the exposure of people and non-target organisms to the pesticide, before, during and after the application. Read the most current pesticide label thoroughly before application. The pesticide label is a legal document and must be followed. Pesticides may only be used in accordance with label instructions. 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, application equipment, timing, appropriate weather conditions)
- required personal protective equipment (PPE)
- hazard symbols and warnings
- restricted entry intervals
- pre-harvest intervals
- buffer zones / vegetative strips
- precautionary statements
- steps to be taken in case of an accident
- disposal
- equipment sanitation

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

For more information on pesticide application, see:

- Sprayers 101 at www.sprayers101.com
- OMAFRA Factsheet *Pesticide Drift from Ground Applications*
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos at www.opep.ca/resources/
- OMAFRA Agriculture and Agri-Food Canada booklet Best Management Practices — *Pesticide Storage, Handling and Application,* Order No. BMP13
- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies*
- PMRA's Factsheet *Understanding Restricted Entry Intervals for Pesticides* (English, French and Spanish): www.healthcanada.gc.ca/pmra, search for Restricted Entry Interval

Restricted Entry Intervals

Restricted Entry Interval (REI) is the minimum period of time that must elapse before hand labour tasks can be performed in an area treated with pesticide. The REI allows the pesticide residues and vapours to dissipate to safe levels to protect agricultural workers.

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

An REI can range from 12 hours to several days depending on the crop and the task (e.g., scouting, harvesting). A minimum 12-hour REI must be observed in agricultural crops, even if no REI is indicated on the label. However, REIs do not apply to biopesticides (e.g., microbials, pheromones) unless specified on the label. For golf courses and residential turf applications, the spray solution must be dry before re-entry can occur. When tank-mixing pesticides that have different REIs, you must observe the longest REI.

A Certified Farmer or Licensed Commercial Applicator (i.e., a holder of the appropriate Exterminator License, such as an Agriculture Exterminator License or a Greenhouse/Interior Plant Exterminator License) may need to enter a treated area early to do short-term tasks before the end of the REI. In these cases, the Certified Farmer or Licensed Commercial Applicator may enter between 4–12 hr after the application wearing a NIOSH-approved respirator and any other protective clothing (PC) and personal protective equipment stated on the label for mixing and loading. This Certified Farmer or Licensed Commercial Applicator (exterminator) must not be in the treated area during the REI for more than a total of 1 hr in any 24-hr period.

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

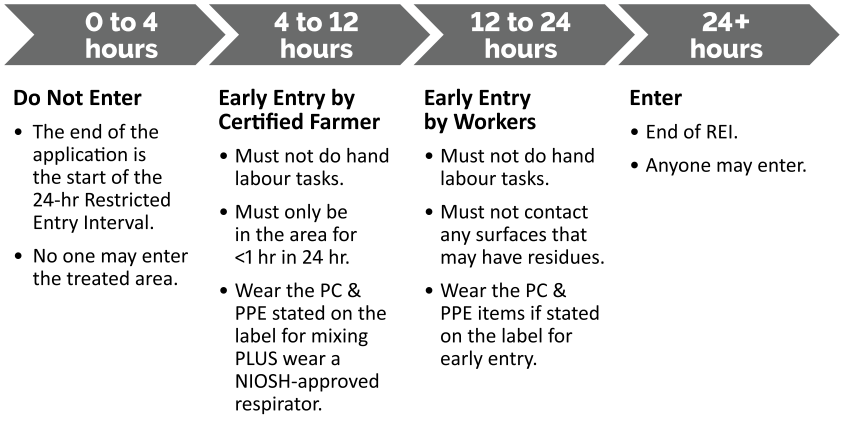

Figure 1–1. Example of a 24-hr REI on a pesticide label.

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

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

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

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

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

Spray Buffer Zones

Spray buffer zones are no-spray areas required at the time of application between the area being treated and the closest downwind edge of a sensitive aquatic or terrestrial habitat. Spray buffer zones reduce the amount of spray drift that enters non-target areas.

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.

The pesticide label indicates the size of the spray buffer zone, which depends on the product used, the method of application, and the crop being sprayed.

Unless forbidden by the pesticide label, Health Canada's online Buffer Zone Calculator may allow applicators to reduce the spray buffer zones based on weather conditions, the category of the spray equipment and the droplet size. For more information, search for "Buffer Zone Calculator" at www.canada.ca.

For soil fumigation, a buffer zone is an area established around the perimeter of each application block.

Vegetative Filter Strips

A vegetative filter strip is:

- a permanently vegetated strip of land.
- sits between an agricultural field and downslope surface waters.
- must be at least 10 m wide from edge of field to the surface water body.
- must be composed of grasses, but may also contain other vegetation (shrubs, trees, etc.).

Vegetative filter strips reduce the amount of pesticide entering surface waters from runoff by slowing runoff water and filtering out pesticides carried with the runoff. Certain pesticide labels will require a vegetative filter strip. Other labels will recommend a vegetative filter strip as a best management practice.

Protect the Environment

Protect Water Sources

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

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

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

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

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

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

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

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

Bee Poisoning

Honey bees, native bee species (e.g., bumble bees, squash bees) and other pollinating insects are important pollinators for many Ontario crops.

Insecticides, some of which may negatively affect bees, require careful management to achieve both pollination and insect control of pest species. Growers and licensed commercial applicators can protect bees by following these suggestions:

- Time insecticide applications to minimize bee exposure (e.g., apply post bloom). Daytime treatments, when bees are foraging, are most hazardous. Insecticide applications in the evening are the safest, unless there is evidence of a strong temperature inversion or high humidity. Under normal circumstances, spraying after 8 p.m. allows the spray to dry before the bees are exposed to it the next day. Spraying during

early morning is the next best time, when fewer bees are foraging, but pesticide residues may still be present. Spraying should be completed well before 7 a.m. While honey bees and most other pollinating insects do not usually forage at temperatures below 13°C, bumblebees do. If you plan to spray in the morning, contact beekeepers who have bees within 5 km of your crop and spray site. The beekeepers may then have the option of taking any possible protective action.

- Do not apply insecticides while fruit trees are in bloom. The Bees Act makes it an offence to do so in Ontario. Do not spray any flowering crop on which bees are foraging.
- To prevent drift toward nearby hives, do not apply insecticides on windy days or when there is evidence of a strong temperature inversion.
- Bees and other pollinators may be poisoned by visiting flowering weeds, trees and cover crops that have come into contact with an insecticide via spray drift or drift of insecticide-contaminated dust during planting. Avoid spray drift to flowering weeds that are adjacent to or within the target field. Where possible, mow down flowering cover crops or flowering weeds in and bordering target fields prior to spraying to help safeguard the bees. Control dandelions and other flowering weeds within fields before spraying or planting seeds treated with an insecticide. Take measures to reduce movement of dust from insecticide seed treatments to flowering trees, weeds and water sources that are in or adjacent to the target field. For more information on reducing dust movement, search for "Pollinator Protection and Responsible Use of Treated Seed — Best Management Practices" at www.canada.ca.
- Systemic insecticides may also pose a high risk to bees and other insect pollinators. Bees can be exposed to insecticide residues in or on flowers, leaves, pollen, nectar and/or surface water. Do not apply insecticide or allow it to drift onto blooming crops or off-site habitat if bees are foraging in or adjacent to the treatment area.
- In crop settings where pesticide use is highly likely, beekeepers should remove honey bee colonies as soon as pollination and bloom are complete in the crop and before any insecticides are applied post bloom.

  In emergency situations, if the colonies cannot be removed in time, beekeepers can place burlap or cloth soaked in water at the entrance of the hive to disrupt the flight of the bees for up to 12 hr and provide more time for spray to dry. To help prevent overheating of the hive during this time, keep an opening of 2.5 cm on each side of the hive entrance so bees can still get out and ventilate the hive. Also, the water on the burlap or cloth will help cool the colony.
- Not all pesticides are equally toxic to bees. If there is a risk of honey bee poisoning, try to choose an insecticide that is not highly toxic to bees. When there is a choice, choose a product formulation that is less hazardous to bees.
- Always read the most current pesticide label for guidance. Some pesticides cannot be used when bees are active in the crop.

For more information on ways to reduce bee poisoning, see:

- *Practices to Reduce Bee Poisoning from Agricultural Pesticides in Canada*, available at honeycouncil.ca. Select "Bee Health Roundtable."

Manage Drift

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

- Do not spray when wind direction is changeable, or wind speeds are high or gusty. These conditions increase the potential for off-target drift. While most pesticide labels indicate allowable wind speeds, some do not.
- Regularly monitor wind conditions during spraying, preferably in the field with a handheld wind meter at nozzle height or elevated to the top of the target canopy from within the planted area. Record the wind speed and direction. As conditions change, make adjustments to manage drift potential. Adjustments may include a coarser droplet size, minimizing nozzle-to-target distance, adjusting air energy or vector on air-assisted sprayers, slowing travel speed, using a drift reducing adjuvant or discontinuing spraying until conditions improve.

- Do not spray during periods of dead calm. Periods of dead calm may occur between late evening and early morning and can result in the vapour or fine spray droplets remaining aloft, like fog. Spray-filled air can move unpredictably over great distances several hours after the spray event is completed.

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

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

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

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

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

- If specified, use the sprayer output indicated on the pesticide label.
- Use a nozzle at a pressure that will produce the droplet size specified on the pesticide label or delivers droplets appropriate for the job.
- Coarser droplets reduce drift significantly. Air induction nozzles used above 2bar (30psi) will produce Coarse to Ultra Coarse droplets. They can be used in the top nozzle positions on air-assist sprayers in specialty crops, or along conventional horizontal booms. Ensure the droplet size and volume are appropriate for the application being performed.
- Minimize the distance between nozzle and target as much as possible while still maintaining spray uniformity.
- Establish buffer zones for the protection of adjacent sensitive areas. Some pesticide labels will state buffer zone setbacks; follow these carefully.
- Use drift reduction technology, such as hoods, shrouds, screens or air curtains.
- If appropriate, use drift-reducing adjuvants in the spray tank. The intense agitation in air-assist sprayers for specialty crops has been shown to reduce the effectiveness of drift-reducing adjuvants. Certain combinations of drift-reducing adjuvants and air-induction nozzles have been shown to increase the incidence of fine droplets. Consult with the adjuvant manufacturer.
- When possible, use non-volatile pesticide formulations or products.

For more information about spray drift, see:

- Sprayers 101: www.sprayers101.com
- OMAFRA website: ontario.ca/spraydrift
- OMAFRA Factsheet Pesticide Drift from Ground Applications
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) *Drift of Pesticides video* series, available at www.opep.ca/resources (click the "YouTube" icon)

Waste Management

Empty Pesticide and Fertilizer Containers up to 23 L

Never re-use empty pesticide containers.

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

Empty Pesticide Containers Greater than 23 L (Totes and Drums)

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

Empty Seed and Pesticide Bags

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

Surplus Spray Mix

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

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

If you cannot find another allowable crop to spray, then dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix.

The diluted solution can be safely applied to the original treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest or disposal of surplus spray mix.

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

Surplus Pesticide Disposal

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

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original, unopened container.
- Hire a licensed waste hauler who is licensed under Part V of the *Environmental Protection Act* to carry hazardous wastes.
- Cleanfarms operates a free Obsolete Pesticide and Animal Health Product Collection Program throughout the province every 3 years. To locate the closest collection point and date, visit the Cleanfarms website (www.cleanfarms.ca), contact Cleanfarms at 416-622-4460 (toll-free at 877-622- 4460) or info@cleanfarms.ca or contact your local dealer for program details.
- Contact your municipality to see if any hazardous waste collection days are scheduled and verify whether quantities of agricultural pesticides will be accepted.

Storing Pesticides

Ontario's *Pesticides Act* and Regulation 63/09 provide details on storage requirements for pesticide storage facilities. As shown in Table 1-2, the storage requirements that must be followed are dependent on which classes of pesticides you store.

Table 1–2. Requirements for Pesticide Storage Facilities

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

Note: Sufficient precautions are needed in your storage area to prevent the pesticide from entering the natural environment. Ensure your floor drain does not enter the natural environment.

* See ontario.ca for requirements for warning sign G (Search for sample warning signs for pesticide use). These signs can be purchased from your pesticide dealer/vendor.

** Emergency contact numbers must include telephone numbers for the local fire department, hospital and poison control centre. The number for the MECP Spills Action Centre (1-800-268-6060) should also be readily available.

*** Only applies to Class C pesticides that are fumigants

**** Does not apply to animal repellent products that only contain the active ingredient Capsaicin or Capsaicin and related capsaicinoids.

For more information about storing pesticides, see:

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

Pesticide Spills

Part X of the *Environmental Protection Act* defines a spill as a discharge of pollutant (including pesticides) that is abnormal in quality or quantity, from or out of a structure, vehicle or other container into the environment. An overturned pesticide sprayer that results in the release of the pesticide 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.

Part X of the *Environmental Protection Act* requires every person having control of a pollutant that is spilled or who spills, causes or permits a spill of a pesticide shall immediately notify:

- the Ministry (through the Spills Action Centre)
- the municipality within the boundaries of the spill, and
- the owner of the pesticide or the person having charge, management or control of the pesticide.

Ontario's Spills Action Centre receives calls 24 hours a day (1-800-268-6060). Your local municipality may have additional reporting numbers such as fire department and Medical Officer of Health.

Where a spill causes or is likely to cause an adverse effect as defined by the Act, Part X of the *Environmental Protection Act* requires the owner of the pesticide and the person having control of the pesticide to:

- immediately do everything practicable to prevent, eliminate and ameliorate any harm, and
- restore the natural environment or other property to the state it was in prior to the spill.

Additionally, Ontario Regulation 63/09 under the *Pesticides Act* requires the person responsible for a pesticide to immediately notify the Ministry's Spills Action Centre in the event of a fire or other occurrence that may result in the pesticide being discharged into the environment out of the normal course of events if the discharge would be likely to:

- cause impairment of the quality of the environment for any use that can be made of it;
- cause injury or damage to property or to plant or animal life;
- cause harm or material discomfort to any person;
- adversely affect the health of any person;
- impair the safety of any person; or
- render directly or indirectly any property or plant or animal life unfit for use by humans.

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

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

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

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

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

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

For information on preventing spills, see:

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

For pesticide poisonings and pesticide injuries, call:

Ontario Poison Centre: 1-800-268-9017
(TTY) 1-877-750-2233

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

2. Pest Management

Integrated pest management (IPM) is an approach to managing pests that uses all available strategies to reduce pest populations below an economic injury level. IPM does not advocate a continuous pesticide spray program to eradicate pests. Instead, it promotes the integration of cultural, mechanical/physical, biological, behavioural and chemical control strategies. With IPM, adverse effects of pesticides are minimized and economic returns are maintained.

An IPM program makes management decisions based on:

- pest identification, biology and behaviour
- resistance management strategies
- beneficial organisms
- monitoring techniques
- use and timing of appropriate management tools
- stage of crop growth
- record keeping
- sprayer calibration

More information on pest management for tree nuts and other orchard crops can be found at:

- Publication 863: *Guide to Hazelnut Production in Ontario* (new publication expected in 2021)
- Ontario CropIPM at ontario.ca/cropIPM
- the ONspecialtycrops blog at onspecialtycrops.ca
- the ONfruit blog at onfruit.ca

Additional information on tree nuts is available on the OMAFRA website at ontario.ca/crops, or through industry newsletters and meetings.

Pest Management Tools

Cultural and Mechanical/Physical

Integrated pest management incorporates cultural and mechanical/physical practices to prevent or delay the development of pest outbreaks. Management tools include, but are not limited to:

- Site selection
- Resistant/tolerant cultivars
- Crop rotation between orchard planting
- Clean, certified nursery stock
- Orchard sanitation
- Elimination of alternative hosts
- Inter-cropping
- Encouraging natural enemies
- Pruning
- Water management
- Nutrient management

Biological

Biological control uses beneficial organisms to help suppress pest populations. These biological control agents may be predatory insects, parasites, pathogens or nematodes. Many beneficials occur naturally in the environment; others may be introduced.

Beneficials will not completely eliminate damage by pests. However, once they are established, they can maintain pest populations at lower levels. They are also effective against indirect pests such as aphids, leafhoppers and mites, but less effective at keeping populations of direct pests, which attack the harvested product, at levels acceptable for commercial production. Important insects and mites for biological control include ground beetles, mullein bugs, minute pirate bugs, lacewings, lady bird beetles and phytoseiid mites.

Natural pathogens of insects and mites include bacteria, viruses, fungi and protozoa. Pathogens circulate naturally in insect populations. Under the right conditions, they can cause disease outbreaks in insects, which can significantly reduce insect populations. Aphids and caterpillars are routinely infected by cycles of viral or fungal disease, which thrive when the environment is moist.

Follow these practices to conserve beneficial insects in fruit crops:

- Avoid use of pesticides that are toxic to the most important beneficials in a cropping system. See Table 3–11. *Toxicity of Pesticides to Honeybees and Mite/Aphid Predators.*
- Encourage a diverse habitat within and/or around the perimeter of the orchard where beneficial insects can live. Small flowering plants are an important food source for parasitic wasps.
- Avoid ultra-clean cultivation. Crop residue, mulch or ground cover will encourage ground beetles and other important predators in the soil.

For additional information on predators and parasitoids, see Ontario CropIPM at ontario.ca/cropIPM or OMAFRA Publication 208, *Predatory Insects in Fruit Orchards*.

Behavioural

Behavioural control uses a pest's natural behaviour to suppress the population. The most commonly used behavioural control in orchard systems is mating disruption, but also includes use of bait trap/crop or sterile insect release.

Managing insects using mating disruption is very different from using insecticides. Mating disruption products are highly specific, targeting a single or few very closely related insect pests. They do not kill the target pest, nor will they control immigration of mated females from untreated or poorly managed areas.

For more information on using mating disruption in tree fruit, see OMAFRA Factsheet 03–079, *Mating Disruption for Management of Insect Pests.* Mating disruption products are pest control products and must be registered by the Pest Management Regulatory Agency for use on a specific crop and insect combination. Refer to Chapter 3 of this publication for mating disruption products registered for use on tree nuts in Ontario. Note that not all mating disruption products for tree nut-specific pests (e.g., filbertworm) are registered for use in Canada.

Chemical

Chemical controls include synthetic, inorganic, botanical and biological pesticides. They kill/inhibit development of target pests and thus limit subsequent pest populations. Plant defence activators induce natural plant defences against crop pests, but do not directly impact the plant pathogen itself. Applications of plant defence activators to crops may "activate" the defence response of the plant, thus inhibiting infection.

Chemical controls are important tools for crop protection when used as part of an IPM program. Understand the pest's life cycle and apply chemicals at the stage when the pest is most vulnerable. Select the appropriate product for the target pests. To control insects and mites, monitor blocks closely. Spray according to action thresholds, degree-day timing (see *Degree-Day Modeling* below) or at critical stages of crop development. To control disease, apply fungicides prior to disease infection and development. Use factors such as weather conditions, crop stage and (where available) disease prediction models to assist in fungicide spray timing.

Organic and Biopesticide Pest Control Products

All organic pest control products must be registered by the PMRA on the pest and crop on which they are used and meet the requirements of the Canadian Organic Standards and any additional requirements of the local organic certification body.

While organic and biopesticide products are used most widely by organic producers, they can be useful tools for conventional growers as well. Possible advantages include:

- lower potential for pest resistance
- a rotational option to help manage resistance development in other conventional products
- shorter re-entry and preharvest intervals
- potentially lower toxicity to non-target organisms

Although many organic and biopesticide products are formulated, packaged and applied in a very similar fashion to conventional pesticides, the active ingredients are different. They have unique, specialized modes of action that make them more susceptible to numerous biological and environmental factors.

Some of the possible challenges associated with using these products are:

- more frequent applications needed to control pests
- slower acting than conventional pesticides
- may provide suppression rather than control of the pest
- more expensive than conventional pesticides
- fewer pests controlled

Degree-Day Modeling

Temperature, light and moisture affect the growth and development of plants and pests. Of these, temperature is the most important factor for insect and mite development. These pests need a certain amount of heat to move to the next development stage.

The amount of heat required for insect and mite development remains constant from year to year, but depending on weather conditions, the amount of actual time that it takes to complete development can vary. Insects and mites have a minimum and maximum base temperature below or above which development does not occur. These base temperatures are different for each organism.

Degree-Days Celcius (DDC) are used to estimate the growth and development of pests in the growing season. Events such as egg-laying, egg hatch, movement of crawlers or the occurrence of disease infection can be predicted and used to schedule inspection and spray programs.

There are several methods used to calculate DDC, but the method commonly used with simple monitoring equipment is the averaging method or “max/min” method. DDC for a given organism are calculated as follows:

$$\text{DDC} = \frac{(\text{Daily max } °\text{C}) + (\text{Daily min } °\text{C})}{2} - \text{min base } °\text{C}$$

Degree-Days Celcius are accumulated daily. The averaging method works well in most years. However, the actual DDC accumulations may be underestimated in extended periods of cool weather or overestimated in hot weather.

An example of the averaging method on a relatively cool spring day:

For a given pest:
Lower base temperature = 10°C
Upper base temperature = 35°C

On a given day:
Minimum temperature = 5°C
Maximum temperature = 15°C

Degree-Days Celcius (DDC) for that day is = (maximum + minimum temperature) / 2 – lower base temperature = (15+5) / 2 – 10 = 0 DDC

Note that the maximum temperature was higher than the base temperature for the insect, so growth and development were possible for at least part of the day. However, no DDC were accumulated. This illustrates how cool temperatures, especially over several days, could lead to an underestimation of insect development.

Degree-Days Celcius are either accumulated from a set start date, such as April 1, or from a specific event known as a biofix. A biofix is a biological event or indicator of a developmental event, that initiates the beginning of DDC calculations. A common biofix used for insects is the first sustained catch in pheromone traps. Using a biofix provides predictions that are more accurate and requires tracking temperatures over a shorter period.

There are several limitations to degree-days models:

- Factors such as humidity, light intensity and rainfall also affect pest development. As a result, DDC predictions are only estimates of pest development. Verify these predictions with field observations.
- Temperatures used to determine DDC must represent the environment where organisms develop. Use weather data collected from within a mile or less of the actual orchard or field being monitored. Site specific information can be obtained by using data loggers. Ventilated heat shields should be used with temperature sensors data loggers to ensure accurate air temperatures. Place data loggers at locations in the crop where the pest is normally active.
- DDC models have been developed and validated for very few fruit pests in Ontario.
- DDC model calculators can be found online, such as http://uspest.org/cgi-bin/ddmodel.us?spp=swd. Keep in mind that many of these models have not been validated under Ontario conditions. Use precise temperature data measured on or very close to your farm for the best estimate of the development of these pests.

Managing Pesticide Resistance

Pesticide resistance is the ability of a pest to survive exposure to a pesticide at a rate that previously controlled it. It can occur in any pest population, including fungi, insects and weeds, and can occur very quickly. Resistance to a pesticide develops after repeated exposure to the same pesticide or pesticide family. In any population, there are a few individuals with naturally occurring resistance to a particular chemical. When the pesticide is applied, those resistant individuals survive, while the susceptible portion of the population is killed. These resistant survivors multiply and gradually replace the susceptible ones. Eventually most of the population is composed of resistant individuals, causing the pesticide to lose efficacy. Modern pesticides often have very specific modes of action on pests, which makes the development of resistance more likely.

Resistance management is based on knowledge of a pest control product's mode of action. The mode of action refers to the way the product affects the pest — for example one mode of action may target a protein in an insect's gut which affects its ability to eat, while a different mode of action may target an insect's nervous system. A pesticide family is a group of products and active ingredients with the same mode of action. When a pest becomes resistant to one product in a pesticide family (or group), it is often resistant to all members of that family because they all work in the same way.

The development of resistance can be prevented or delayed by rotating pesticides with different modes of action. This is because, while there are always individuals in a pest population that are resistant to one mode of action, there are far fewer that are resistant to two modes of action. A pest

individual that survives the first application is therefore much less likely to survive a second application if it has a different mode of action.

Certain pests are more prone to developing resistance to pesticides than others. Pests with a short life cycle and many generations per growing season are more likely to become resistant. Pests are also more likely to become resistant to pesticides that have a single mode of action than those with multiple modes of action.

It is important to be aware that resistance is not the only cause of a pesticide failure. Before assuming a population is resistant to a product, consider the following factors, which may impact the effectiveness of pest control products:

- Product selection – Does the product actually have activity against the pest? Was the product applied as directed on the label (foliar, trunk, soil drench, etc.)? How long does the product take to knockdown pests? How long does that knockdown effect last?
- Weather conditions – Was the product applied under the right conditions as specified on the product label (prior to rain, evening, etc.)? Could weather conditions during or after application have affected spray coverage or pesticide efficacy? Does the label specify the time required for the product to become rainfast?
- Timing – Was the product applied at the appropriate pest life stage?
- Water volume/quality/tank-mix partners – Was sufficient water volume used to ensure adequate coverage where the target pest is found (under leaf, on trunk, etc.)? Was the pH of the water higher or lower than what is listed on the product label? Was the sprayer properly calibrated? Were all tank-mix partners (other pest control products, adjuvants, etc.) compatible with the product as specified on the label or by the registrant? If the product label specified use of an adjuvant, was this applied as directed?

Resistance Management Strategies

The number of available products for tree nut pest control is limited. It is critical to rotate between different modes of action to ensure that currently registered products remain effective for as long as possible. Resistance management strategies include rotating products from different groups and limiting the total number of applications from a single group within a growing season. Specific knowledge is required for growers to manage resistance effectively.

General Resistance Management Strategies

- Follow an integrated pest management program that makes use of a variety of different pest control strategies, including resistant varieties when available, monitoring, crop rotation and cultural, biological and chemical control options.
- Spray only when necessary. Use established thresholds where available.
- Do not use pesticides at levels below label rates.
- Use adequate water volumes to deliver the pesticide to all tissues.
- Spray at the best timing for the pest and the product you are using.
- Make each spray application count. Be sure the sprayer is calibrated, the correct rate is applied and spray coverage is complete.
- Read the product label. New products include resistance management recommendations on the label.
- Know the active ingredient of a pesticide. Many chemicals with the same active ingredients are marketed under different brand names. For example, the insecticide dimethoate is marketed under the brand names Cygon and Lagon.
- Know the product group. Choose products from different groups whenever possible in your spray rotation. Each group is assigned a number. For example, both Altacor and Exirel are in the same insecticide group (Group 28). To use Exirel after Altacor to control leafrollers is equivalent to using Exirel after Exirel, since resistance to both chemicals develops in the same way.
- Insecticide and fungicide groups may have similar numbers, but they are distinct from one another. For example, a group 3 fungicide, such as Quash, is not the same as a group 3 insecticide, such as Matador.

For a list of groups and their modes of action, see Table 2–1. *Fungicide/ Bactericide Groups,* Table 2–2. *Insecticide/Miticide Groups* or Table 3-2. *Products Used on Hazelnuts,* Table 3-6. *Products Used on Walnuts* and Table 3-9. *Products Used on Chestnuts and Pecan.* In addition to these general resistance management strategies for all products, more specific strategies have been developed for fungicides and insecticides.

Managing Resistance to Fungicides

- Know the fungicide groups. Over a season, choose fungicides from different groups whenever possible.
- Limit the total number of applications, and the number of sequential applications, of a particular fungicide group per season. Look for specific resistance management strategies on the product label. For example, some product labels specify that the product should account for no more than a certain percentage of that season's applications against a particular pest.
- For high-risk pathogens with fungicide options from many groups, rotation to a different group is advisable after a single application of a resistance-prone fungicide, although this is not necessarily required by the label.
- For pathogens controlled by only a few registered fungicide groups, use no more than 2 consecutive applications of a resistance-prone fungicide and then alternate to a different fungicide group.
- Know which disease is targeted by which fungicide group. For combination products, know which fungicide component is controlling which disease.
- When a product contains active ingredients from more than one group, each application counts as a single use for each group. For example, one use of Miravis Duo counts as a single use of difenoconazole (Group 3) and a single use of pydiflumetofen (Group 7).
- In some cases, a single fungicide group can control more than one pathogen. In this case, the maximum number of consecutive and total applications per season should be based on the pathogen with the highest risk of developing resistance.
- Apply fungicides before disease occurs. Applications of fungicides after the disease is established are more likely to select for resistant populations of the pathogen. For eastern filbert blight, fungicide applications should begin at bud break and continue until prolonged wet periods end, typically in late spring.
- Make use of Group M fungicides, if they are registered. These fungicides are known as multi-site inhibitors (Table 2–1. *Fungicide/Bactericide Groups*). They affect a wide range of metabolic processes in fungi and are less prone to the development of resistance. While there is no significant risk of resistance development, integrated resistance management should still be applied. For example, bacteria causing walnut blight have developed resistance to copper products in some growing regions.

Table 2–1. Fungicide/Bactericide Groups

Group	Chemical Group	Product Name	Active Ingredient	Resistance Risk[1]
3	DMI (demethylation inhibitors) Note: sometimes loosely known as sterol inhibitors (SI)	Cevya	mefentrifluconazole	Medium
		Miravis Duo	pydiflumetofen + difenoconazole*	Medium
		Quash	metconazole	Medium
7	SDHI (succinate dehydrogenase inhibitors)	Fontelis	penthiopyrad	Medium–High
		Miravis Duo	pydiflumetofen* + difenoconazole	Medium
11	QoI (quinone outside inhibitors) Note: strobilurins belong in this group, but not all QoI are strobilurins	Azoshy 250 SC	trifloxystrobin	High
		Flint	trifloxystrobin	High
		Quadris Flowable	azoxystrobin	High
24	Antibiotic	Kasumin 2L	kasugamycin	Medium
M1	Inorganic	Guardsman Copper Oxychloride 50	copper oxychloride	Low (except bacterial pathogens)
		Copper Spray	copper oxychloride	Low (except bacterial pathogens)
		Cueva	copper octanoate	Low (except bacterial pathogens)
		Parasol Flowable	copper hydroxide	Low (except bacterial pathogens)
M5	Chloronitrile	Bravo ZNC	chlorothalonil	Low

M = Multi-site fungicides. *Indicates active ingredient (a.i.) that puts it in this group.

[1] According to Fungicide Resistance Action Committee (FRAC) www.frac.info

Managing Resistance to Insecticides and Miticides

- Know the insecticide groups. Rotate products from different groups. Avoid sequential applications of the same group or repeated use of any insecticide or group of insecticides.
- Insecticide group 4 has been divided into subgroups (4A= Admire, 4C=Closer, 4D=Sivanto Prime). Compounds from these subgroups are structurally distinct but share the same mode of action. The risk of cross-resistance between these subgroups is considered low. However, where alternatives are available, rotate with other groups. If only Group 4 insecticides are registered against the pest but more than one subgroup is included, rotate between subgroups only if it is clear that cross-resistance does not exist in the target populations.
- For insects with multiple, discrete generations (e.g., oriental fruit moth, codling moth), manage each generation as separate units or "treatment windows". Use products from a single insecticide group to manage a given generation of a pest. If the pest emergence or activity of that generation is prolonged, apply a second application of the same product. This exposes each generation to only one group. Rotate to another insecticide group (or groups) for subsequent generations.
- For pests whose populations build quickly and with multiple, overlapping generations (e.g., aphids, mites), rotate between products in different insecticide groups for each spray.

- Avoid unnecessary or repeated applications of miticides and rotate among products in different groups. Many labels limit the number of applications of a product to one per season. Consider a multi-year rotation of miticides, so that mites are not exposed to products with a similar mode of action more frequently than once every few years.
- Time sprays to contact the most susceptible life stage of the pest. Consider the time of day when the pest is most active and location in the crop to maximize exposure with the treatment. For example, insecticides are only effective against Lecanium scale when the susceptible crawler stage is present.
- Consider the use of mating disruption where available and practical.
- Encourage biological control by choosing pesticides less harmful to beneficial insects and by landscaping to provide flowering plants and unsprayed habitat for these natural enemies. This may reduce the need for insecticides or miticides, particularly those targeting indirect pests such as aphids and mites.
- Monitor problematic pests to detect shifts in sensitivity to a group of pesticides.

Table 2–2. Insecticide/Miticide Groups

Group	Type of Action	Chemical Sub-group or Exemplifying Active Ingredient	Product Name	Active Ingredient
1	nerve	1B[1] Organophosphates	Cygon 480-AG	dimethoate
			Lagon 480 E	dimethoate
			Sharphos	chlorpyrifos
			Warhawk 480 EC	chlorpyrifos
3	nerve	3A Pyrethroids	Danitol	fenpropathrin
			Labamba	lambda-cyahlothrin
			Matador 120 EC	lambda-cyhalothrin
4	nerve	4A[2] Neonicotinoids	Admire 240 Flowable	imidacloprid
		4C[2] Sulfoxafimines	Closer	sulfoxaflor
		4D[2] Butenilides	Sivanto Prime	flupyradifurone
5	nerve	Spinosyns	Delegate	spinetoram
			Entrust	spinosad
			GF-120 Fruit Fly Bait	spinosad
9	nerve	9D Pyropenes	Versys	afidopyropen
11	disrupt midgut membrane	11A B.t. microbial (and the insecticidal proteins they produce)	Bioprotec Plus	*Bacillus thuringiensis var. kurstaki*
			Dipel 2X DF	*Bacillus thuringiensis var. kurstaki*
			XenTari WG	*Bacillus thuringiensis var. kurstaki*

NC = Not classified by IRAC, or group not indicated on product label.

[1] All members of Group 1 may not be cross-resistant, although they share the same primary target site and mode of action. For this reason, Group 1 is divided into sub-groups Group 1A and 1B, each with different mechanisms of resistance. Assume that cross-resistance exists between pesticides in each sub-group, but that rotation of pesticides between sub-groups is an acceptable part of a resistance management program.

[2] Although compounds in Groups 4A, 4C and 4D are thought to have the same target site, current evidence suggests the risk of metabolic cross-resistance between Groups 4A, 4C and 4D is low. If there are no other alternatives, then compounds from Groups 4A, 4C and 4D may be rotated.

Table 2–2. Insecticide/Miticide Groups (cont'd)

Group	Type of Action	Chemical Sub-group or Exemplifying Active Ingredient	Product Name	Active Ingredient
18	growth regulation	Diacylhydrazine	Intrepid 240 F	methoxyfenozide
20	energy metabolism	20B Acequinocyl	Kanemite 15 SC	acequinocyl
		20D Bifenazate	Acramite 50 WS	bifenazate
23	lipid synthesis, growth regulation	Tetronic and tetramic acid derivatives	Envidor 240 SC	spirodiclofen
			Movento 240 SC	spirotetramat
28	nerve and muscle	Diamides	Altacor	chlorantraniliprole
			Exirel	cyantraniliprole
			Harvanta 50 SL	cyclaniliprole
			Vayego 200 SC	tetraniliprole
NC	not classified	—	Kopa	potassium salts of fatty acids
			Opal	potassium salts of fatty acids
			Purespray Green Spray Oil 13E	mineral oil
			Surround	kaolin clay
			Vegol Crop Oil	canola oil

NC = Not classified by IRAC, or group not indicated on product label.

[1] All members of Group 1 may not be cross-resistant, although they share the same primary target site and mode of action. For this reason, Group 1 is divided into sub-groups Group 1A and 1B, each with different mechanisms of resistance. Assume that cross-resistance exists between pesticides in each sub-group, but that rotation of pesticides between sub-groups is an acceptable part of a resistance management program.

[2] Although compounds in Groups 4A, 4C and 4D are thought to have the same target site, current evidence suggests the risk of metabolic cross-resistance between Groups 4A, 4C and 4D is low. If there are no other alternatives, then compounds from Groups 4A, 4C and 4D may be rotated.

Handling and Mixing Pesticides

Carrier Volume and Coverage

When the pesticide label does not prescribe a carrier volume or concentration, the sprayer operator must decide the appropriate volume. There should be sufficient carrier to disperse or dissolve the product and create enough spray to contact all target surface(s) with minimal runoff. The degree of contact is called coverage, which is a combination of the percent surface area covered and the droplet density on that surface. The operator must consider the following factors when choosing a volume:

- **The level of coverage required reflects the product's mode-of-action.** For example, a contact product generally requires a higher droplet density than a locally systemic product (which has limited translocation in plant tissues). A miticide intended to saturate bark is a dilute application that often incurs runoff. Plant growth regulators have very specific coverage requirements and should not be generalized.
- **The location and nature of the target.** For example, if the target is a mobile insect found predominately on the upper-side of the leaf, it may be controlled with less carrier than a disease found deep in the plant canopy. Further, the orientation and surface texture of the target will affect how spray is retained and how it spreads.

- **The impact of environmental conditions, sprayer design and the crop size, density and developmental stage.** For example, the more plant canopy to be protected per hectare, the more carrier volume will be required. More volume is required when sprayer air is poorly adjusted, the weather is dry and/or windy and the distance-to-target is long or convoluted (such as tree-tops or deep in unpruned canopies).

To understand the relationship between carrier volume and coverage, the sprayer operator requires a feedback mechanism. Visual inspection of foliar "wetness" or spray residue is subjective and transient, and therefore insufficient. Water-sensitive papers distributed within the target canopy provide a fast, repeatable and quantifiable means for evaluating coverage. Most conventional foliar products require minimal coverage of 10–15% with a droplet density of 85 droplets/cm^2.

Smartphone apps such as the GRDC's SnapCard (https://www.agric.wa.gov.au/grains/snapcard-spray-app) quickly calculate and record spray coverage for future consideration in light of the level of protection achieved. For more information on quantifying coverage, see the Sprayers101 website at www.sprayers101.com and use the keyword "coverage" in the search engine. Download a copy of *Airblast 101, A Handbook of Best Practices in Airblast Spraying* (https://sprayers101.com/airblast101/)

General Mixing Steps

1. **Read all product labels** — Know the product formulation (which affects mixing method and order). Look for information about the influence of carrier pH, hardness and any requirement for adjuvants. Defer to label instructions should they differ from these mixing steps.

2. **Shake any liquid products** — This ensures the active ingredient and inert ingredients are thoroughly mixed.

3. **Add carrier to the tank** — For water, fill the tank 50% with the required volume. For oil, fill the tank 75%.

4. **Agitate** — Agitation should continue through the mixing process. Excessive agitation may create foaming. If possible, reduce the level of agitation or use a defoamer adjuvant (50% of which should be added during step 3, and the remainder during step 7.)

5. **Add products in order** — The formulation type dictates the order in which tank-mix partners should be added (see *Product Order by Formulation*). If using an inductor, flush with water between additions.

6. **Wait and check** — Dry products and water-soluble packets must fully disperse and/or dissolve before adding the next product. Several factors affect the duration, but 3–5 minutes is typical.

7. **Add remaining carrier.**

8. **Measure pH** — This is best done after all products are added to account for their impact on pH and buffering capacity. If required, pH adjusters can be added at the end of mixing to ensure the solution is in the range required by the label.

Product Order by Formulation

Pesticide labels usually provide directions for mixing different materials, including the sequence for mixing. The order in which you add each product to the tank is critical.

1. **Dry Formulations** — These include water dispersible granules (WDG or WG), wettable powders (WP) and soluble granules (SG). Allow more time for these products to dissolve and/or disperse completely. Best practice is to premix these products with water in a slurry before adding to the tank.

2. **Anti-drift adjuvants, compatibility agents or anti-foamers** — Consult labels as these products may require multiple additions or a different order than indicated here.

3. **Liquid Formulations** — Liquid pesticide formulations mix in water to form a solution. Some pesticides may be oil-based, such as emulsifiable concentrates (EC), and form an opaque (milky) emulsion that requires moderate agitation and may be prone to foaming.

Water Soluble Packaging

Water-soluble packaging (WSP) is often used for dry formulations. The PVA (polyvinyl alcohol) packaging should dissolve completely when added directly to the tank water (not the basket filter). Protect them from moisture by leaving them in outer packing until just before use and do not handle them with wet gloves. Reseal them to protect remainder.

Do not mix WSP with any product incompatible with the PVA packaging. This includes residues from prior applications of:

- Oils (e.g., Superior Oil)
- EC formulations containing mineral or vegetable oil
- Boron
- Chelated micronutrients
- Water-soluble fertilizers

Compatibility of Spray Materials

Tank-mixing is adding more than one formulated product in the tank at the same time, where permitted, for efficiency, resistance management and improved performance. However, the odds of incompatibility increase with the number of tank-mix partners.

Physical incompatibility can result in the solution thickening, foaming, separating or falling out of suspension, which in turn leads to poor coverage uniformity or plugged / damaged spray equipment. Chemical incompatibility (i.e. antagonism or synergy) can result in reduced pesticide efficacy or cause plant injury when sprayed on the crop.

For information on compatibility, always check the product label, product manufacturer or distributor. Do not decide on tank-mixes during loading; do so off-season. Before tank-mixing pest control products, ensure the following:

- each product is registered for use in Canada on the crop.
- each product is used according to the label.
- the tank-mix only includes an adjuvant when specifically required by one of the product labels.
- the application timing of each product is compatible with crop and pest staging.
- no product is specifically excluded on any other of the tank-mix product labels.

Registered product labels can be downloaded through Health Canada's label search webpage at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php. Incompatibilities are specified on labels for some registered tree nut products, for example, Exirel and certain fungicides. To look for incompatibilities, search for terms such as:

- Do not mix
- Mix
- Hours
- Agitation
- The trade name of any intended tank-mix partner

Jar Test for Pesticide Compatibility

Absence of wording on incompatibility does not mean that all other products are compatible. If labels do not discuss compatibility, or you are considering a new tank-mix, use a *Jar Test* to test physical incompatibility. Note, this will not reveal a chemical incompatibility. When performing a jar test, do so in a safe and ventilated area, away from sources of ignition, and always wear personal protective equipment (PPE).

1. Measure 500 mL of carrier into a 1 L glass jar. Be sure to use the same carrier at the same temperature used in the sprayer.

2. Add ingredients according to Table 2–3. *Tank-Mix Order for Pesticide Compatibility Test,* stirring after each addition.

3. Let the solution stand in a ventilated area for 15 minutes and observe the results. If the mixture is giving off heat, these ingredients are not compatible. If gel or scum forms or if solids settle to the bottom (except for the wettable powders) then the mixture is likely incompatible.

4. Keep records and retain the jars for the season. They may indicate products prone to settling or separating after prolonged rest (e.g., parking the sprayer overnight). They may also indicate potential problems during re-suspension or cleanout.

If you experience a physical incompatibility issue in the sprayer, do not immediately add water, ammonia, non-ionic surfactants or detergents to the tank. This may create further problems. First, contact the manufacturer or dealer for more information. Then, perform a *Reverse Jar Test* by sampling the solution and attempting to break down a small volume before doing so in the sprayer. If you succeed in re-suspending the solution, it may no longer be viable and must be safely discarded.

Table 2–3. Tank-mix Order for Pesticide Compatibility Test

Order	Ingredient	Quantity for 500 mL or 500 g of Product Labeled for 1,000 L of Final Spray Volume
1	Compatibility agents	5 mL (1 teaspoon)
2	Water-soluble packets, wettable powders and dry flowables. Include a ~1cm^2 cutting of the PVA packaging.	15 g (1 tablespoon)
3	Liquid drift retardants	5 mL (1 teaspoon)
4	Liquid concentrates, micro-emulsions and suspension concentrates	5 mL (1 teaspoon)
5	Emulsifiable concentrates	5 mL (1 teaspoon)
6	Water-soluble concentrates or solutions	5 mL (1 teaspoon)
7	Remaining adjuvants and surfactants	5 mL (1 teaspoon)

For more information on pesticide handling and operator safety, consult the Ontario Pesticide Education Program (OPEP) Grower Pesticide Safety course (www.opep.ca/resources).

Adjuvants Used in Fruit Crops

Spray adjuvants are tank-mix additives used to modify and enhance the effectiveness of the pesticide. They can improve pesticide performance by modifying the spray pattern, quality, uptake and penetration into the plant or insect exoskeleton. Other benefits to adjuvants may include:

- Keep pesticide from binding to minerals suspended in water.
- Adjust water pH so pesticide is less likely to break down.
- Manipulate droplet size to reduce on-target and off-site movement of pesticide.
- Improve odds that a spray droplet will stay on the target by reducing factors that cause droplets to bounce and roll off.
- Modify or reduce surface tension to enhance the ability of a droplet to be retained on or spread across the target surface.
- Minimize spray droplet evaporation.
- Prevent spray deposit from being washed off the leaf surface.
- Protect the droplet from degrading in sunlight.
- Improve pesticide's absorption and uptake by the plant or insect exoskeleton.

Unless the product label specifies an adjuvant be added to the tank, growers do not need to use them. However, if use of an adjuvant is stated on the product label, pesticide performance and efficacy can be significantly reduced if it is not included. There are many types of adjuvants which include:

- surfactants / wetter-spreaders (e.g., non-ionic surfactant, including organosilicones)
- stickers / spreader-sticker (e.g., kaolin clay)
- oil concentrates (e.g., petroleum-based crop oil, modified/methylated seed oils)
- water conditioning agents

- evaporation retardants
- anti-foaming agents
- pH adjusters (e.g., acidifiers, buffering agents)
- drift suppressing agents

A label may specify a particular name brand or generalize a category of adjuvant. In the latter case, the grower is free to use any adjuvant in that category, provided it is registered for use on the crop and in combination with the pesticide being applied. Always use adjuvants as directed on the product label. For specific adjuvants, consult your local input retailer or product registrant.

General cautions around the use of adjuvants include:

- Avoid the use of adjuvants that help with penetration into plant tissue with copper, sulphur or captan fungicides (note that not all of these active ingredients are registered on tree nuts). This includes the use of oils. Penetrants should not be used with contact or surface pesticides.
- Avoid adjuvants with sticker activity that could impede movement of systemic pesticides in plant tissue.
- Avoid adjuvants with sticker activity early in the growing season when redistribution is important to protect newly emerging leaves. However, this may be a desirable characteristic during wet springs.

For more information on adjuvants, see the Sprayers 101 website at sprayers101.com.

Hazelnuts

In this section:

Table 3–1.	Hazelnut (Filbert) Calendar
Table 3–2.	Products Used on Hazelnuts
Table 3–3.	Activity of Insecticides and Miticides on Hazelnuts Pests
Table 3–4.	Activity of Fungicides on Eastern Filbert Blight (EFB)

Products are listed in the calendar by chemical group and are in alphabetical order within each group. The order does not reflect efficacy. For preharvest interval, restricted entry interval, and maximum applications, see Table 3-2. *Products Used on Hazelnuts.*

Where a product in the calendar is followed by a "*", it is potentially acceptable for organic use based on the publication Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). Réseau d'avertissements phytosanitaires. *2020. RAP - Réseau Général. Bulletin D'Information No. 1, Special phytoprotection bio.* 18 juin 2020 or a letter of certification provided by the registrant. Check with your certifying body to verify the acceptability of any product prior to using it.

Thorough coverage of all affected plant surfaces is essential for maximum efficacy of many tree nut products. Sufficient water volumes are necessary to provide complete coverage with insecticides, miticides and fungicides. Consult the product label for suggested water volumes. Otherwise, use enough water to ensure thorough spray coverage. Where the product rate is listed in amount per 1,000 L, or if a water volume is not provided on the label, use enough water to wet the foliage to the near drip point.

Crop Nutrition

Crop nutrition is important for plant growth, fruit quality development and the acquisition of adequate cold hardiness by tree fruit. For fruit crops, soil testing, plant tissue analysis and visual deficiency symptoms all play an important role in assessing and monitoring the crop's nutritional status. For more information, visit ontario.ca/apples (click on *Soil Management, Fertilizer Use, Crop Nutrition and Cover Crops for Fruit Production*) and see OMAFRA Publication 611, *Soil Fertility Handbook.* For specialty crop nutrition, including tree nuts, visit the Specialty Cropportunities tool at http://www.omafra.gov.on.ca/CropOp/en/index.html (click on *General Agronomics, Nutrient Management*). For information on hazelnut nutrition, see OMAFRA Publication 863, *Guide to Hazelnut Production in Ontario* (new publication expected in 2021).

Pest Control Product Persistence

Some products are persistent and may carry over from one year to the next. Where possible, avoid using these products in areas treated during the previous season. Consult product labels for product-specific information.

Resistance Management

To delay development of resistance to insecticides, miticides and fungicides, follow resistance management guidelines outlined in *Resistance Management Strategies,* Chapter 2. The chemical group is indicated in the column labelled "Group" before the "Product" column. Products belonging to the same chemical group are grouped together in the calendar. Multi-site (M) fungicides are less prone to resistance. Some products are not classified to mode of action (NC) and the mode of action has not been determined for others (U or UN).

Fungicide resistance management

Take the following steps to avoid rapid development of fungicide resistance:

- Do not reduce rates below those specified on the label.
- Do not use products containing the same chemical group in consecutive applications.
- Do not rely on fungicides alone for control of tree nut diseases. Use in conjunction with cultural management practices such as disease-tolerant cultivars (where available) and timely pruning and destruction of diseased branches or twigs.

Insecticide resistance management

Take the following steps to avoid development of insecticide resistance:

- For pests with discrete generations (leafroller, codling moth), do not use insecticides from the same group for more than one generation. Within a generation, if more than one spray is required, use a product from the same chemical group.
- For pests with overlapping generations (aphids, mites), do not use products containing the same chemical group in consecutive applications.

Bee Toxicity

Some pesticides are toxic to bees and other pollinating insects. Use of pesticides on flowering crops requires careful management to avoid negative effects on pollinators. Insecticides should not be applied when tree fruit are in bloom or when bees are active. Before and after bloom, bees may still be present on flowering cover crops and weeds — do not allow drift onto these or other flowering crops. Always follow label precautions regarding avoiding impacts on bees. For more information, see *Bee Poisoning,* Chapter 1 and honeybee toxicity ratings in Table 3–9. *Toxicity of Pesticides to Honeybees and Mite/Aphid Predators.*

Read the product label and follow all safety precautions. Labels for registered pest control products are available at the Pest Management Regulatory Agency (PMRA) website at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php. Many products listed are under re-evaluation with the PMRA and may change within the lifetime of this publication. Consult the most recent label on the PMRA website and/or product registrant for complete information.

Table 3–1. Hazelnut (Filbert) Calendar

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Bud break (up to ¼-inch vegetative growth)						
Eastern filbert blight	**General Comments:** • Eastern filbert blight is the most significant disease of hazelnuts in Ontario. • Apply protective fungicides preventatively to protect new growth starting at bud break. Protective sprays should continue for at least 8 weeks or longer, if prolonged wet conditions persist. • Blight-tolerant cultivars may require fewer fungicide applications. • Rotate between different fungicide groups (M, 3, 7+3 and/or 11) for these sprays • For resistance management, do not make more than 2 consecutive applications of Group 3 or 11 products before rotating to a different group. • Copper products may not all be equally effective against filbert blight. • Fungicides should always be used in conjunction with cultural controls, in particular removing and destroying cankers prior to budbreak.					
	M	Bravo ZN/Bravo ZNC	6.72 L/ha	12 hours[1]/ 2 days[2]/ 10 days[3]/ 18 days[4]	120 days	Apply from bud break to shoot elongation. Do not tank-mix with oils, other pesticides, surfactants or fertilizers. Do not apply within 1 week of oil. Use caution when using in a spray program with Purespray Green Spray Oil. See label for details.
		Copper Spray * or Guardsman Copper Oxychloride	3–9 kg/ha	48 hours	2 days	Apply beginning at bud swell, when tissue is susceptible to infection. For Copper Spray and Guardsman Copper Oxychloride, use 3 kg/ha on small trees and up to 9 kg/ha on large trees. Apply in a high-volume spray to ensure thorough coverage. Do not use in combination with or closely following Vegol or Exirel. See product labels for details. When mixed with lime (if label permits), these products cannot be mixed with insecticide wettable powders. Cueva may cause leaf spots in copper-sensitive crops during excessive moisture and cold. If concerned about sensitivity of plants, apply first to small areas.
		Cueva *	1% v/v in 470–940 L water/ha	4 hours	1 day	
	3	Quash	245 g/ha	12 hours	25 days	**Suppression only.** Do not make alternate row applications. Most effective when applied and allowed to dry before rainfall.
	7+3	Miravis Duo	1.0 L/ha	12 hours	14 days	Apply at bud break, when tissue is susceptible to infection. Apply in a spray volume of at least 375 L/ha. For resistance management, rotate between different fungicide groups.

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–1. Hazelnut (Filbert) Calendar (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Bud break (up to ¼-inch vegetative growth)						
Eastern filbert blight (cont'd)	11	Flint	140–280 g/ha	12 hours	60 days	Apply at bud break and continue as needed on a 14-day interval. Use 140 g/ha on small trees or up to 280 g/ha on larger trees. Avoid drift, especially onto Concord grapes. For resistance management, rotate between different fungicide groups. Do not use in combination with or closely following Exirel. See labels for details.
		Quadris Flowable or Azoshy 250 SC	900 mL/ha	12 hours	45 days	Apply beginning at bud swell, when tissue is susceptible to infection. Highly phytotoxic to certain apple varieties. Use dedicated sprayer and avoid spray drift. For resistance management, rotate between different fungicide groups. Do not use in combination with or closely following Exirel. See label for details.
Early spring (> ¼-inch vegetative growth)						
INSECTICIDES MAY BE VERY TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1.						
Eastern filbert blight	Use one of the products listed for Eastern filbert blight at **Bud break**. Some products have limited numbers of applications per year. See Table 3-2. *Products Used on Hazelnuts.*					
Leafrollers	**General Comments:** • Obliquebanded leafrollers feed predominantly on leaves but can also feed between the husk and the nut. Examine undersides of husks for larvae from late spring through July. • Apply insecticide when larvae have emerged and before they roll up in the leaves. Reapply in 1–2 weeks, if needed. • Look under husks for larvae in late spring/early summer. Pheromone traps for adult flights and degree-day models for this pest in apples can be used to determine optimal spray timing. For information on calculating degree-days, see Chapter 2, *Degree-Day Modelling*. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	83 mL/ha	24 hours	14 days	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	5	Delegate	210–420 g/ha	12 hours	14 days	Use higher rate under high pest pressure or for larger larvae. Reapply in 14 days if needed.
	11	Bioprotec Plus * Dipel 2X DF * or Xentari WG *	1.8–2.5 L/ha 1.12–1.67 kg/ha 0.5–1.6 kg/ha	4 hours	0 days	Product must be consumed to be effective. Spray when and where pests are actively feeding. Apply in a high-volume spray to ensure thorough coverage on both sides of the leaf. Apply to young larvae, early in infestation. Death of insect may take several days. Products have short residual activity and repeat applications may be required. Use dilute spray mixture within 12 hours. For Dipel, use 1.6 kg/ha for large or mature trees.
	18	Intrepid	750 mL/ha	12 hours	14 days	For overwintering generation of obliquebanded leafroller, apply when larvae become active in the spring.

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–1. Hazelnut (Filbert) Calendar (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Early spring (> ¼-inch vegetative growth) (cont'd)						
INSECTICIDES MAY BE VERY TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1.						
Leafrollers (cont'd)	28	Altacor	145–285 g/ha	12 hours	10 days	**Use Vayego postbloom only.** For overwintering generation of obliquebanded leafroller, apply when larvae become active in the spring. Tank-mixing or sequential applications of Exirel with certain fungicides (e.g., copper, Quadris/Azoshy, Flint, Bravo), oils or other products can cause crop injury. See product label for tank-mix restrictions.
		Exirel	0.5–1.0 L/ha	12 hours	5 days	
		Harvanta 50 SL	1.2–1.6 L/ha	12 hours	30 days	
		Vayego 200 SC	225 mL/ha	12 hrs	10 days	
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Reduction in damage only.** Apply at first egg hatch. Make a second application 10 days later. Repeat at 7–14-day intervals as subsequent generations emerge. Use 50 kg/ha for initial application. Adjust rate with subsequent applications, or for larger trees, as per label instructions. Efficacy depends on complete coverage of leaves and fruit. Light rain will help distribute product. Reapply after heavy rain, wind, overhead irrigation or new growth. Creates a white film on plant parts. Stop application once nuts are sizing. Do not use with anti-foaming agents, spreader/stickers or summer oils.
Aphids	**General Comments:** • Aphid populations on hazelnut are often kept in check by natural parasitism and predation and control will not be required. • Where control is required, apply in early stages of aphid infestation for best results. Consider delaying or avoiding sprays if large numbers of predators are active or parasitism is evident in aphid colonies. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	1	Cygon 480-AG or Lagon 480 E	5 L/ha	5 days[1]/21 days[5]/ 34 days[6]	45 days	Avoid application during bloom. Apply primarily on younger trees when aphids appear. Toxic to certain beneficial insects. Use caution when using in a spray program with Purespray Green Spray Oil. See label for details.
		Warhawk 480 EC or Sharphos 250 SC	4.2–4.8 L/ha	48 hours[1]/4 days[4] 24 hours[1]/4 days[4]	14 days	**Filbert aphid only.** Use in 100 L/ha. This product is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	3	Matador 120 EC or Labamba	104 mL/ha	24 hours	14 days	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application of products from this group per season.
	4	Admire 240 Flowable	230 mL/ha	24 hours	7 days	**Use postbloom only.** Maximum of 2 applications of Group 4A insecticides per season. Repeated use may cause mite outbreaks.
	4C	Closer	100–200 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects
	4D	Sivanto Prime	500–750 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–1. Hazelnut (Filbert) Calendar (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Early spring (> ¼-inch vegetative growth) (cont'd)						
INSECTICIDES MAY BE VERY TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1.						
Aphids (cont'd)	9D	Versys	100 mL/ha	12 hours	7 days	**Filbert aphid only.** Apply in a minimum of 1,000 L/ha water.
	23	Movento 240 SC	365–435 mL/ha	12 hours	7 days	**Use postbloom only.** Control may not be apparent for 2–3 weeks. Under high pest pressure, reapply 2 weeks later. Tank-mix with an adjuvant/additive that has spreading and penetrating properties at a suggested rate of 0.2% v/v. See label for further details. Do not tank-mix with sulphur (note: no sulphur products are currently registered on tree nuts).
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are currently registered on tree nuts).
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.
Spider mites	**General Comments:** • Foliar mites on hazelnuts, such as spider and rust mites, are usually controlled by natural predators. Populations may increase to damaging levels on water-stressed trees or where insecticides applied for other pests have reduced levels of beneficial insects. • Where control of foliar mites is required, treat in late spring or early summer if populations become high and leaf bronzing appears. • For resistance management, apply products only when needed and avoid using a single product more than once per season. • There are no miticides currently registered for bud mite, the main yield-limiting mite pest of hazelnut.					
	20B	Kanemite 15 SC	2.07 L/ha	12 hours	14 days	For resistance management, maximum of 1 application per season.
	20D	Acramite 50 WS	568 g/ha	12 hours	14 days	Rate controls two-spotted spider mite. If European red mite is present, apply 851 g/ha. Maximum of 1 application per season.
	23	Envidor 240 SC	750 mL/ha	12 hours	7 days	**Use postbloom only.** Maximum of 1 application per season. Do not use in orchards inter-planted with other crops.

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–1. Hazelnut (Filbert) Calendar (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Early spring (> ¼-inch vegetative growth) (cont'd)						
INSECTICIDES MAY BE VERY TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1.						
Spider mites (cont'd)	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are currently registered on tree nuts).
		Purespray Green Spray Oil 13 E *	10 L/1,000 L water	12 hours	—	**Suppression only. Spider mites only.** Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Use caution when using in a spray program with Cygon, Lagon or Bravo. See label for details. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of using sulphur (note: no sulphur products are currently registered on tree nuts). See label for compatibility with other products.
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.
Scale	**General Comments:** • Scale insects on hazelnut are often kept in check by natural predation. However, in some orchards, populations can increase to damaging levels, causing excess honeydew, sooty mold and leaf drop. • Lecanium scale is the most common species infesting hazelnuts, although others are occasionally found. • Monitor scaffold branches for adult scale. Spray when crawlers (the active immatures stages) emerge from the large, immobile females, which is typically late spring to early summer for Lecanium scale. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	4C	Closer	200–400 mL/ha	12 hours	7 days	**San Jose scale only.** Where possible, rotate with insecticides outside of Group 4 between generations. Toxic to certain beneficial insects

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–1. Hazelnut (Filbert) Calendar (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Early spring (> ¼-inch vegetative growth) (cont'd)						
INSECTICIDES MAY BE VERY TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1.						
Scale (cont'd)	23	Movento 240 SC	365–585 mL/ha	12 hours	7 days	**Control of San Jose scale and suppression of Lecanium scale. Use postbloom only.** Control may not be apparent for 2–3 weeks. Under high pest pressure, reapply 2 weeks later. Tank-mix with an adjuvant/additive that has spreading and penetrating properties at a suggested rate of 0.2% v/v. See label for further details. Do not tank-mix with sulphur (note: no sulphur products are currently registered on tree nuts).
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are currently registered on tree nuts).
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.
Leafhopper	**General Comments:** • In Ontario hazelnuts, leafhoppers are generally only economically damaging on young trees. • Monitor crops for presence of leafhoppers beginning in mid-late spring. If control is required, apply early in infestation for best results.					
	4A	Admire 240 Flowable	200 mL/ha	24 hours	7 days	**Suppression only. Use postbloom only.** Maximum of 2 applications of Group 4A insecticides per season. Repeated use may cause mite outbreaks.
Dogwood borer	NC	Isomate DWB	250–375 dispensers/ha	—	—	Dogwood borer is not commonly a pest of tree nuts. Apply where there is a history of infestation. Reduces mating of dogwood borer. Apply before adult borer emergence (end of May). Use high rate for high-pressure areas or initial year of treatment. For more information on mating disruption, see OMAFRA Factsheet 03–079, *Mating Disruption for Management of Insect Pests.*

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–1. Hazelnut (Filbert) Calendar (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer						
Aphids	Use one of the products listed for Aphids at **Early spring (> ¼-inch vegetative growth).**					
Leafhopper	Use one of the products listed for Leafhoppers at **Early spring (> ¼-inch vegetative growth).**					
Leafroller	Use one of the products listed for Leafrollers at **Early spring (> ¼-inch vegetative growth).**					
Spider mites	Use one of the products listed for Mites at **Early spring (> ¼-inch vegetative growth).**					
Scale	Use one of the products listed for Scale at **Early spring (> ¼-inch vegetative growth).**					
Late Summer/Fall						
Botrytis grey mould	7	Fontelis	1.0–1.5 L/ha	12 hours	14 days	Botrytis is not a common problem on hazelnuts. Apply only if there has been a history of disease. Begin application prior to disease development. Contains mineral oil in the formulation. Tank-mixing or rotating with oil-sensitive products may cause crop safety issues. See label for tank-mix restrictions.
Bacterial blight	**General Comments:** • Young hazelnut trees less than 10 years old are particularly susceptible to bacterial blight. • Apply after harvest but before fall rains. For severe infections or heavy rains, another application can be made when ¾ of the leaves have dropped. • Parasol should only be applied as a dormant spray. • Products are preventative and will not affect existing infections. Prune out and destroy infected branches and twigs.					
	M	Copper Spray * or Guardsman Copper Oxychloride 50	3–9 kg/ha	48 hours	2 days	Apply the first spray in late August or early September before the start of the fall rains and nut drop. Repeat after harvest at leaf fall and in early spring just before leaf bud break. Use 3 kg/ha on small trees, and up to 9 kg/ha on large trees in proportionately more water. Apply in a high-volume spray to ensure thorough coverage. Do not use in combination with or closely following Vegol or Exirel. See product labels for details. When mixed with lime (if label permits), these products cannot be mixed with insecticide wettable powders.
		Cueva *	1% v/v in 470–940 L water/ha	4 hours	1 day	May cause leaf spots in copper-sensitive crops during excessive moisture and cold. If concerned about sensitivity of plants, apply first to small areas. Do not use in combination with or closely following Vegol or Exirel. See product labels for details.
		Parasol Flowable	4.4–11.4 L/ha	48 hours	2 days	**Dormant spray only.** Apply when ¾ of leaves have fallen. Use other registered products for bacterial blight control before dormancy. Do not use in combination with or closely following Vegol or Exirel.
Kernel molds	No products registered in Ontario. Harvest before fall rains. Keep harvested nuts dry.					

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–1. Hazelnut (Filbert) Calendar (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Special sprays (when monitoring indicates the need)						
Brown Rot, Alternaria leaf spot	3	Cevya	0.25-0.375 L/ha	12 hours	14 days	**Suppression only.** Brown rot and Alternaria are not normally a problem in Ontario hazelnuts. In orchards where these diseases have been a problem in the past, apply when conditions are conducive to disease development.
	7	Fontelis	1.0–1.5 L/ha	12 hours	14 days	**Control of brown rot, suppression only of Alternaria.** Brown rot and Alternaria are not normally a problem in Ontario hazelnuts. In orchards where these diseases have been a problem in the past, apply when conditions are conducive to disease development. Contains mineral oil in the formulation. Tank-mixing or rotating with oil-sensitive products may cause crop safety issues. See label for tank-mix restrictions.
Hazelnut weevil	M	Delegate	420 g/ha	12 hours	14 days	**Suppression only.** Apply at the first sign of adult feeding damage. Repeat in 14 days if populations warrant. Hazelnut weevil is not usually a problem in commercial hazelnut orchards.
Brown marmorated stink bug	At time of printing this publication, this pest has not caused damage to hazelnuts in Ontario. However, nut damage has been observed in other hazelnut-growing regions and breeding populations are present in Ontario. Check ontario.ca/stinkbug for updates on pest development, registered products and management strategies.					

[1] General re-entry. [2] Orchard maintenance. [3] Transplanting. [4] Scouting activities. [5] Hand harvest, hand-line irrigation. [6] Thinning. [7] Mechanical harvest.
— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–2. Products Used on Hazelnuts

Use this table as a guide but refer to product label for specific information.

The preharvest interval (PHI) is the number of days between the last spray and first harvest.

The restricted entry interval (REI) is the minimum interval that must be observed between application of the pesticide and work in the treated crop without protective equipment. If no re-entry period is stated on the label, assume it is 12 hours. Where the REI exceeds the PHI, follow the REI.

The maximum number of applications is the labelled maximum number for the growing season and may be higher than what is recommended for resistance management or for the preservation of beneficial insects.

Products with a check mark may be acceptable for organic use based on the publication *Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). Réseau d'avertissements phytosanitaires. 2020. RAP - Réseau Général. Bulletin D'Information No. 1, Special phytoprotection bio. 18 juin 2020* or a letter of certification provided by the registrant. Check with certifying body to verify the acceptability of any product prior to using it.

Product Name	Registration Number	Common Name	Group	Preharvest Interval (PHI)	Restricted Entry Interval (REI)	Maximum Applications	Potentially Organic
Products for insect control or suppression							
Acramite 50 WS	27925	bifenazate	20D	14 days	12 hours	1	—
Admire 240 Flowable	24094	imidacloprid	4A	7 days	24 hours	2	—
Altacor	28981	chlorantraniliprole	28	10 days	12 hours	3 (max. 645 g/ha)	—
Bioprotec Plus	32425	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Closer	30826	sulfoxaflor	4C	7 days	12 hours	2	—
Cygon 480-AG	25651	dimethoate	1B	45 days	5 days[1]/21 days[2]/ 34 days[3]	1	—
Danitol	33817	fenpropathrin	3	3 days[4]	24 hours[1]/7 days[5,6]/ 3 days[4]	1	—
Delegate	28778	spinetoram	5	14 days	12 hours	3	—
Dipel 2X DF	26508	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Envidor 240 SC	28051	spirodiclofen	23	7 days	12 hours	1	—
Exirel	30895	cyantraniliprole	28	5 days	12 hours	4	—
Harvanta 50 SL	32889	cyclaniliprole	28	30 days	12 hours	3 (max 4.8 L/ha)	—
Intrepid	27786	methoxyfenozide	18	14 days	12 hours	max. 2 L/ha	—
Isomate DWB	30589	pheromone, dogwood borer	NC	—	—	—	—
Kanemite 15 SC	28641	acequinocyl	20B	14 days	12 hours	2 (max 4.1 L/ha)	—
Kopa	31433	potassium salts of fatty acids	NC	0 days	12 hours	3[7]	✓
Labamba	33576	lambda-cyhalothrin	3	14 days	24 hours	max 390 mL/ha	—

M = Multi-site fungicides. NC = Not classified by FRAC/IRAC, or group not indicated on product label.

— = Information is not specified on the product label. ✓ = Potentially organic. Check with certifying body.

[1] General re-entry. [2] Hand harvest, hand-line irrigation. [3] Thinning. [4] Mechanical harvest. Contact registrant for information on hand harvest PHI and REI. [5] Scouting activities. [6] Hand pruning.
[7] Maximum of 3 consecutive applications to ensure plant injury does not occur. Additional applications may be possible if previous experience with repeat applications of the product under the same conditions have not produced plant injury. [8] Maximum 2 dormant and 4 summer applications per year. [9] Orchard maintenance. [10] Transplanting.

Table 3–2. Products Used on Hazelnuts (cont'd)

Product Name	Registration Number	Common Name	Group	Preharvest Interval (PHI)	Restricted Entry Interval (REI)	Maximum Applications	Potentially Organic
Products for insect control or suppression (cont'd)							
Lagon 480 E	9382	dimethoate	1B	45 days	5 days[1]/21 days[2]/ 34 days[3]	1	—
Matador 120 EC	24984	lambda-cyhalothrin	3	14 days	24 hours	max. 390 mL/ha	—
Movento 240 SC	28953	spirotetramat	23	7 days	12 hours	max. 1.58 L/ha	—
Opal	28146	potassium salts of fatty acids	NC	0 days	12 hours	3[7]	✓
Purespray Green Spray Oil 13 E	27666	mineral oil	NC	—	12 hours	8	✓
Sharphos	32768	chlorpyrifos	1B	14 days	24 hours[1]/4 days[5]	3	—
Sivanto Prime	31452	flupyradifurone	4D	7 days	12 hours	max. 2 L/ha	—
Surround WP	27469	kaolin	NC	0 days	12 hours	—	✓
Vayego 200 SC	33711	tetraniliprole	28	10 days	12 hours	4	—
Vegol Crop Oil	32408	canola oil	NC	0 days	12 hours	2/4[8]	✓
Versys	33266	afidopyropen	9D	7 days	12 hours	2	—
Warhawk 480 EC	29984	chlorpyrifos	1B	14 days	48 hours[1]/4 days[5]	3	—
Xentari WG	31557	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Products Used for Disease Control or Suppression							
Azoshy 250 SC	32263	azoxystrobin	11	45 days	12 hours	4	—
Bravo ZNC	33515	chlorothalonil	M	120 days	12 hours[1]/2 days[9]/ 10 days[10]/18 days[5]	3	—
Cevya	33405	mefentrifluconazole	3	14 days	12 hours	max. 1.125 L/ha	—
Copper Spray	19146	copper oxychloride	M	2 days	48 hours	3	✓
Cueva	31825	copper octanoate	M	1 day	4 hours	15	✓
Flint	30619	trifloxystrobin	11	60 days	12 hours	4	—
Fontelis	30331	penthiopyrad	7	14 days	12 hours	max. 4.5 L/ha	—
Guardsman Copper Oxychloride 50	13245	copper oxychloride	M	2 days	48 hours	3	—
Miravis Duo	33206	pydiflumetofen+difenoconazole	7+3	14 days	12 hours	Max 3.0 L/ha	—
Parasol Flowable	25901	copper hydroxide	M1	2 days	48 hours	2	—
Quadris Flowable	26153	azoxystrobin	11	45 days	12 hours	4	—
Quash	30402	metconazole	3	25 days	12 hours	4 (max. 980 g/ha)	—

M = Multi-site fungicides. NC = Not classified by FRAC/IRAC, or group not indicated on product label.
— = Information is not specified on the product label. ✓ = Potentially organic. Check with certifying body.

[1] General re-entry. [2] Hand harvest, hand-line irrigation. [3] Thinning. [4] Mechanical harvest. Contact registrant for information on hand harvest PHI and REI. [5] Scouting activities. [6] Hand pruning.
[7] Maximum of 3 consecutive applications to ensure plant injury does not occur. Additional applications may be possible if previous experience with repeat applications of the product under the same conditions have not produced plant injury. [8] Maximum 2 dormant and 4 summer applications per year. [9] Orchard maintenance. [10] Transplanting.

Notes on Hazelnut Insect and Disease Control Products

Use the information in the following notes to assist with choosing the best product for the pest complex present. Consider the life stage present and resistance management strategies, as well as the activity of each product to pests and beneficial insects.

Information in Table 3–3 is based partly on information from other tree fruit in Ontario and the northeastern United States. Impact on these insects in tree nuts is expected to be similar to that of apples. However, differences in production systems, timing of applications and other factors may change efficacy of these products.

Table 3–3. Activity of Insecticides and Miticides on Hazelnut Pests

Use products only for pests listed on the product label for the crop. The information provided in this table is intended to assist the grower in choosing the best insecticide for control of pests listed on the product label, while managing resistance and avoiding unnecessary sprays for non-target pests. Efficacy can be affected by rate of the product.

Insecticide	Brown marmorated stink bug	Japanese beetle	Oblique-banded leafroller	Potato leafhopper	Weevils[1]	Scale[2]	Spring-feeding caterpillar	Codling Moth	Aphids	Mites		
										Bud mite[3]	European red mite	Two-spotted spider mite
Acramite 50 WS	—	—	—	—	—	—	—	—	—	—	C *	C *
Admire 240 Flowable	SC	—	—	S *	—	SC	—	—	C *	—	—	—
Altacor	—	SC	C *	—	—	SC	SC	C *	SC	—	—	—
Bioprotec Plus	—	—	C *	—	—	—	SC	—	—	—	—	—
Closer	SC	—	—	SC	—	C *	—	—	C *	—	—	—
Cygon 480 AG	—	—	—	SC	—	SC	—	—	C *	—	—	—
Danitol	—	SC	SC	SC	SC	—	SC	C *	—	—	— *	— *
Delegate	—	—	C *	—	S *	—	SC	C *	—	—	—	—
Dipel 2X DF	—	—	C *	—	—	—	SC	SC	—	—	—	—
Envidor 240 SC	—	—	—	—	—	—	—	—	—	SC[3]	C *	C *
Exirel	—	SC	C *	SC	SC	—	SC	C *	SC	—	—	—

C = Control S = Suppression RD = Reduction in numbers or damage SC = Some control of this pest may be expected when the product is applied against labelled pests under certain conditions
— = Not registered for control of this pest, or activity on this pest has not been documented * (shaded area) = Pest is listed on the product label for control or suppression.

[1] Efficacy based mainly on plum curculio in apples. Impact on weevil pests in hazelnut should be similar but may vary between the two cropping systems.
[2] Products may not be labelled on all scale species affecting hazelnut. Check product label for labelled pests.
[3] Any product activity would only be on exposed, migrating mites and not on growth stages within buds.
[4] Suppression of Lecanium scale but control of San Jose scale

Ratings are based on moderate insect or mite pressure. Efficacy may be affected by rate of insecticide, coverage, timing, product residual and pest resistance, if present. Products must be applied at timings and rates specfied on the product label for each pest.
Source: Efficacy based mainly on northeastern apple pests in OMAFRA *Publication 360A –Apple Crop Protection Guide, 2021*, *Cornell Pest Management Guidelines for Tree Fruit and Pennsylvania Tree Fruit Production Guide.* Efficacy in tree nuts is expected to be similar to that of apples, however differences in production systems, timing of applications and other factors may change efficacy of these products.

Table 3–3. Activity of Insecticides and Miticides on Hazelnut Pests (cont'd)

Insecticide	Brown marmorated stink bug	Japanese beetle	Oblique-banded leafroller	Potato leafhopper	Weevils[1]	Scale[2]	Spring-feeding caterpillar	Codling Moth	Aphids	Mites		
										Bud mite[3]	European red mite	Two-spotted spider mite
Harvanta 50 SL	—	SC	C *	—	SC	—	SC	C *	—	—	—	—
Intrepid	—	—	C *	—	—	—	SC	SC	—	—	—	—
Kanemite 15 SC	—	—	—	—	—	—	—	—	—	—	SC	C *
Kopa	—	—	—	—	—	C *	—	—	C *	—	C *	C *
Labamba	SC	SC	C *	SC	SC	SC	SC	SC	C *	—	—	—
Lagon	—	—	—	SC	—	SC	—	—	C *	—	—	—
Matador 120 EC	SC	SC	C *	SC	SC	SC	SC	SC	C *	—	—	—
Movento 240 SC	—	—	—	—	—	S *[4]	—	—	C *	—	—	—
Opal	—	—	—	—	—	C *	—	—	C *	—	C *	C *
Purespray Green Spray Oil 13 E (summer)	—	—	—	—	—	SC	—	—	SC	—	—	S *
Sharphos	SC	—	—	—	SC	SC	—	—	C *	—	—	—
Sivanto Prime	—	—	—	SC	—	SC	—	—	C *	—	—	—
Surround WP	SC	—	RD *	SC	SC	SC	SC	SC	—	—	SC	—
Vayego 200 SC	—	—	C *	—	SC	—	SC	C *	S *	—	—	—
Vegol Crop Oil	—	—	—	—	—	C *	—	—	C *	—	C *	C *
Versys	—	—	—	—	—	—	—	—	C *	—	—	—
Warhawk 480 EC	SC	—	—	—	SC	SC	—	—	C *	—	—	—
Xentari WG	—	—	C *	—	—	—	SC	SC	—	—	—	—

C = Control S = Suppression RD = Reduction in numbers or damage SC = Some control of this pest may be expected when the product is applied against labelled pests under certain conditions
— = Not registered for control of this pest, or activity on this pest has not been documented * (shaded area) = Pest is listed on the product label for control or suppression.

[1] Efficacy based mainly on plum curculio in apples. Impact on weevil pests in hazelnut should be similar but may vary between the two cropping systems.
[2] Products may not be labelled on all scale species affecting hazelnut. Check product label for labelled pests.
[3] Any product activity would only be on exposed, migrating mites and not on growth stages within buds.
[4] Suppression of Lecanium scale but control of San Jose scale

Ratings are based on moderate insect or mite pressure. Efficacy may be affected by rate of insecticide, coverage, timing, product residual and pest resistance, if present. Products must be applied at timings and rates specfied on the product label for each pest.
Source: Efficacy based mainly on northeastern apple pests in OMAFRA *Publication 360A –Apple Crop Protection Guide, 2021*, *Cornell Pest Management Guidelines for Tree Fruit and Pennsylvania Tree Fruit Production Guide.* Efficacy in tree nuts is expected to be similar to that of apples, however differences in production systems, timing of applications and other factors may change efficacy of these products.

Table 3–4. Activity of Fungicides on Eastern Filbert Blight (EFB)

Use fungicides only for the disease listed on the product label for the crop. This table is intended to assist the grower in choosing the best fungicide for control of pests listed on the product label, while managing resistance and avoiding unnecessary sprays for non-target pests. The information provided in this table is based primarily on research done in Oregon hazelnuts. Efficacy in Ontario may be affected by rate of the product, fungal strains, environmental conditions, hazelnut cultivar or by the presence of resistant populations of fungi. The information provides guidelines on how fungicides may perform against some strains of the EFB fungus. However, growers may need to adapt their fungicide programs as they gain experience with the particular disease conditions present in their orchard.

Group	Fungicide	Active Ingredient	EFB Control
M1	Copper Spray	copper oxychloride	— [1]
M1	Guardsman Copper Oxychloride	copper oxychloride	— [1]
M1	Cueva	copper octanoate	0 [1]
M5	Bravo ZNC	chlorothalonil	4
3	Quash	metconazole	3
7+3	Miravis Duo	pydiflumetofen + difenoconazole	3–4
11	Azoshy	azoxystrobin	2–3
11	Quadris Flowable	azoxystrobin	2–3
11	Flint	trifloxystrobin	3–4

0 = Not effective. 1 = Slight control. 2 = Fair. 3 = Good. 4 = Excellent. — = Information not available.

Adapted from *2019 Pest Management Guide for the Willamette Valley*, Oregon State University (OSU) Extension Service and information from OSU researchers. Ratings are relative and based on full application rates and proper coverage/spray timing. Actual control will be affected by these factors and others including pathogen strain, tree cultivar, disease pressure and weather conditions.

[1] Copper oxychloride was not evaluated in Oregon trials. Copper hydroxide was evaluated against Eastern Filbert Blight in Oregon and was found to provide good control (ranking = 3) relative to other products evaluated, while copper octanoate was not found to be effective under Oregon conditions.

Walnuts

In this section:

Table 3–5. Walnut Calendar
Table 3–6. Products Used on Walnuts
Table 3–7. Activity of Insecticides and Miticides on Walnut Pests

Products are listed in the calendar by chemical group and are in alphabetical order within each group. The order does not reflect efficacy. For preharvest interval, restricted entry interval, and maximum applications, see *Table 3–6. Products Used on Walnuts.*

Where a product in the calendar is followed by a "*", it is potentially acceptable for organic use based on the publication Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). Réseau d'avertissements phytosanitaires. 2020. RAP - *Réseau Général. Bulletin D'Information No. 1, Special phytoprotection bio.* 18 juin 2020 or a letter of certification provided by the registrant. Check with your certifying body to verify the acceptability of any product prior to using it.

Thorough coverage of all affected plant surfaces is essential for maximum efficacy of many tree nut products. Sufficient water volumes are necessary to provide complete coverage with insecticides, miticides and fungicides. Consult the product label for suggested water volumes. Otherwise, use enough water to ensure thorough spray coverage. Where the product rate is listed in amount per 1,000 L, or if a water volume is not provided on the label, use enough water to wet the foliage to the near drip point.

Crop Nutrition

Crop nutrition is important for plant growth, fruit quality development and the acquisition of adequate cold hardiness by tree fruit. For fruit crops, soil testing, plant tissue analysis and visual deficiency symptoms all play an important role in assessing and monitoring the crop's nutritional status. For more information, visit ontario.ca/apples (click on *Soil Management, Fertilizer Use, Crop Nutrition and Cover Crops for Fruit Production*) and see OMAFRA Publication 611, Soil Fertility Handbook. For specialty crop nutrition, including tree nuts, visit the Specialty Cropportunities tool at http://www.omafra.gov.on.ca/CropOp/en/index.html (click on *General Agronomics, Nutrient Management*)

Pest Control Product Persistence

Some products are persistent and may carry over from one year to the next. Where possible, avoid using these products in areas treated during the previous season. Consult product labels for product-specific information.

Resistance Management

To delay development of resistance to insecticides, miticides and fungicides, follow resistance management guidelines outlined in *Resistance Management Strategies*, Chapter 2. The chemical group is indicated in the column labelled "Group" before the "Product" column. Products belonging to the same chemical group are grouped together in the calendar. Multi-site (M) fungicides are less prone to resistance. Some products are not classified to mode of action (NC) and the mode of action has not been determined for others (U or UN).

Fungicide resistance management

Take the following steps to avoid rapid development of fungicide resistance:

- Do not reduce rates below those specified on the label.
- Do not use products containing the same chemical group in consecutive applications.
- Do not rely on fungicides alone for control of tree nut diseases. Use in conjunction with cultural management practices such as disease-tolerant cultivars (where available) and timely pruning and destruction of diseased branches or twigs.

Insecticide resistance management

Take the following steps to avoid development of insecticide resistance:

- For pests with discrete generations (leafroller, codling moth), do not use insecticides from the same group for more than one generation. Within a generation, if more than one spray is required, use a product from the same chemical group.
- For pests with overlapping generations (aphids, mites), do not use products containing the same chemical group in consecutive applications.

Bee Toxicity

Some pesticides are toxic to bees and other pollinating insects. Use of pesticides on flowering crops requires careful management to avoid negative effects on pollinators. Insecticides should not be applied when tree fruit are in bloom or when bees are active. Before and after bloom, bees may still be present on flowering cover crops and weeds — do not allow drift onto these or other flowering crops. Always follow label precautions regarding avoiding impacts on bees. For more information, see *Bee Poisoning*, Chapter 1 and honeybee toxicity ratings in Table 3–11. *Toxicity of Pesticides to Honeybees and Mite/Aphid Predators.*

Read the product label and follow all safety precautions. Labels for registered pest control products are available at the Pest Management Regulatory Agency (PMRA) website at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php. Many products listed are under re-evaluation with the PMRA and may change within the lifetime of this publication. Consult the most recent label on the PMRA website and/or product registrant for complete information.

Table 3–5. Walnut Calendar

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom						
Leafrollers	**General Comments:** • Leafrollers are generally not a problem on walnut and will not often require control. • If needed, apply when larvae have emerged and before they roll up in the leaves. Reapply in 1–2 weeks, if needed. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	83 mL/ha	24 hours	14 days	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	5	Delegate	210–420 g/ha	12 hours	14 days	Use higher rate under high pest pressure or for larger larvae. Reapply in 14 days if needed.
		Entrust *	364 mL/ha	when dry	14 days	Reapply in 7–10 days if needed.
	11	Bioprotec Plus * Dipel 2X DF * or Xentari WG *	1.8–2.5 L/ha 1.12–1.67 kg/ha 0.5–1.6 kg/ha	4 hours	0 days	Product must be consumed to be effective. Spray when and where pests are actively feeding. Apply in a high-volume spray to ensure thorough coverage on both sides of the leaf. Apply to young larvae, early in infestation. Death of insect may take several days. Products have short residual activity—repeat applications may be required. Use diluted spray mixture within 12 hours. For Dipel, use 1.6 kg/ha for large or mature trees.
	18	Intrepid	750 mL/ha	12 hours	14 days	For overwintering generations of obliquebanded leafroller, apply when larvae become active in the spring.
	28	Altacor	145–285 g/ha	12 hours	10 days	For overwintering generations of obliquebanded leafroller, apply when larvae become active in the spring. Tank-mixing or sequential applications of Exirel with certain fungicides (e.g., copper), oils or other products can cause crop injury. See product label for tank-mix restrictions.
		Exirel	0.5–1.0 L/ha	12 hours	5 days	
		Harvanta 50 SL	1.2–1.6 L/ha	12 hours	30 days	

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Leafrollers (cont'd)	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Reduction in damage only.** Apply at first egg hatch. Make a second application 10 days later. Repeat at 7–14-day intervals as subsequent generations emerge. Use 50 kg/ha for initial application. Adjust rate with subsequent applications, or for larger trees, as per label instructions. Efficacy depends on complete coverage of leaves and fruit. Light rain will help distribute product. Reapply after heavy rain, wind, overhead irrigation or new growth. Creates a white film on plant parts. Stop application once nuts are sizing. Do not use with anti-foaming agents, spreader/stickers or summer oils.
Codling moth	**General Comments:** • Codling moth is a sporadic problem in commercial walnuts. Control may not be required. • If control is required, pheromone traps for adult flights and degree-day models for this pest in apples can be used to determine optimal spray timing. For information on calculating degree-days, see *Degree-Day Modeling* in Chapter 2: *Pest Management*. Pheromone traps should be considered in orchards where codling moth was a problem the previous year. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Danitol	0.78–1.56 L/ha	24 hours[1]/ 7 days[2]/3 days[3]	3 days[3]	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season. PHI of 3 days for Danitol refers to mechanical harvest only. For information on hand harvest PHI and REI, contact product registrant.
		Matador 120 EC or Labamba	83 mL/ha	24 hours	14 days	
	5	Delegate	420 g/ha	12 hours	14 days	Apply at first egg hatch, before larvae penetrate nuts. Reapply in 14 days if needed.
		Entrust *	364 mL/ha	when dry	14 days	**Suppression only.** Apply at first egg hatch, before larvae penetrate nuts. Reapply in 7–10 days if needed.
	11	Xentari WG	0.5–1.6 kg/ha	4 hours	0 days	Product must be consumed to be effective. Spray when and where pests are actively feeding. Apply in a high-volume spray to ensure thorough coverage on both sides of the leaf. Apply to young larvae, early in infestation. Death of insect may take several day. Short residual activity — repeat applications may be required. Use diluted spray mixture within 12 hours.
	28	Altacor	145–215 g/ha	12 hours	10 days	Apply before first egg hatch. Reapply 10–14 days later if needed. Under high pest pressure, use high rate. Tank-mixing or sequential applications of Exirel with certain fungicides (e.g., copper), oils or other products can cause crop injury. See product label for tank-mix restrictions.
		Exirel	500–750 mL/ha	12 hours	5 days	
		Harvanta 50 SL	1.6 L/ha	12 hours	30 days	

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Codling moth (cont'd)	NC	Isomate-CM/OFM TT *	500 dispensers/ha	—	—	Reduces mating of codling moth and oriental fruit moth. Place dispensers in upper third of canopy, before first codling moth flight in the spring. Dispensers last up to 150 days for codling moth and up to 90 days for oriental fruit moth. If populations of codling are very high, additional control measures may be required. For more information on mating disruption, see OMAFRA Factsheet 03–079, *Mating Disruption for Management of Insect Pests.*
Aphids	**General Comments:** • Aphids on walnut are generally controlled by natural enemies. When controlling other pests, select products with minimal impacts on beneficial insects. • If control is required, apply in early stages of aphid infestation for best results. Consider delaying or avoiding sprays if large numbers of predators are active or parasitism is evident in aphid colonies • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	104 mL/ha	24 hours	14 days	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season. Do not apply when bees are active.
	4C	Closer	100–200 mL/ha	12 hours	7 days	Where possible, rotate with products outside of Group 4. Toxic to certain beneficial insects.
	4D	Sivanto Prime	500–750 mL/ha	12 hours	7 days	Where possible, rotate with products outside of Group 4. Toxic to certain beneficial insects.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are currently registered on tree nuts).

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Aphids (cont'd)	NC (cont'd)	Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not use within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not apply to wet foliage. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Avoid application during bloom.
Scale	**General Comments:** • Monitor scaffold branches and apply when crawlers are active. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	4C	Closer	200–400 mL/ha	12 hours	7 days	**San Jose scale only.** Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	**Soft brown scale only.** Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are currently registered on tree nuts).

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Scale (cont'd)	NC (cont'd)	Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.
Spider mites	**General Comments:** • Two-spotted spider mite and European red mite are rarely an economically significant problem on commercial walnut in Ontario. • If required, apply when mites are active on foliage. Thorough spray coverage is essential for good control. • For resistance management, apply products only when needed and avoid using a single product more than once per season.					
	20B	Kanemite 15 SC	2.07 L/ha	12 hours	14 days	For resistance management, make only 1 application per season.
	20D	Acramite 50 WS	568 g/ha	12 hours	14 days	Rate controls two-spotted spider mite. If European red mite is present, apply 851 g/ha. Maximum of 1 application per season.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are currently registered on tree nuts).

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Spider mites (cont'd)	NC (cont'd)	Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.
Dogwood borer	NC	Isomate DWB	250–375 dispensers/ha	—	—	Dogwood borer is not commonly a pest of tree nuts. Apply where there is a history of infestation. Reduces mating of dogwood borer. Apply before adult borer emergence (end of May). Use high rate for high pressure areas or initial year of treatment. For more information on mating disruption, see OMAFRA Factsheet 03–079, *Mating Disruption for Management of Insect Pests.*
Walnut blight	**General Comments:** • Walnut blight is predominantly a problem of Persian (English) walnuts. • Apply preventative sprays to protect developing buds and nuts in spring or during periods of prolonged leaf wetness. Repeat, as needed, at 7–10-day intervals. • Note that in other growing regions, resistance of the walnut blight pathogen to copper has become a problem. Use copper only when necessary and rotate with products from other groups, • Thorough coverage is essential to protect susceptible green tissue.					
	M	Copper Spray *	4 kg/1,000 L water	48 hours	40 days	Apply at first pistillate or late May and repeat monthly if needed. Apply in a high-volume spray to ensure thorough coverage. Do not use in combination with or closely following Vegol or Exirel. See product labels for details. When mixed with lime (if label permits), this product cannot be mixed with insecticide wettable powders.
		Cueva *	1% v/v in 470–940 L water/ha	4 hours	1 day	May cause leaf spots in copper-sensitive crops during excessive moisture and cold. If concerned about sensitivity of plants, apply first to small areas. Do not use in combination with or closely following Vegol or Exirel. See product labels for details.
	24	Kasumin 2L	5 L/ha	12 hours	100 days	Apply when conditions favour disease development.

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
First pistillate flower						
INSECTICIDES MAY BE TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1.						
Aphids	**General Comments:** • Aphids on walnut are generally controlled by natural enemies. When controlling other pests, select products with minimal impacts on beneficial insects. • If control is required, apply in early stages of aphid infestation for best results. Consider delaying or avoiding sprays if large numbers of predators are active or parasitism is evident in aphid colonies • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Aphids in **Prebloom.**
Scale	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Scale in **Prebloom.**
Butternut curculio	**General Comments:** • Butternut curculio is an economically significant pest of black and English (Persian) walnut. • Begin monitoring for curculio activity in early spring, when shoot growth begins.					
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Reduction in damage only.** Apply when visual inspection shows adult feeding and egg-laying scars on new flower shoots. Repeat at 7-day intervals as needed to keep nuts covered throughout egg-laying period. Use 50 kg/ha for initial application. Adjust rate with subsequent applications, or for larger trees, as per label instructions. Efficacy depends on complete coverage of leaves and fruit. Light rain will help distribute product. Reapply after heavy rain, wind, overhead irrigation or new growth. Creates a white film on plant parts. Stop application once nuts are sizing. Do not use with anti-foaming agents, spreader/stickers or summer oils.
Walnut blight	Use one of the products listed for Walnut blight at Prebloom.					
Summer sprays						
Leafroller	**General Comments:** • Leafrollers are generally not a problem on walnut and will not often require control. • If control is required, pheromone traps for adult flights and degree-day models for this pest in apples can be used to determine optimal spray timing. For information on calculating degree-days, see: *Degree-Day Modeling*, in Chapter 2. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	83 mL/ha	24 hours	14 days	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Leafroller (cont'd)	5	Delegate	210–420 g/ha	12 hours	14 days	Apply at first egg hatch.
		Entrust *	364 mL/ha	when dry	14 days	
	11	Bioprotec Plus * or Dipel 2X DF * or Xentari WG *	1.8–2.5 L/ha 1.12–1.67 kg/ha 0.5–1.6 kg/ha	4 hours	0 days	See comments for these products under Leafrollers in **Prebloom.**
	18	Intrepid	750 mL/ha	12 hours	14 days	Apply at first egg hatch. Reapply 10–14 days later if needed
	28	Altacor	145–285 g/ha	12 hours	10 days	**For Vayego, apply postbloom only.** Apply at first egg hatch. Reapply 10 days later if needed. Tank-mixing or sequential applications of Exirel with certain fungicides (e.g., copper), oils or other products can cause crop injury. See product label for tank-mix restrictions.
		Exirel	0.5–1.0 L/ha	12 hours	5 days	
		Harvanta 50 SL	1.2–1.6 L/ha	12 hours	30 days	
		Vayego 200 SC	225 mL/ha	12 hours	10 days	
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Reduction in damage only.** See comments for this product under Leafrollers in **Prebloom.**
Codling moth	**General Comments:** • Codling moth is a sporadic problem in commercial walnuts. Control may not always be required. • If control is required, pheromone traps for adult flights and degree-day models for this pest in apples can be used to determine optimal spray timing. For information on calculating degree-days, see: *Degree-Day Modeling*, in Chapter 2. Pheromone traps should be considered in orchards where codling moth was a problem the previous year. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	83 mL/ha	24 hours	14 days	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	5	Delegate	420 g/ha	12 hours	14 days	Apply at first egg hatch, before larvae penetrate nuts. Reapply in 14 days if needed.
		Entrust *	364 mL/ha	when dry	14 days	**Suppression only.** Apply at first egg hatch, before larvae penetrate nuts. Reapply in 7–10 days if needed.
	11	Xentari WG	0.5–1.6 kg/ha	4 hours	0 days	Product must be consumed to be effective. Spray when and where pests are actively feeding. Apply in a high-volume spray to ensure thorough coverage on both sides of the leaf. Apply to young larvae, early in infestation. Death of insect may take several day. Short residual activity — repeat applications may be required. Use diluted spray mixture within 12 hours.
	18	Intrepid	1.0 L/ha	12 hours	14 days	**Suppression only.** Apply at first egg hatch and repeat in 10–14 days if needed.

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Codling moth (cont'd)	28	Altacor	145–215 g/ha	12 hours	10 days	**For Vayego, apply postbloom only.** Apply at first egg hatch. Use high rate under high pressure. Reapply 10–14 days later if needed. Tank-mixing or sequential applications of Exirel with certain fungicides (e.g., copper), oils or other products can cause crop injury. See product label for tank-mix restrictions.
		Exirel	500–750 mL/ha	12 hours	5 days	
		Harvanta 50 SL	1.6 L/ha	12 hours	30 days	
		Vayego 200 SC	225 mL/ha	12 hours	10 days	
Aphids	**General Comments:** • Aphids on walnut are generally controlled by natural enemies. When controlling other pests, select products with minimal impacts on beneficial insects. • If control is required, apply in early stages of aphid infestation for best results. Consider delaying or avoiding sprays if large numbers of predators are active or parasitism is evident in aphid colonies • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	104 mL/ha	24 hours	14 days	This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	4A	Admire 240 Flowable	230 mL/ha	24 hours	7 days	**Use postbloom only.** Maximum 2 applications of Group 4A insecticides per season. Repeated use may cause mite outbreaks.
	4C	Closer	100–200 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects.
	4D	Sivanto Prime	500–750 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects.
	23	Movento 240 SC	365–435 mL/ha	12 hours	7 days	**Use postbloom only.** Control may not be apparent for 2–3 weeks. Under high pest pressure, reapply 2 weeks later. Tank-mix with an adjuvant/additive that has spreading and penetrating properties at a suggested rate of 0.2% v/v. See label for further details. Do not tank-mix with sulphur (note: no sulphur products are currently registered on tree nuts).
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Aphids in **Prebloom.**
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for this product under Aphids in **Prebloom.**

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Scale	**General Comments:** • Monitor scaffold branches and apply when crawlers are active. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	4C	Closer	200–400 mL/ha	12 hours	7 days	**San Jose scale only.** Where possible, rotate with insecticides outside of Group 4 between generations. Toxic to certain beneficial insects.
	23	Movento 240 SC	365–585 mL/ha	12 hours	7 days	**Control of San Jose scale and suppression of Lecanium scale. Use postbloom only.** Control may not be apparent for 2–3 weeks. Under high pest pressure, reapply 2 weeks later. Tank-mix with an adjuvant/additive that has spreading and penetrating properties at a suggested rate of 0.2% v/v. See label for further details. Do not tank-mix with sulphur (note: no sulphur products are currently registered on tree nuts).
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	**Soft brown scale only.** See comments for these products under Scale in Prebloom.
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for this product under Scale in **Prebloom.**
Spider mites	**General Comments:** • Two-spotted spider mite and European red mite are rarely an economically significant problem on commercial walnut in Ontario. • If required, apply when mites are active on foliage. Thorough spray coverage is essential for good control.					
	20B	Kanemite 15 SC	2.07 L/ha	12 hours	14 days	For resistance management, maximum of 1 application per season.
	20D	Acramite 50 WS	568 g/ha	12 hours	14 days	Rate controls two-spotted spider mite. If European red mite is present, apply 851 g/ha. Maximum of 1 application per season.
	23	Envidor 240 SC	750 mL/ha	12 hours	7 days	**Use postbloom only.** Maximum of 1 application per season. Do not use in orchards inter-planted with other crops.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Spider mites in **Prebloom.**
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for this product under Spider mites in **Prebloom.**

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Leafhopper	**General Comments:** • Leafhoppers are a sporadic problem on walnuts. • Control may be required with heavy infestations, particularly on young trees. Monitor for leafhopper activity beginning in late spring.					
	4A	Admire 240 Flowable	200 mL/ha	24 hours	7 days	**Suppression only. Use postbloom only.** Maximum of 2 applications of Group 4A insecticides per season. Repeated use may cause mite outbreaks.
Butternut curculio	**General Comments:** • Butternut curculio is an economically significant pest of black and English (Persian) walnut. • Begin monitoring for curculio activity in early spring, when shoot growth begins. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	104 mL/ha	24 hours	14 days	Apply when visual inspection shows adult feeding or egg-laying scars in new flower shoots. This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	5	Delegate	420 g/ha	12 hours	14 days	**Suppression only.** Apply at first sign of feeding damage after bloom. Reapply 14 days later depending on pest pressure.
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	See comments for this product under Butternut Curculio in **First Pistillate Flower.**
Husk maggot	**General Comments:** • Husk maggot will attack husks of English and black walnut but are a more significant problem on English (Persian) walnut. • Use sticky traps to monitor for adult flies prior to egg laying typically August to mid-September. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	104 mL/ha	24 hours	14 days	Apply when sticky traps show adult activity. This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	5	Delegate	420 g/ha	12 hours	14 days	**Suppression only.** Apply 7–10 days after first fly is caught on sticky traps. Reapply 14 days later depending on pest pressure.

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Husk maggot (cont'd)	5 (cont'd)	GF-120 Fruit Fly Bait *	1.5 L in 6 L water	when dry	0 days	Under high pest pressure, this product may provide suppression only. Mix 1-part GF-120 with 4 parts water and apply to tree canopy at 7.5 L spray mix/ha for orchards and 200–300 mL mixture for individual trees. Apply when first fly is caught on sticky traps. Reapply every 7 days or sooner if rain washes off residue. Large droplet sizes optimize the attractiveness of the bait. Proper application techniques help ensure adequate coverage. Apply using an all-terrain vehicle fitted with an appropriate sprayer and nozzle for a large spray droplet size of 4–6 mm directed to underside of leaves and inside the canopy.
	28	Harvanta 50 SL	1.2–1.6 L/ha	12 hours	30 days	—
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Reduction in damage only.** Apply when sticky traps show adult activity. Repeat at 7-day intervals as needed to maintain good coverage. Use 50 kg/ha for initial application. Adjust rate with subsequent applications, or for larger trees, as per label instructions. Efficacy depends on complete coverage of leaves and fruit. Light rain will help distribute product. Reapply after heavy rain, wind, overhead irrigation or new growth. Creates a white film on plant parts. Stop application once nuts are sizing. Do not use with anti-foaming agents, spreader/stickers or summer oils.
Walnut blight	If necessary, use one of the products listed for Walnut blight at **Prebloom**. See Table 3-6. *Products Used on Walnuts* for preharvest intervals. Walnut blight controls should predominantly be targeted at protecting developing buds and nuts in the spring. Last Copper Spray application should be no later than husk split.					
Botrytis grey mould	7	Fontelis	1.0–1.5 L/ha	12 hours	14 days	Botrytis is not a common problem on walnuts. Apply only if there has been a history of disease. Begin application prior to disease development and repeat in 7–14 days if needed. Contains mineral oil in the formulation. Tank-mixing or rotating with oil-sensitive products (see labels for details) may cause crop safety issues. See label for tank-mix restrictions.

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–5. Walnut Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Brown Rot, Alternaria leaf spot	3	Cevya	0.25-0.375 L/ha	12 hours	14 days	**Suppression only.** Brown rot and Alternaria are not normally a problem in Ontario walnuts. In orchards where these diseases have been a problem in the past, apply when conditions are conducive to disease development.
	7	Fontelis	1.0–1.5 L/ha	12 hours	14 days	**Control of brown rot, suppression only of Alternaria.** Brown rot and Alternaria are not normally a problem in Ontario walnuts. In orchards where these diseases have been a problem in the past, apply when conditions are conducive to disease development. Contains mineral oil in the formulation. Tank-mixing or rotating with oil-sensitive products may cause crop safety issues. See label for tank-mix restrictions.

[1] General Re-entry. [2] Mechanical harvesting. [3] Scouting activities, hand pruning.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–6. Products Used on Walnuts

Use this table as a guide but refer to product label for specific information.

The preharvest interval (PHI) is the number of days between the last spray and first harvest.

The restricted entry interval (REI) is the minimum interval that must be observed between application of the pesticide and work in the treated crop without protective equipment. If no re-entry period is stated on the label, assume it is 12 hours. Where the REI exceeds the PHI, follow the REI.

The maximum number of applications is the labelled maximum number for the growing season and may be higher than what is recommended for resistance management or for the preservation of beneficial insects.

Products with a check mark may be acceptable for organic use based on the publication *Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). Réseau d'avertissements phytosanitaires. 2020. RAP - Réseau* Général. *Bulletin D'Information No. 1, Special phytoprotection bio. 18 juin 2020* or a letter of certification provided by the registrant. Check with certifying body to verify the acceptability of any product prior to using it.

Product Name	Registration Number	Common Name	Group	Preharvest Interval (PHI)	Restricted Entry Interval (REI)	Maximum Applications	Potentially Organic
Products for insect control or suppression							
Acramite 50 WS	27925	bifenazate	20D	14 days	12 hours	1	—
Admire 240 Flowable	24094	imidacloprid	4A	7 days	24 hours	2	—
Altacor	28981	chlorantraniliprole	28	10 days	12 hours	3 (max. 645 g/ha)	—
Bioprotec Plus	32425	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Closer	30826	sulfoxaflor	4C	7 days	12 hours	2	—
Danitol	33817	fenpropathrin	3	3 days[1]	24 hours[2]/7 days[3]/3 days[1]	1	—
Delegate	28778	spinetoram	5	14 days	12 hours	3	—
Dipel 2X DF	26508	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Entrust	30382	spinosad	5	14 days	when dry	3	✓
Envidor 240 SC	28051	spirodiclofen	23	7 days	12 hours	1	—
Exirel	30895	cyantraniliprole	28	5 days	12 hours	4	—
GF-120 Fruit Fly Bait	28336	spinosad bait	5	0 days	when dry	10	✓
Harvanta 50 SL	32889	cyclaniliprole	28	30 days	12 hours	3 (max 4.8 L/ha)	—
Intrepid	27786	methoxyfenozide	18	14 days	12 hours	max. 2 L/ha	—

M = Multi-site fungicides. NC = Not classified by FRAC/IRAC, or group not indicated on product label.
— = Information is not specified on the product label. ✓ = Potentially organic. Check with certifying body.

[1] Mechanical harvest. Contact registrant for information on hand harvest PHI and REI. [2] General re-entry [3] Scouting activities, hand pruning. [4] Maximum of 3 consecutive applications to ensure plant injury does not occur. Additional applications may be possible if previous experience with repeated applications of the product under the same conditions have not produced plant injury.
[5] Maximum 2 dormant and 4 summer applications per year.

Table 3–6. Products Used on Walnuts (cont'd)

Product Name	Registration Number	Common Name	Group	Preharvest Interval (PHI)	Restricted Entry Interval (REI)	Maximum Applications	Potentially Organic
Products for insect control or suppression (cont'd)							
Isomate-CM/OFM TT	29352	pheromone, oriental fruit moth and codling moth	NC	—	—	—	✓
Isomate DWB	30589	pheromone, dogwood borer	NC	—	—	—	—
Kanemite 15 SC	28641	acequinocyl	20B	14 days	12 hours	2 (max 4.1 L/ha)	—
Kopa	31433	potassium salts of fatty acids	NC	0 days	12 hours	3[4]	✓
Labamba	33576	lambda-cyhalothrin	3	14 days	24 hours	max 390 mL/ha	—
Matador 120 EC	24984	lambda-cyhalothrin	3	14 days	24 hours	max. 390 mL/ha	—
Movento 240 SC	28953	spirotetramat	23	7 days	12 hours	max. 1.58 L/ha	—
Opal	28146	potassium salts of fatty acids	NC	0 days	12 hours	3[4]	✓
Sivanto Prime	31452	flupyradifurone	4D	7 days	12 hours	max. 2 L/ha	—
Surround WP	27469	kaolin	NC	0 days	12 hours	—	✓
Vayego 200 SC	33711	tetraniliprole	28	10 days	12 hours	4	—
Vegol Crop Oil	32408	canola oil	NC	0 days	12 hours	2/4[5]	✓
Xentari WG	31557	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Products for disease control or suppression							
Cevya	33405	mefentrifluconazole	3	14 days	12 hours	max. 1.125 L/ha	—
Copper Spray	19146	copper oxychloride	M	40 days	48 hours	4	✓
Cueva	31825	copper octanoate	M	1 day	4 hours	15	✓
Fontelis	30331	penthiopyrad	7	14 days	12 hours	max. 4.5 L/ha	—
Kasumin 2L	30591	kasugamycin	24	100 days	12 hours	4	—

M = Multi-site fungicides. NC = Not classified by FRAC/IRAC, or group not indicated on product label.
— = Information is not specified on the product label. ✓ = Potentially organic. Check with certifying body.

[1] Mechanical harvest. Contact registrant for information on hand harvest PHI and REI. [2] General re-entry [3] Scouting activities, hand pruning. [4] Maximum of 3 consecutive applications to ensure plant injury does not occur. Additional applications may be possible if previous experience with repeated applications of the product under the same conditions have not produced plant injury.
[5] Maximum 2 dormant and 4 summer applications per year.

Notes on Walnut Insect Control Products

Use the information in the following notes to assist with choosing the best product for the pest complex present. Consider the life stage present and resistance management strategies, as well as the activity of each product to pests and beneficial insects.

Information in Table 3–7 is based partly on information from other tree fruit in Ontario and the northeastern United States. Impact on these insects in tree nuts is expected to be similar to that of apples. However, differences in production systems, timing of applications and other factors may change efficacy of these products.

Table 3–7. Activity of Insecticides and Miticides on Walnut Pests

Use products only for pests listed on the product label for the crop. The information provided in this table is intended to assist the grower in choosing the best insecticide for control of pests listed on the product label, while managing resistance and avoiding unnecessary sprays for non-target pests. Efficacy can be affected by rate of the product.

Insecticide	Husk maggot[1]	Codling moth	Dogwood borer	Japanese beetle	Leafrollers	Potato leafhopper	Butternut curculio[2]	Scale[3]	Spring-feeding caterpillar	Aphids	Mites	
											European red mite	Two-spotted spider mite
Acramite 50 WS	—	—	—	—	—	—	—	—	—	—	C *	C *
Admire 240 Flowable	SC	—	—	—	—	S *	—	SC	—	C *	—	—
Altacor	SC	C *	SC	SC	C *	—	—	SC	SC	SC	—	—
Bioprotec Plus	—	—	—	—	C *	—	—	—	SC	—	—	—
Closer	—	—	—	—	—	SC	—	C *	—	C *	—	—
Danitol	SC	C *	—	SC	SC	SC	—	—	SC	—	— *	— *
Delegate	S *	C *	SC	—	C *	—	S *	—	SC	—	—	—
Dipel 2X DF	—	SC	—	—	C *	—	—	—	SC	—	—	—
Entrust	SC	S *	—	—	C *	—	SC	—	SC	—	—	—
Envidor 240 SC	—	—	—	—	—	—	—	—	—	—	C *	C *

C = Control S = Suppression RD = Reduction in numbers or damage SC = Some control of this pest may be expected when the product is applied against labelled pests under certain conditions
— = Not registered for control of this pest, or activity on this pest has not been documented * (shaded area) = Pest is listed on the product label for control or suppression.

[1] Efficacy based on apple maggot in Ontario apples. Impact on the closely related walnut husk fly should be similar but may vary between the two cropping systems.
[2] Efficacy based on plum curculio in Ontario apples. Impact on the closely related butternut curculio should be similar but may vary between the two cropping systems.
[3] Products may not be labelled on all scale species affecting walnut. Check product label for labelled pests.
[4] Under extreme pest pressure, product may only provide suppression.
[5] Suppression of Lecanium scale but control of San Jose scale.

Ratings are based on moderate insect or mite pressure. Efficacy may be affected by rate of insecticide, coverage, timing, product residual and pest resistance, if present. Products must be applied at timings and rates specfied on the product label for each pest.
Source: Efficacy based mainly on northeastern apple pests in OMAFRA *Publication 360A.Apple Crop Protection Guide, 2021, Cornell Pest Management Guidelines for Tree Fruit and Pennsylvania Tree Fruit Production Guide.* Efficacy in tree nuts is expected to be similar to that of apples, however differences in production systems, timing of applications and other factors may change efficacy of these products.

Table 3–7. Activity of Insecticides and Miticides on Walnut Pests (cont'd)

Insecticide	Husk maggot[1]	Codling moth	Dogwood borer	Japanese beetle	Leafrollers	Potato leafhopper	Butternut curculio[2]	Scale[3]	Spring-feeding caterpillar	Aphids	Mites	
											European red mite	Two-spotted spider mite
GF-120 Fruit Fly Bait	C *[4]	—	—	—	—	—	—	—	—	—	—	—
Harvanta 50 SL	C *	C *	—	SC	C *	—	SC	—	SC	—	—	—
Intrepid	—	S *	—	—	C *	—	—	—	SC	—	—	—
Kanemite 15 SC	—	—	—	—	—	—	—	—	—	—	SC	C *
Kopa	—	—	—	—	—	—	—	C *	—	C *	C *	C *
Labamba	C *	C *	—	SC	C *	SC	C *	SC	SC	C *	—	—
Movento 240 SC	—	—	—	—	—	—	—	S *[5]	—	C *	—	—
Opal	—	—	—	—	—	—	—	C *	—	C *	C *	C *
Sivanto Prime	—	—	—	—	—	SC	—	SC	—	C *	—	—
Surround WP	RD *	SC	—	—	RD *	SC	RD *	SC	SC	SC	SC	—
Vayego 200 SC	SC	C *	—	—	C *	—	SC	—	SC	S *	—	—
Vegol Crop Oil	—	—	—	—	—	—	—	C *	—	C *	C *	C *
Xentari WG	—	C *	—	—	C *	—	—	—	SC	—	—	—

C = Control S = Suppression RD = Reduction in numbers or damage SC = Some control of this pest may be expected when the product is applied against labelled pests under certain conditions
— = Not registered for control of this pest, or activity on this pest has not been documented * (shaded area) = Pest is listed on the product label for control or suppression.

[1] Efficacy based on apple maggot in Ontario apples. Impact on the closely related walnut husk fly should be similar but may vary between the two cropping systems.
[2] Efficacy based on plum curculio in Ontario apples. Impact on the closely related butternut curculio should be similar but may vary between the two cropping systems.
[3] Products may not be labelled on all scale species affecting walnut. Check product label for labelled pests.
[4] Under extreme pest pressure, product may only provide suppression.
[5] Suppression of Lecanium scale but control of San Jose scale.

Ratings are based on moderate insect or mite pressure. Efficacy may be affected by rate of insecticide, coverage, timing, product residual and pest resistance, if present. Products must be applied at timings and rates specfied on the product label for each pest.
Source: Efficacy based mainly on northeastern apple pests in OMAFRA *Publication 360A.Apple Crop Protection Guide, 2021, Cornell Pest Management Guidelines for Tree Fruit and Pennsylvania Tree Fruit Production Guide.* Efficacy in tree nuts is expected to be similar to that of apples, however differences in production systems, timing of applications and other factors may change efficacy of these products.

Chestnuts and Pecans

In this section:

Table 3–8.	Chestnut and Pecan Calendar
Table 3–9.	Products Used on Chestnuts and Pecans
Table 3–10.	Activity of Insecticides and Miticides on Chestnut and Pecan Pests

Products are listed in the calendar by chemical group and are in alphabetical order within each group. The order does not reflect efficacy. For preharvest interval, restricted entry interval, and maximum applications, see Table 3–9. *Products Used on Chestnuts and Pecans.*

Where a product in the calendar is followed by a "*", it is potentially acceptable for organic use based on the publication Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). Réseau d'avertissements phytosanitaires. *2020. RAP - Réseau* Général. *Bulletin D'Information No. 1, Special phytoprotection bio.* 18 juin 2020 or a letter of certification provided by the registrant. Check with your certifying body to verify the acceptability of any product prior to using it.

Thorough coverage of all affected plant surfaces is essential for maximum efficacy of many tree nut products. Sufficient water volumes are necessary to provide complete coverage with insecticides, miticides and fungicides. Consult the product label for suggested water volumes. Otherwise, use enough water to ensure thorough spray coverage. Where the product rate is listed in amount per 1,000 L, or if a water volume is not provided on the label, use enough water to wet the foliage to the near drip point.

Crop Nutrition

Crop nutrition is important for plant growth, fruit quality development and the acquisition of adequate cold hardiness by tree fruit. For fruit crops, soil testing, plant tissue analysis and visual deficiency symptoms all play an important role in assessing and monitoring the crop's nutritional status. For more information, visit ontario.ca/apples (click on *Soil Management, Fertilizer Use, Crop Nutrition and Cover Crops for Fruit Production*) and see OMAFRA Publication 611, Soil Fertility Handbook. For specialty crop nutrition, including tree nuts, visit the Specialty Cropportunities tool at http://www.omafra.gov.on.ca/CropOp/en/index.html (click on *General Agronomics, Nutrient Management)*

Pest Control Product Persistence

Some products are persistent and may carry over from one year to the next. Where possible, avoid using these products in areas treated during the previous season. Consult product labels for product-specific information.

Resistance Management

To delay development of resistance to insecticides, miticides and fungicides, follow resistance management guidelines outlined in *Resistance Management Strategies*, Chapter 2. The chemical group is indicated in the column labelled "Group" before the "Product" column. Products belonging to the same chemical group are grouped together in the calendar. Multi-site (M) fungicides are less prone to resistance. Some products are not classified to mode of action (NC) and the mode of action has not been determined for others (U or UN).

Fungicide resistance management

Take the following steps to avoid rapid development of fungicide resistance:

- Do not reduce rates below those specified on the label.
- Do not use products containing the same chemical group in consecutive applications.
- Do not rely on fungicides alone for control of tree nut diseases. Use in conjunction with cultural management practices such as disease-tolerant cultivars (where available) and timely pruning and destruction of diseased branches or twigs.

Insecticide resistance management

Take the following steps to avoid development of insecticide resistance:

- For pests with discrete generations (leafroller, codling moth), do not use insecticides from the same group for more than one generation. Within a generation, if more than one spray is required, use a product from the same chemical group.
- For pests with overlapping generations (aphids, mites), do not use products containing the same chemical group in consecutive applications.

Bee Toxicity

Some pesticides are toxic to bees and other pollinating insects. Use of pesticides on flowering crops requires careful management to avoid negative effects on pollinators. Insecticides should not be applied when tree fruit are in bloom or when bees are active. Before and after bloom, bees may still be present on flowering cover crops and weeds — do not allow drift onto these or other flowering crops. Always follow label precautions regarding avoiding impacts on bees. For more information, see *Bee Poisoning*, Chapter 1 and honeybee toxicity ratings in Table 3–11. *Toxicity of Pesticides to Honeybees and Mite/Aphid Predators.*

Read the product label and follow all safety precautions. Labels for registered pest control products are available at the Pest Management Regulatory Agency (PMRA) website at http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php. Many products listed are under re-evaluation with the PMRA and may change within the lifetime of this publication. Consult the most recent label on the PMRA website and/or product registrant for complete information.

Table 3–8. Chestnut and Pecan Calendar

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom						
Leafrollers	**General Comments:** • Leafrollers are generally not a problem on chestnut or pecan and will not often require control. • If needed, apply when larvae have emerged and before they roll up in the leaves. Reapply in 1–2 weeks, if needed. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	83 mL/ha	24 hours	14 days	**Chestnut only.** This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	5	Delegate	210–420 g/ha	12 hours	14 days	Use higher rate under high pest pressure or for larger larvae. Reapply in 14 days if needed.
	11	Bioprotec Plus * Dipel 2X DF * or Xentari WG *	1.8–2.5 L/ha 1.12–1.67 kg/ha 0.5–1.6 kg/ha	4 hours	0 days	Product must be consumed to be effective. Spray when and where pests are actively feeding. Apply in a high-volume spray to ensure thorough coverage on both sides of the leaf. Apply to young larvae, early in infestation. Death of insect may take several days. Products have short residual activity and repeat applications may be required. Use dilute spray mixture within 12 hours. For Dipel, use 1.6 kg/ha for large or mature trees.
	18	Intrepid	750 mL/ha	12 hours	14 days	Apply when larvae become active in the spring.
	28	Altacor	145–285 g/ha	12 hours	10 days	Tank-mixing or sequential applications of Exirel with certain fungicides (e.g., copper), oils or other products can cause crop injury. See product label for tank-mix restrictions.
		Exirel	0.5–1.0 L/ha	12 hours	5 days	
		Harvanta 50 SL	1.2–1.6 L/ha	12 hours	30 days	
Aphids	**General Comments:** • Aphids on chestnut and pecan are generally controlled by natural enemies. When controlling other pests, select products with minimal impacts on beneficial insects. • Begin monitoring in mid-spring for young nymphs. If control is required, apply in early stages of aphid infestation for best results. Consider delaying or avoiding sprays if large numbers of predators are active or parasitism is evident in aphid colonies • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Aphids (cont'd)	3	Matador 120 EC or Labamba	104 mL/ha	24 hours	14 days	**Chestnut only.** This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	4C	Closer	100–200 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects.
	4D	Sivanto Prime	500–750 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are registered on tree nuts).
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.
Leafhoppers	**General Comments:** • Leafhopper damage to chestnut leaves and shoots can be significant in some years, particularly on younger trees. • Monitor for leafhoppers weekly beginning in mid-late spring so populations can be detected early and controls are applied prior to significant leaf damage.					

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Leafhoppers (cont'd)	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Chestnut only. Reduction in damage only.** Begin applications at initial infestation, as determined by monitoring. Repeat at 7–14-day intervals as needed. Use 50 kg/ha for initial application. Adjust rate with subsequent applications, or for larger trees, as per label instructions. Efficacy depends on complete coverage of leaves and fruit. Light rain will help distribute product. Reapply after heavy rain, wind, overhead irrigation or new growth. Creates a white film on plant parts. Stop application once nuts are sizing. Do not use with anti-foaming agents, spreader/stickers or summer oils.
Scale	**General Comments:** • Scale is rarely a problem in chestnuts or pecans. • Monitor scaffold branches and apply when crawlers are active. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	4C	Closer	200–400 mL/ha	12 hours	7 days	**San Jose scale only.** Where possible, rotate with insecticides outside of Group 4 between generations. Toxic to certain beneficial insects.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are registered on tree nuts).
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Mites	**General Comments:** • Both two-spotted spider mite and European red mite will feed on chestnut. However, plants can tolerate some damage without significantly affecting yield or crop health. • Control may not always be required, particularly when populations of predatory mites are high. If required, apply when mites are active on foliage. • For resistance management, apply only when needed and avoid using more than once per season.					
	20B	Kanemite 15 SC	2.07 L/ha	12 hours	14 days	For resistance management, maximum of 1 application per season.
	20D	Acramite 50 WS	568 g/ha	12 hours	14 days	Rate controls two-spotted spider mite. If European red mite is present, apply 851 g/ha. Maximum of 1 application per season.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of susceptible, soft-bodied insects to be effective. Good coverage of all sides of plant parts is critical. Applying soaps more than 3 times may cause plant injury. See label for more information. Avoid application in direct sunlight. Use caution when applying to new seedlings or blooms. Do not apply when plants are under stress. Application within 3 days of sulphur may increase plant injury on sensitive plants (note: no sulphur products are registered on tree nuts).
		Purespray Green Spray Oil 13 E *	10 L/1,000 L water	12 hours	—	**Chestnut only. Suppression only. Spider mites only.** Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of using sulphur (note: no sulphur products are currently registered on tree nuts). See label for compatibility with other products.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Prebloom (cont'd)						
Mites (cont'd)	NC (cont'd)	Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all nut varieties. Test a small area of each variety prior to spraying the whole block. Do not apply within 48 hours of freezing temperatures, when temperatures are high (above 30°C), prior to rain or to heat- or moisture-stressed trees. Do not use within 14 days of copper or 30 days of sulphur (note: no sulphur products are currently registered on tree nuts). Do not apply to wet foliage. Avoid application during bloom.
Dogwood borer	NC	Isomate DWB	250–375 dispensers/ha	—	—	Dogwood borer is not commonly a pest of tree nuts. Apply where there is a history of infestation. Reduces mating of dogwood borer. Apply before adult borer emergence (end of May). Use high rate for high-pressure areas or initial year of treatment. For more information on mating disruption, see OMAFRA Factsheet 03–079, *Mating Disruption for Management of Insect Pests.*
First pistillate flower						
INSECTICIDES MAY BE VERY TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1						
Butternut curculio	**General Comments:** • Butternut curculio is not a common pest of pecan.					
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Pecan only. Reduction in damage only.** Apply when visual inspection shows adult feeding and egg-laying scars on new flower shoots. Repeat at 7-day intervals as needed to keep nuts covered during egg laying period. Use 50 kg/ha for initial application. Adjust rate with subsequent applications, or for larger trees, as per label instructions. Efficacy depends on complete coverage of leaves and fruit. Light rain will help distribute product. Reapply after heavy rain, wind, overhead irrigation or new growth. Creates a white film on plant parts. Stop application once nuts are sizing. Do not use with anti-foaming agents, spreader/stickers or summer oils.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
First pistillate flower (cont'd)						
INSECTICIDES MAY BE VERY TOXIC TO BEES. DO NOT SPRAY WHEN BEES ARE WORKING. SPRAY IN THE EVENING. SEE *BEE POISONING*, Chapter 1						
Aphids	**General Comments:** • Aphids on chestnut and pecan are generally controlled by natural enemies. When controlling other pests, select products with minimal impacts on beneficial insects. • Begin monitoring in mid-spring for young nymphs. If control is required, apply in early stages of aphid infestation for best results. Consider delaying or avoiding sprays if large numbers of predators are active or parasitism is evident in aphid colonies • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Aphids in **Prebloom.**
Leafhoppers	Use one of the products listed for Leafhoppers at Prebloom. Leafhopper feeding can do significant damage to chestnut leaves and shoots, particularly on younger trees. Monitor for leafhoppers weekly beginning in mid-late spring so populations can be detected early and controls are applied prior to significant leaf damage.					
Scale	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Scale in **Prebloom.** Scale is rarely a problem in chestnuts or pecans.
Summer sprays						
Leafroller	**General Comments:** • Leafrollers are generally not a problem on chestnut or pecan and will not often require control. • If needed, apply when larvae have emerged and before they roll up in the leaves. Reapply in 1–2 weeks, if needed. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	83 mL/ha	24 hours	14 days	**Chestnut only.** This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	5	Delegate	210–420 g/ha	12 hours	14 days	Use higher rate under high pest pressure or for larger larvae. Reapply in 14 days if needed.
	11	Bioprotec Plus * Dipel 2X DF * or Xentari WG *	1.8–2.5 L/ha 1.12–1.67 kg/ha 0.5–1.6 kg/ha	4 hours	0 days	Product must be consumed to be effective. Spray when and where pests are actively feeding. Apply in a high-volume spray to ensure thorough coverage on both sides of the leaf. Apply to young larvae, early in infestation. Death of insect may take several days. Products have short residual activity and repeat applications may be required. Use dilute spray mixture within 12 hours. For Dipel, use 1.6 kg/ha for large or mature trees.
	18	Intrepid	750 mL/ha	12 hours	14 days	Apply when larvae become active in the spring.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Leafroller (cont'd)	28	Altacor	145–285 g/ha	12 hours	10 days	**For Vayego, use postbloom only.** Tank-mixing or sequential applications of Exirel with certain fungicides (e.g., copper), oils or other products can cause crop injury. See product label for tank-mix restrictions.
		Exirel	0.5–1.0 L/ha	12 hours	5 days	
		Harvanta 50 SL	1.2–1.6 L/ha	12 hours	30 days	
		Vayego 200 SC	225 mL/ha	12 hours	10 days	
Aphids	**General Comments:** • Aphids on chestnut and pecan are generally controlled by natural enemies. When controlling other pests, select products with minimal impacts on beneficial insects. • Begin monitoring in mid-spring for young nymphs. If control is required, apply in early stages of aphid infestation for best results. Consider delaying or avoiding sprays if large numbers of predators are active or parasitism is evident in aphid colonies • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	3	Matador 120 EC or Labamba	104 mL/ha	24 hours	14 days	**Chestnut only.** This group is highly toxic to beneficial insects and may lead to mite outbreaks. Maximum of 1 application per season.
	4A	Admire 240 Flowable	230 mL/ha	24 hours	7 days	**Pecan only. Use postbloom only.** Maximum of 2 applications of Group 4A insecticides per season. Repeated use may cause mite outbreaks.
	4C	Closer	100–200 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects.
	4D	Sivanto Prime	500–750 mL/ha	12 hours	7 days	Where possible, rotate with insecticides outside of Group 4. Toxic to certain beneficial insects.
	23	Movento 240 SC	365–435 mL/ha	12 hours	7 days	**Use postbloom only.** Control may not be apparent for 2–3 weeks. Under high pest pressure, reapply 2 weeks later. Tank-mix with an adjuvant/additive that has spreading and penetrating properties at a suggested rate of 0.2% v/v. See label for further details. Do not tank-mix with sulphur (note: no sulphur products are currently registered on tree nuts).
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Aphids in **Prebloom.**
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for this product under Aphids in **Prebloom.**

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Scale	**General Comments:** • Scale is rarely a problem in chestnuts or pecans. • Monitor scaffold branches and apply when crawlers are active. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	4C	Closer	200–400 mL/ha	12 hours	7 days	**San Jose scale only.** Where possible, rotate with insecticides outside of Group 4 between generations. Toxic to certain beneficial insects.
	23	Movento 240 SC	365–585 mL/ha	12 hours	7 days	**For control of San Jose scale, and suppression of Lecanium scale. Use postbloom only.** Control may not be apparent for 2–3 weeks. Under high pest pressure, reapply 2 weeks later. Tank-mix with an adjuvant/ additive that has spreading and penetrating properties at a suggested rate of 0.2% v/v. See label for further details. Do not tank-mix with sulphur (note: no sulphur products are currently registered on tree nuts).
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Scale in Prebloom.
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for this product under Scale in **Prebloom**.
Spider mites	**General Comments:** • Both two-spotted spider mite and European red mite will feed on chestnut. However, plants can tolerate some damage without significantly affecting yield or crop health. • Control may not always be required, particularly when populations of predatory mites are high. If required, apply when mites are active on foliage.					
	20B	Kanemite 15 SC	2.07 L/ha	12 hours	14 days	For resistance management, maximum of 1 application per season
	20D	Acramite 50 WS	568 g/ha	12 hours	14 days	Rate controls two-spotted spider mite. If European red mite is present, apply 851 g/ha. Maximum of 1 application per season.
	23	Envidor 240 SC	750 mL/ha	12 hours	7 days	**Use postbloom only.** Maximum of 1 application per season. Do not use in orchards inter-planted with other crops.
	NC	Kopa * or Opal *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for these products under Spider mites in Prebloom.
		Purespray Green Spray Oil 13 E *	10 L/1,000 L water	12 hours	—	**Chestnut only. Suppression only. Spider mites only.** See comments for this product under Mites in Prebloom.
		Vegol Crop Oil *	2% v/v in 700–1,900 L water/ha	12 hours	0 days	See comments for this product under Spider mites in **Prebloom**.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Leafhoppers	**General Comments:** • Leafhopper damage to chestnut leaves and shoots can be significant in some years, particularly on younger trees. • Monitor for leafhoppers weekly beginning in mid-late spring so populations can be detected early and controls are applied prior to significant leaf damage. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	4A	Admire 240 Flowable	200 mL/ha	24 hours	7 days	**Pecan only. Suppression only. Use postbloom only.** Maximum of 2 applications of Group 4A insecticides per season. Repeated use may cause mite outbreaks.
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Chestnut only. Reduction in damage only.** See comments for this product under Leafhoppers in Prebloom.
Butternut curculio	**General Comments:** • Butternut curculio is rarely a problem in pecan and chestnut in Ontario. • Some of these products are toxic to bees. Do not apply when bees are active on flowering weeds or other crops in the treatment area. Refer to label for specific bee toxicity statements.					
	5	Delegate	420 g/ha	12 hours	14 days	**Suppression only.** Apply at first sign of feeding damage after bloom. Reapply 14 days later depending on pest pressure.
	NC	Surround WP *	25–50 kg/ha	12 hours	0 days	**Pecan only. Reduction in damage only.** Begin applications at initial infestation, as determined by monitoring. Repeat at 7–14-day intervals as needed. Use 50 kg/ha for initial application. Adjust rate with subsequent applications, or for larger trees, as per label instructions. Efficacy depends on complete coverage of leaves and fruit. Light rain will help distribute product. Reapply after heavy rain, wind, overhead irrigation or new growth. Creates a white film on plant parts. Stop application once nuts are sizing. Do not use with anti-foaming agents, spreader/stickers or summer oils.
Chestnut weevil	5	Delegate	420 g/ha	12 hours	14 days	**Chestnut only. Suppression only.** Apply when adults first appear in traps or at the first sign of adult feeding damage. Repeat 14 days later depending on pest pressure.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–8. Chestnut and Pecan Calendar (cont'd)

Disease or Insect Group	Group	Product	Rate	Restricted Entry Interval (REI)	Preharvest Interval (PHI)	Product Specific Comments
Summer sprays (cont'd)						
Botrytis grey mould	7	Fontelis	1.0–1.5 L/ha	12 hours	14 days	**Chestnut only.** Botrytis is not a common problem on chestnuts. Apply only if there has been a history of disease. Begin application prior to disease. Contains mineral oil in the formulation. Tank-mixing or rotating with oil-sensitive products may cause crop safety issues. See label for tank-mix restrictions.
Brown Rot, Alternaria leaf spot	3	Cevya	0.25-0.375 L/ha	12 hours	14 days	**Suppression only. Chestnut only.** Brown rot and Alternaria are not normally a problem in Ontario chestnuts. In orchards where these diseases have been a problem in the past, apply when conditions are conducive to disease development.
	7	Fontelis	1.0–1.5 L/ha	12 hours	14 days	**Control of brown rot, suppression only of Alternaria. Chestnut only.** Brown rot and Alternaria are not normally a problem in Ontario chestnuts. In orchards where these diseases have been a problem in the past, apply when conditions are conducive to disease development. Contains mineral oil in the formulation. Tank-mixing or rotating with oil-sensitive products may cause crop safety issues. See label for tank-mix restrictions.

— = Information not applicable or not specified on product label. * = Potentially organic. Check with certifying body.

Table 3–9. Products Used on Chestnuts and Pecan

Use this table as a guide but refer to product label for specific information.

The preharvest interval (PHI) is the number of days between the last spray and first harvest.

The restricted entry interval (REI) is the minimum interval that must be observed between application of the pesticide and work in the treated crop without protective equipment. If no re-entry period is stated on the label, assume it is 12 hours. Where the REI exceeds the PHI, follow the REI.

The maximum number of applications is the labelled maximum number for the growing season and may be higher than what is recommended for resistance management or for the preservation of beneficial insects.

Products with a check mark may be acceptable for organic use based on the publication *Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ). Réseau d'avertissements phytosanitaires. 2020. RAP - Réseau* Général. *Bulletin D'Information No. 1, Special phytoprotection bio. 18 juin 2020* or a letter of certification provided by the registrant. Check with certifying body to verify the acceptability of any product prior to using it.

Product Name	Registration Number	Common Name	Group	Preharvest Interval (PHI)	Restricted Entry Interval (REI)	Maximum Applications	Potentially Organic
Products for insect control or suppression							
Acramite 50 WS	27925	bifenazate	20D	14 days	12 hours	1	—
Admire 240 Flowable *(pecan only)*	24094	imidacloprid	4A	7 days	24 hours	2	—
Altacor	28981	chlorantraniliprole	28	10 days	12 hours	3 (max. 645 g/ha)	—
Bioprotec Plus	32425	*Bacillus thuringiensis*	11	0 days	4hours	—	✓
Closer	30826	sulfoxaflor	4C	7 days	12 hours	2	—
Danitol	33817	fenpropathrin	3	3 days[1]	24 hours[2]/7 days[3]/3 days[1]	1	—
Delegate	28778	spinetoram	5	14 days	12 hours	3	—
Dipel 2X DF	26508	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Envidor 240 SC	28051	spirodiclofen	23	7 days	12 hours	1	—
Exirel	30895	cyantraniliprole	28	5 days	12 hours	4	—
Harvanta 50 SL	32889	cyclaniliprole	28	30 days	12 hours	3 (max 4.8 L/ha)	—
Intrepid	27786	methoxyfenozide	18	14 days	12 hours	max. 2 L/ha	—
Isomate DWB	30589	pheromone, dogwood borer	NC	—	—	—	—
Kanemite 15 SC	28641	acequinocyl	20B	14 days	12 hours	2 (max 4.1 L/ha)	—
Kopa	31433	potassium salts of fatty acids	NC	0 days	12 hours	3[4]	✓
Labamba *(chestnut only)*	33576	lambda-cyhalothrin	3	14 days	24 hours	max 390 mL/ha	—
Matador 120 EC *(chestnut only)*	24984	lambda-cyhalothrin	3	14 days	24 hours	max. 390 mL/ha	—

M = Multi-site fungicides. NC = Not classified by FRAC/IRAC, or group not indicated on product label.

— = Information is not specified on the product label. ✓ = Potentially organic. Check with certifying body.

[1] Mechanical harvest. Contact registrant for information on hand harvest PHI and REI. [2] General re-entry. [3] Scouting activities, hand pruning.

[4] Maximum of 3 consecutive applications to ensure plant injury does not occur. Additional applications may be possible if previous experience with repeat applications of the product under the same conditions have not produced plant injury. [5] Maximum 2 dormant and 4 summer applications per year.

Table 3–9. Products Used on Chestnuts and Pecan (cont'd)

Product Name	Registration Number	Common Name	Group	Preharvest Interval (PHI)	Restricted Entry Interval (REI)	Maximum Applications	Potentially Organic
Products for insect control or suppression (cont'd)							
Movento 240 SC	28953	spirotetramat	23	7 days	12 hours	max. 1.58 L/ha	—
Opal	28146	potassium salts of fatty acids	NC	0 days	12 hours	3[4]	✓
Purespray Green Spray Oil 13 E *(chestnut only)*	27666	mineral oil	NC	—	12 hours	8	✓
Sivanto Prime	31452	flupyradifurone	4D	7 days	12 hours	max. 2 L/ha	—
Surround WP	27469	kaolin	NC	0 days	12 hours	—	✓
Vegol Crop Oil	32408	canola oil	NC	0 days	12 hours	2/4[5]	✓
Vayego 200 SC	33711	tetraniliprole	28	10 days	12 hours	4	—
Xentari WG	31557	*Bacillus thuringiensis*	11	0 days	4 hours	—	✓
Products for disease control or suppression							
Cevya *(chestnut only)*	33405	mefentrifluconazole	3	14 days	12 hours	max. 1.125 L/ha	—
Fontelis *(chestnut only)*	30331	penthiopyrad	7	14 days	12 hours	max. 4.5 L/ha	—

M = Multi-site fungicides. NC = Not classified by FRAC/IRAC, or group not indicated on product label.
— = Information is not specified on the product label. ✓ = Potentially organic. Check with certifying body.

[1] Mechanical harvest. Contact registrant for information on hand harvest PHI and REI. [2] General re-entry. [3] Scouting activities, hand pruning.
[4] Maximum of 3 consecutive applications to ensure plant injury does not occur. Additional applications may be possible if previous experience with repeat applications of the product under the same conditions have not produced plant injury. [5] Maximum 2 dormant and 4 summer applications per year.

Notes on Chestnut and Pecan Insect Control Products

Use the information in the following notes to assist with choosing the best product for the pest complex present. Consider the life stage present and resistance management strategies, as well as the activity of each product to pests and beneficial insects.

Information in Table 3–10 is based partly on information from other tree fruit in Ontario and the northeastern United States. Impact on these insects in tree nuts is expected to be similar to that of apples. However, differences in production systems, timing of applications and other factors may change efficacy of these products.

Table 3–10. Activity of Insecticides and Miticides on Pecan and Chestnut Pests

Use products only for pests listed on the product label for the crop. The information provided in this table is intended to assist the grower in choosing the best insecticide for control of pests listed on the product label, while managing resistance and avoiding unnecessary sprays for non-target pests. Efficacy can be affected by rate of the product. Some of the products listed below are registered on only pecan or only chestnut. See Chestnut and Pecan Calendar for details.

Insecticide	Japanese beetle	Leafrollers	Potato leafhopper	Weevils[1]	Scale[2]	Spring-feeding caterpillar	Codling Moth	Aphids	Mites	
									European red mite	Two-spotted spider mite
Acramite 50 WS	—	—	—	—	—	—	—	—	C *	C *
Admire 240 Flowable	—	—	S *	—	SC	—	—	C *	—	—
Altacor	SC	C *	—	—	SC	SC	C *	SC	—	—
Bioprotec Plus	—	C *	—	—	—	SC	—	—	—	—
Closer	—	—	SC	—	C *	—	—	C *	—	—
Danitol	SC	SC	SC	SC	—	SC	C *	—	— *	— *
Delegate	—	C *	—	S *	—	SC	C *	—	—	—
Dipel 2X DF	—	C *	—	—	—	SC	SC	—	—	—
Envidor 240 SC	—	—	—	—	—	—	—	—	C *	C *
Exirel	SC	C *	SC	SC	—	SC	C *	SC	—	—
Harvanta 50 SL	SC	C *	—	SC	—	SC	C *	—	—	—

C = Control S = Suppression RD = Reduction in numbers or damage SC = Some control of this pest may be expected when the product is applied against labelled pests under certain conditions
— = Not registered for control of this pest, or activity on this pest has not been documented * (shaded area) = Pest is listed on the product label for control or suppression.

[1] Efficacy based on plum curculio in Ontario apples. Impact on butternut curculio and chestnut weevil should be similar but may vary between the two cropping systems.
[2] Products may not be labelled on all scale species affecting chestnut and/or pecan. Check product label for labelled pests.
[3] Suppression of Lecanium scale but control of San Jose scale
[4] Labelled for leafhopper on chestnuts only
[5] Labelled for butternut curculio on pecans only

Ratings are based on moderate insect or mite pressure. Efficacy may be affected by rate of insecticide, coverage, timing, product residual and pest resistance, if present. Products must be applied at timings and rates specfied on the product label for each pest.
Source: Efficacy based mainly on northeastern apple pests in OMAFRA P*ublication 360A. Apple Crop Protection Guide, 2021, Cornell Pest Management Guidelines for Tree Fruit and Pennsylvania Tree Fruit Production Guide.* Efficacy in tree nuts is expected to be similar to that of apples, however differences in production systems, timing of applications and other factors may change efficacy of these products.

Table 3–10. Activity of Insecticides and Miticides on Pecan and Chestnut Pests (cont'd)

Insecticide	Japanese beetle	Leafrollers	Potato leafhopper	Weevils[1]	Scale[2]	Spring-feeding caterpillar	Codling Moth	Aphids	Mites	
									European red mite	Two-spotted spider mite
Kanemite 15 SC	—	—	—	—	—	—	—	—	SC	C *
Kopa	—	—	—	—	C *	—	—	C *	C *	C *
Labamba	SC	C *	SC	SC	SC	SC	SC	C *	—	—
Matador 120 EC	SC	C *	SC	SC	SC	SC	SC	C *	—	—
Movento 240 SC	—	—	—	—	S *[3]	—	—	C *	—	—
Opal	—	—	—	—	C *	—	—	C *	C *	C *
Purespray Green Spray Oil 13 E (summer)	—	—	—	—	SC	—	—	SC	—	S *
Sivanto Prime	—	—	SC	—	SC	—	—	C *	—	—
Surround WP	—	SC	RD *[4]	RD *[5]	SC	SC	SC	—	SC	—
Vayego 200 SC	—	C *	—	SC	—	SC	C *	S *	—	—
Vegol Crop Oil	—	—	—	—	C *	—	—	C *	C *	C *
Xentari WG	—	C *	—	—	—	SC	SC	—	—	—

C = Control S = Suppression RD = Reduction in numbers or damage SC = Some control of this pest may be expected when the product is applied against labelled pests under certain conditions
— = Not registered for control of this pest, or activity on this pest has not been documented * (shaded area) = Pest is listed on the product label for control or suppression.

[1] Efficacy based on plum curculio in Ontario apples. Impact on butternut curculio and chestnut weevil should be similar but may vary between the two cropping systems.
[2] Products may not be labelled on all scale species affecting chestnut and/or pecan. Check product label for labelled pests.
[3] Suppression of Lecanium scale but control of San Jose scale
[4] Labelled for leafhopper on chestnuts only
[5] Labelled for butternut curculio on pecans only

Ratings are based on moderate insect or mite pressure. Efficacy may be affected by rate of insecticide, coverage, timing, product residual and pest resistance, if present. Products must be applied at timings and rates specfied on the product label for each pest.
Source: Efficacy based mainly on northeastern apple pests in OMAFRA P*ublication 360A. Apple Crop Protection Guide, 2021, Cornell Pest Management Guidelines for Tree Fruit and Pennsylvania Tree Fruit Production Guide.* Efficacy in tree nuts is expected to be similar to that of apples, however differences in production systems, timing of applications and other factors may change efficacy of these products.

Toxicity of Tree Nut Pest Control Products to Beneficial Insects

Use the information in the following notes to assist with choosing the products with the least impact on beneficial insects in the orchard. For more information on impact of pest control products on honey bees see the boxes on *Bee Toxicity* in this chapter and *Bee Poisoning*, Chapter 1

Information in Table 3–11 on impacts on mite/aphid predators is based partly on information from other tree fruit in Ontario and the northeastern United States.

In this section:

Table 3–11. Toxicity of Pesticides to Honeybees and Mite/Aphid Predators

Table 3–11. Toxicity of Pesticides to Honeybees and Mite/Aphid Predators

Product	Honeybees[1]	*Stethorus* (spider mite destroyer)	Predatory mites		*Aphidoletes* (Aphid midge)	Ladybugs	Minute pirate bugs	Lacewings	Fly and wasp parasitoids
			Typhlodromus pyri	*Amblyseius fallacis*					
Insecticides									
Admire 240 Flowable	VT	MT	ST	ST	ST	MT	MT	MT	MT
Altacor	NT	NT	NT	NT	NT	NT	NT	NT	NT
Bioprotec Plus	NT	NT	NT	NT	NT	NT	NT	NT	NT
Closer	VT	VT	ST	ST	MT	MT	MT	MT	VT
Cygon 480 AG	VT	MT	VT	VT	VT	—	—	—	—
Danitol	VT	VT	VT	VT	VT	VT	VT	VT	VT
Delegate	VT	ST	MT	MT	ST	ST	ST	ST	MT
Dipel 2X DF	NT	NT	NT	NT	NT	NT	NT	NT	NT
Entrust	VT	ST	ST	ST	ST	NT	NT	NT	ST
Exirel	VT	MT	ST	ST	ST	MT	ST	ST	MT
GF-120 Fruit Fly Bait	VT	NT	ST	ST	NT	NT	NT	NT	ST
Harvanta 50 SL	VT	—	—	—	—	—	—	—	—
Intrepid	NT	NT	NT	NT	NT	NT	NT	NT	NT
Labamba	VT	VT	VT	VT	VT	VT	VT	VT	VT
Lagon 480 E	VT	MT	VT	VT	VT	—	—	—	—
Matador 120 EC	VT	VT	VT	VT	VT	VT	VT	VT	VT
Movento 240 SC	VT[2]	ST	NT	NT	ST	ST	ST	ST	—
Sharphos	VT	MT	MT	MT	—	—	—	—	—
Sivanto Prime	MT	ST	NT	NT	ST	—	—	—	—
Surround WP	I[3]	MT	MT	MT	MT	MT	—	ST	MT
Warhawk 480 EC	VT	MT	MT	MT	—	—	—	—	—
Vayego 200 SC	VT	—	—	—	—	—	—	—	—
Versys	MT	—	—	—	—	—	—	—	—
Xentari WG	NT	NT	NT	NT	NT	NT	NT	NT	NT

NT = Non toxic. ST = Slightly toxic. MT = Moderately toxic. VT = Very toxic. I = Irritant. — = No information is available. Consult label or manufacturer for more information.

[1] Source: PMRA Environmental Assessment Division. For more detailed information on the toxicity of specific pesticides to honeybees, refer to the pesticide label.
[2] May be toxic to bee colonies exposed to direct treatment, drift or residues on flowering crops or weeds.
[3] White film barrier on plant tissue may act as a repellent to bees if used during bloom.

Only registered products with toxicity data available are listed in this table. Consult label or manufacturer for more information.
Adapted from *Cornell Pest Management Guidelines for Tree Fruit* and the *Pennsylvania Tree Fruit Production Guide* information on products registered on other tree fruit.

Table 3–11. Toxicity of Pesticides to Honeybees and Mite/Aphid Predators (cont'd)

Product	Honeybees[1]	*Stethorus* (spider mite destroyer)	Predatory mites		*Aphidoletes* (Aphid midge)	Ladybugs	Minute pirate bugs	Lacewings	Fly and wasp parasitoids
			Typhlodromus pyri	*Amblyseius fallacis*					
Miticides									
Acramite 50 WS	MT	NT	MT	MT	ST	NT	NT	NT	—
Envidor 240 SC	MT	MT	NT	NT	—	—	—	—	—
Kanemite 15 SC	NT	ST	ST	ST	—	—	—	—	—
Kopa	NT	ST	MT	MT	ST	ST	ST	ST	—
Purespray Green Spray Oil 13 E	NT	ST	MT	MT	ST	ST	ST	ST	—
Vegol Crop Oil	NT	ST	MT	MT	ST	ST	ST	ST	—
Fungicides									
Azoshy 250 SC	NT	ST	NT	NT	—	—	—	—	—
Copper Spray	NT	—	—	—	—	—	—	—	—
Cueva	NT	—	—	—	—	—	—	—	—
Flint	ST	ST	NT	NT	—	—	—	—	—
Fontelis	NT	—	—	—	—	—	—	—	—
Kasumin	NT	—	—	—	—	—	—	—	—
Miravis Duo	—	—	—	—	—	—	—	—	—
Parasol Flowable	NT	—	—	—	—	—	—	—	—
Quadris Flowable	NT	ST	NT	NT	—	—	—	—	—

NT = Non toxic. ST = Slightly toxic. MT = Moderately toxic. VT = Very toxic. I = Irritant. — = No information is available. Consult label or manufacturer for more information.

[1] Source: PMRA Environmental Assessment Division. For more detailed information on the toxicity of specific pesticides to honeybees, refer to the pesticide label.
[2] May be toxic to bee colonies exposed to direct treatment, drift or residues on flowering crops or weeds.
[3] White film barrier on plant tissue may act as a repellent to bees if used during bloom.

Only registered products with toxicity data available are listed in this table. Consult label or manufacturer for more information.
Adapted from *Cornell Pest Management Guidelines for Tree Fruit* and the *Pennsylvania Tree Fruit Production Guide* information on products registered on other tree fruit.

Soilborne Pathogens and Fumigants for Tree Fruit

Soil fumigants are applied to control soil-borne pests of horticultural and other crops, including plant parasitic nematodes, weeds and plant pathogens. They must be applied prior to planting, and because of the cost and effort involved in their application they are generally only used in fields where soilborne pests are expected to be a significant problem in the crop. Preplant fumigation is not a common practice for tree nuts in Ontario since soilborne pathogens and nematodes are only sporadic, patchy problems. The most common reason that fumigants are applied in other tree fruit crops in Ontario is to manage nematodes and replant disease, which is very common when perennial crops are re-planted in the same location. Because tree nuts are relatively new in Ontario, it is not yet known whether these pests will be problematic or if fumigation will be necessary.

Replant Disease in Perennial Crops

When removing a crop, soil pathogens with wide host ranges (e.g. *Phytophthora, Rhizoctonia, Fusarium, Pythium*) can carry over to a subsequent crop. Growers must always be aware of this potential when planting into a field that had high levels of disease the previous season, although typically crop rotation reduces the impact. However, many perennial crops have a specific condition called replant disease which only occurs when the same crop species is grown twice on the same land, even if a different crop was grown in between. Replant disease is characterized by poor establishment or reduced productivity, likely as a result of weakening of the host crop by a complex of soil factors. Because it is crop-specific, replant disease of one crop species does not appear to affect other crop species grown on the same land.

In Ontario, replant disease is a known problem for apple and tender fruit. Replant has not yet been reported in Ontario tree nuts. However, they are a perennial crop so nut growers should be aware of the causes and symptoms in other tree fruit prior to replanting a tree nut orchard in the same location. There is no information on causes, incidence and management of replant disease for Ontario tree nuts. The following information comes from experience with apples and tender fruit in Ontario and can serve as a guide to tree nut growers, however may not always be directly applicable to their production systems.

Although thought to occur in sites replanted after removing very old fruit trees, replant disease has been documented to occur within three years of establishing an apple orchard on new ground. The causes and symptoms of replant disease vary from region to region and even from site to site. Biological factors play a major role in this disorder.

Symptoms of replant disease on affected trees include:

- stunting of the tree with short internodes
- small and light green rosette leaves
- small root systems and decayed or discoloured roots
- few new lateral or feeder roots are produced
- affected trees leaf out in the spring but often produce little or no shoot growth
- severe disease results in the death of young trees and entire orchards
- trees in orchards not killed by replant disease often bear fruit two to three years later than healthy trees and rarely attain comparable yields.

The causes and symptoms of apple replant disorder vary from region to region and even from site to site. While not well understood, apple research suggests that biological factors play a major role in this disorder including

a complex of several fungal pathogens (*Cylindrocarpon, Phytophthora, Pythium* spp. and *Rhizoctonia*), bacteria and parasitic nematodes. In addition to biological factors, soil pH, moisture stress (too much and too little), soil compaction, toxins, soil structure, heavy metals and insufficient availability of nutrients (particularly phosphorous) are also implicated as contributing factors to replant disorder. However, research showing dramatic tree growth in response to soil pasteurization and fumigation suggests this disorder is primarily a biological phenomenon.

Prevention of replant problems is much easier and more successful than control. There is very little that can be done to correct replant problems once the trees are planted. The causes of replant disease on different sites are highly variable. Not all soils respond in the same way to the various pre-plant treatments, and a treatment that is beneficial in one orchard may have no effect in another. Cultural practices to avoid replant disease in apples include:

- avoiding planting on the same ground where an old apple orchard has recently been removed
- rotating out of pome fruit for several years (two to eight years)
- ensuring new trees have adequate nutrition and irrigation
- planting nematode-suppressive cover crops prior to establishing a new orchard
- staggering planting rows to avoid planting directly in old tree sites
- use of pre-plant soil fumigants.

While replant is not well documented in tree nuts in any location and has not been observed in Ontario tree nuts, it is a possibility for any perennial crop. Tree nut growers should be aware of the symptoms of the condition. If possible, avoid planting new nut trees into the exact location that the same species was recently planted, especially if the older tree was diseased.

Nematodes

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

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

Generally, symptoms of nematode injury include:

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

The impact of nematodes on tree nuts has not been studied in Ontario. However, root-lesion nematodes can be a major cause of orchard replant failures and are a significant factor in Apple Replant Disorder (ARD). They can also cause a decline in vigour of existing peach and cherry orchards. These nematodes cause small brown lesions on the white lateral roots and kill the fine feeder roots. When lesions merge, the entire root system appears discoloured. Root lesions are frequently invaded by other pathogens which can cause root rot. Severely affected trees may lose all feeder roots. Young replant trees may die. Existing trees lack uniformity.

Nematode problems are most often found in sandy-loam and sandy soils. Sample these soils for nematode populations before planting fruit crops. Root-lesion and root-knot nematode problems are not usually found in clay or clay-loam soils. Consider sampling these soils for nematodes before planting in replant sites or where susceptible crops have been recently grown. For more information on how to sample for nematodes, see OMAFRA Factsheet, *Sampling Soil and Roots for Plant Parasitic Nematodes.* Information on how to sample soil for nematodes and where to send the samples can be found in Appendix B: *Diagnostic Services.*

Nematode damage to tree nuts has not been widely reported, so preplant management may not be required for nut crops. For other tree fruit crops where nematode management is required, practices generally start a year before planting to allow clean trees to establish before nematodes populations rebound. Young plants are much less tolerant of nematode feeding than established plants. A combination of the following methods to manage nematodes can be used:

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

Soil Fumigation for Fruit Trees

It is not yet known whether fumigants will be required for tree nuts. The following section outlines fumigation requirements for all tree fruit. Fumigants can be broadcast over the whole field or applied only in bands where crop will be planted. Tree-row application, or the treatment of a 2.0–2.5 m strip centred on the row, is more economical but requires good planning. However, broadcast fumigation will reduce the risk of re-contamination if non-fumigated soil is mixed into the fumigated strip.

For products, rates and other information on fumigants, refer to Table 4–1. *Products for Management of Nematodes and Other Soil-borne Pests.*

Application of Fumigants Before Planting

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

- Fumigate when soil temperatures are above 4°C at 20 cm depth. Warmer temperatures (15°C and over) are preferred for more rapid fumigant dispersal in the soil. Fumigation in the early fall before planting is best for fruit crops which are planted in early spring when soils are still cool.
- Land preparation is critical for effective fumigant application. Fumigants cannot easily penetrate large clumps of soil and organic matter. Remove trash and old root systems. One week prior to fumigation, work the soil to a depth of 25–30 cm and obtain good seedbed tilth and moisture. Keep soil moist and, if necessary, irrigate the treated area during the week prior to fumigation. A light cultivation immediately before fumigation may be necessary if a soil crust has developed.
- Soil moisture in the top 15–20 cm must be at the level stipulated by the fumigant label prior to and during fumigation. If soil moisture is not sufficient, it must be adjusted before product application can occur. For best results, keep the soil surface moist during application and for 24 hours after application.
- Seal the soil surface immediately after injection of the fumigant. The best method for sealing the soil is covering it with tarps, however, rolling or cultipacking immediately behind the fumigant applicator can also be used. Some fumigants have specific requirements for sealing the soil. Consult product labels to determine what is legally permissible for the fumigant and type of application. Light watering after application will further prevent the escape of fumigant from the soil.

- Leave soil undisturbed for at least 1 week after injection of the fumigant. Colder soils (below 15°C) require longer periods from injection to aeration.
- Work the soil and aerate for about a week before planting. For fall planting, work the soil and aerate for 2 weeks before planting. The time interval between fumigation and planting into fumigated soil depends upon the product used, the rate and the temperature following fumigation (consult product label).
- Use high-quality planting stock, preferably grown in fumigated soil. Nursery operators can provide information on how to manage nematodes.
- Always read the product label. All fumigant labels now contain detailed Good Agricultural Practices for soil conditions, sealing, application and re-entry. These are mandatory and must be followed for all fumigant applications.

Fumigating Single-Tree Sites Before Planting Replacement Trees

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

Table 4–1. Products for Management of Nematodes and Other Soil-borne Pests

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

Product	Active Ingredient	Pests Controlled/Suppressed[1]			Rates (shank injection or surface applied)
		Nematodes	Soil-borne Diseases	Weeds	
Busan 1020	metam sodium 33%	yes	yes	yes	375–935 L/ha (shank injection)
Busan 1180	metam potassium 54%	yes	yes	yes	231–576 L/ha (shank injection)
Busan 1236	metam sodium 42%	yes	yes	yes	274–683 L/ha (shank injection)
Enfuse M 510	metam sodium 42%	yes	yes	yes	260 L/ha (surface applied)
MustGrow	oriental mustard seed meal 100%	yes[2]	no[3]	no	1,121–2,240 kg/ha (surface applied)
Vapam HL	metam sodium 42%	yes	yes	yes	279–696 L/ha (shank injection)

[1] See label for exact registrations. [2] Provides suppression rather than control. [3] Labelled for suppression of soil-borne diseases on other crops but not tree nuts.

Requirements for Fumigants

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

- A Fumigation Management Plan (FMP) must be completed prior to the start of any fumigant application. This is an organized, written description of the steps involved to ensure a safe and effective fumigation. The specific requirements for the FMP will be listed on the product label.
- Mandatory Good Agricultural Practices are now required. This standardizes many practices already on existing labels and helps improve the safety and efficacy of soil fumigations. These practices will vary with the product and application method but will include identifying optimal weather conditions, proper soil preparation, requirements for soil moisture and temperature, methods for soil sealing and use of proper application depths.
- DO NOT apply these products when a temperature inversion is occurring or is predicted to occur within 48 hours after application is complete, as fumigant vapours may drift. For more information on how inversions affect drift of pest control products, see www.sprayers101.com.
- DO NOT apply these products if light wind conditions (less than 3 km/h) are forecast to persist for more than 18 consecutive hours from the time the application starts until 48 hours after the application is complete. Calm conditions could indicate a temperature inversion, which could lead to spray drift. See www.sprayers101.com for more information on temperature inversions.
- Any person involved in the use of fumigants is considered a fumigant handler. All fumigant handlers must hold an appropriate pesticide applicator certificate or license recognized by the provincial pesticide regulatory agency where the pesticide application is to occur.
- Entry into fumigant application blocks by any person (other than fumigant handlers, emergency personnel and local, provincial or federal officials performing inspection, sampling or other official duties) is PROHIBITED during the Application Block Period.
- The Application Block Period begins at the start of application and expires at least 5 days after the application is complete. The length of the period will depend on application criteria (e.g., tarped or non-tarped, etc.). The applicator must verbally warn workers of the application.
- Fumigant application signs must be posted on all entrances to the application block. Signs must be posted prior to the start of the application (but no earlier than 24 hours prior to application) and remain posted for the duration of the Application Block Period. Signs must be removed within 3 days of the end of the Application Block Period.
- Only fumigant handlers with an appropriate pesticide applicator certificate or license recognized by the provincial regulatory agency may be in the application block from the start of the application until the Application Block Period expires, and in the buffer zone during the Buffer Zone Period.

Buffer Zones

- A buffer zone must be established for all fumigant applications. A buffer zone is an area around the perimeter of the fumigated area that extends equally in all directions. The size of the buffer zone area will depend on the product and application criteria.
- Only fumigant handlers with appropriate certification may enter the buffer zone during the Buffer Zone Period, the 48-hour period following application. All non-handlers, including field workers, residents and pedestrians must be excluded from the buffer zone during the Buffer Zone Period, except for transit (e.g., vehicular or bicycle traffic).
- The size of the buffer zone will vary with application method, rate and field size. Product labels will include tables to determine the required buffer zone distance.

- Buffer zones cannot include any residential area or occupied building, outdoor residential areas (e.g., lawns, gardens, play areas) or other areas that may be occupied during the 48-hour period following application.
- An emergency preparedness plan will be required when residences or businesses are located in close proximity to the outer edge of the buffer zone.

APPENDIX A: Additional Resources for Ontario Fruit Growers

Many factsheets, publications and other resources are available from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). These can be ordered from Service Ontario:

- Online at ServiceOntario Publications: ontario.ca/publications
- In person or by appointment at OMAFRA Resource Centres. Many can also be found online at ontario.ca/omafra

OMAFRA Publications

- *Guide to Hazelnut Production in Ontario* – Publication 863 (new publication expected 2021)
- *Growing Strawberries in Ontario* – Publication 513
- *Growing Red Raspberries in Ontario* – Publication 105
- Fruit Crop Protection Guides – Publication *360A Apples,* Publication *360B Berries,* Publication *360C Grapes,* Publication *360D Tender Fruit,* Publication *360E Tree Nuts*
- *Guides to Weed Control* – Publication 75A Field Crops & Publication 75B Hort Crops
- *Integrated Pest Management for Ontario Apples* – Publication 310
- *Predatory Insects in Fruit Orchards* – Publication 208
- *Soil Fertility Handbook* – Publication 611
- *Vegetable Crop Protection Guide* – Publication 838
- *Agronomy Guide for Field Crops* – Publication 811

Websites

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

- OMAFRA gateway to information on crops: ontario.ca/crops
- ONfruit blog: onfruit.ca
- ONspecialtycrops blog: onspecialtycrops.ca
- Spotted wing drosophila: ontario.ca/spottedwing
- Brown marmorated stink bug: ontario.ca/stinkbug
- Ontario CropIPM (integrated pest management) modules: ontario.ca/cropipm
- Specialty Cropportunities to find information on specialty berries and fruit: ontario.ca/crops (search on “cropportunities”)
- Health Canada’s Label Search Tool to find labels for pesticides and products registered for use in Canada: http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php
- Information on pesticide application technology: www.sprayers101.com
- Ontario Pesticide Education Program: www.opep.ca

OMAFRA Factsheets

- *Mating Disruption for Management of Insect Pests*
- *How Weather Conditions Affect Spray Applications*
- *Six Elements of Effective Spraying in Orchards and Vineyards*
- *Calibrating Airblast Sprayers*
- *Adjusting, Maintaining and Cleaning Airblast Sprayers*
- *Pesticide Drift from Ground Applications*

Best Management Practices

The Best Management Practices series of publications presents a practical, affordable approach to conserving a farm’s soil and water resources without sacrificing productivity. For a complete list of books in the BMP series, see: ontario.ca/agbestpractices.

APPENDIX B: Diagnostic Services

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

Agriculture and Food Laboratory
Laboratory Services Division
University of Guelph
95 Stone Road West
Guelph, ON N1H 8J7
Tel: 519-767-6299
Fax: 519-767-6240
Website: www.afl.uoguelph.ca
Email: aflinfo@uoguelph.ca

Payment must accompany samples at the time of submission. Submission forms are available at http://afl.uoguelph.ca/submitting-samples#forms.

To obtain information on the fee schedule, visit www.afl.uoguelph.ca or phone the Pest Diagnostic Clinic.

How to Sample for Nematodes

Soil

When to sample

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

How to sample soil

Use a soil sampling tube, trowel or narrow-bladed shovel to take samples. Sample soil to a depth of 20–25 cm (8–10 in.). If the soil is bare, remove the top 2 cm (1 in.) prior to sampling.

A sample should consist of 10 or more subsamples combined. Mix well, then take a sample of ½–1 L (1 pint–1 qt) from this. No single sample should represent more than 2.5 ha (6.25 acre). Mix subsamples in a clean pail or plastic bag.

Sampling pattern

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

Number of subsamples

Based on the total area sampled:

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

Roots

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

Problem areas

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

Sample Handling

Soil samples

Place in plastic bags as soon as possible after collecting.

Root samples

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

Storage

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

Submitting Plant for Disease Diagnosis or Identification

Sample submission forms

Forms can be obtained from on the Agriculture and Food Laboratory website at https://afl.uoguelph.ca/sites/default/files/pdf/general-submission-form.pdf. Carefully fill in all of the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past three years and this year's pesticide use records.

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

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

Delivery

Deliver to the Agriculture and Food Laboratory as soon as possible by first-class mail or by courier at the beginning of the week.

Submitting Insect Specimens for Identification

Collecting samples

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

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

APPENDIX C: Ontario Ministry of Agriculture, Food and Rural Affairs – Fruit Crop Advisory Staff

Application Technology Specialist	Jason Deveau	Tel: 519-209-1883	jason.deveau@ontario.ca
Crop Protection Specialist	Denise Beaton	Tel: 519-400-3636	denise.beaton@ontario.ca
Entomologist, Horticulture	Hannah Fraser	Tel: 905-708-8014	hannah.fraser@ontario.ca
Fresh Market Quality Specialist	Jennifer R. DeEll	Tel: 519-410-1806	jennifer.deell@ontario.ca
Fruit Crop Specialist (berry)	Erica Pate	Tel: 519-410-0624	erica.pate@ontario.ca
Fruit Crop Specialist (tender fruit, grape)	Kathryn Carter	Tel: 905-687-1280	kathryn.carter@ontario.ca
Horticulture IPM Specialist (pome fruit)	Kristy Grigg-McGuffin	Tel: 519-420-9422	kristy.grigg-mcguffin@ontario.ca
Horticulture IPM Specialist (specialty crops)	Melanie Filotas	Tel: 519-428-4340	melanie.filotas@ontario.ca
Horticulture IPM Specialist (tender fruit, grape)	Wendy McFadden-Smith	Tel: 905-932-8965	wendy.mcfadden-smith@ontario.ca
Horticulture Sustainability Specialist	vacant	—	—
Maple, Tree Nut and Agroforestry Specialist	Jenny Liu	Tel: 519-835-5872	jenny.liu2@ontario.ca
Minor Use Coordinator	Jim Chaput	Tel: 519-546-2482	jim.chaput@ontario.ca
New Crop Development Specialist	Evan Elford	Tel: 519-420-9343	evan.elford@ontario.ca
Pathologist, Horticulture	Katie Goldenhar	Tel: 519-835-5792	katie.goldenhar@ontario.ca
Soil Fertility Specialist, Horticulture	Tejendra Chapagain	Tel: 519-835-5794	tejendra.chapagain@ontario.ca
Soil Management Specialist, Horticulture	Anne Verhallen	Tel: 519-359-6707	anne.verhallen@ontario.ca
Surveillance Coordinator & Data Analyst	Cora Loucks	Tel: 519-546-8245	cora.loucks@ontario.ca
Tree Fruit Specialist	Erika DeBrouwer	Tel: 226-931-4098	erika.debrouwer@ontario.ca
Weed Management Specialist, Horticulture	Kristen Obeid	Tel: 519-965-0107	kristen.obeid@ontario.ca
A complete list of Ontario Ministry of Agriculture, Food and Rural Affairs crop advisory staff is available on the OMAFRA website at 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 Rd. W., Guelph, ON N1G 4Y2
Tel: 1-877-424-1300
Fax: 519-826-3442
Email: ag.info.omafra@ontario.ca

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

In case of pesticide drift concern, contact the Ministry of the Environment, Conservation and Parks' local District or Area office. The local District Office contact information can be found from the Info Go website at http://www.infogo.gov.on.ca/infogo/home.html#orgProfile/-270/en.

After business hours, please contact the Pollution Hotline at 1-866-MOE-TIPS (1-866-663-8477).

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)	=	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)
(0.5 kg) 500 g	=	500 mL (0.5 L)
(0.1 kg) 100 g	=	100 mL (0.1 L)
(0.01 kg) 10 g	=	10 mL (0.01 L)
(0.001 kg) 1 g	=	1 mL (0.001 L)

Weight Measures

1,000 milligrams (mg)	=	1 gram (g)
1,000 g	=	1 kilogram (kg)
1,000 kg	=	1 tonne (t)
1 mg/kg	=	1 part per million (ppm)

Dry–Liquid Equivalents

1 cm^3	=	1 mL
1 m^3	=	1,000 L

Approximate Metric Conversions

5 mL	=	1 tsp
15 mL	=	1 tbsp
28.5 mL	=	1 Imp. fl. oz.

Application Rate Conversions

Metric to Imperial or U.S. (approximate)

litres per hectare × 0.09	=	Imp. gallons per acre
litres per hectare × 0.11	=	U.S. gallons per acre
litres per hectare × 0.36	=	Imp. quarts per acre
litres per hectare × 0.43	=	U.S. quarts per acre
litres per hectare × 0.71	=	Imp. pints per acre
litres per hectare × 0.86	=	U.S. pints per acre
millilitres per hectare × 0.014	=	U.S. fluid ounces per acre
grams per hectare × 0.014	=	ounces per acre
kilograms per hectare × 0.89	=	pounds per acre
tonnes per hectare × 0.45	=	tons per acre

Imperial or U.S. to Metric (approximate)

Imp. gallons per acre × 11.23	=	litres per hectare (L/ha)
U.S. gallons per acre × 9.35	=	litres per hectare (L/ha)
Imp. quarts per acre × 2.8	=	litres per hectare (L/ha)
U.S. quarts per acre × 2.34	=	litres per hectare (L/ha)
Imp. pints per acre × 1.4	=	litres per hectare (L/ha)
U.S. pints per acre × 1.17	=	litres per hectare (L/ha)
Imp. fluid ounces per acre × 70	=	millilitres per hectare (mL/ha)
U.S. fluid ounces per acre × 73	=	millilitres per hectare (mL/ha)
tons per acre × 2.24	=	tonnes per hectare (t/ha)
pounds per acre × 1.12	=	kilograms per hectare (kg/ha)
pounds per acre × 0.45	=	kilograms per acre (kg/acre)
ounces per acre × 70	=	grams per hectare (g/ha)

Liquid Equivalents

LITRES/HECTARE		APPROXIMATE GALLONS/ACRE	
IMPERIAL GALLONS			U.S. GALLONS
50	=	4.45	5.35
100	=	8.9	10.7
150	=	13.53	16.05
200	=	17.8	21.4
250	=	22.25	26.75
300	=	26.7	32.1

Approximate Dry Weight Equivalents

GRAMS/HECTARE		OUNCES/ACRE
100	=	1 ½
200	=	3
300	=	4 ¼
500	=	7
700	=	10

KILOGRAMS/HECTARE		POUNDS/ACRE
1.10	=	1
1.50	=	1 ¼
2.00	=	1 ¾
2.50	=	2 ¼
3.25	=	3
4.00	=	3 ½
5.00	=	4 ½
6.00	=	5 ¼
7.50	=	6 ¾
9.00	=	8
11.00	=	10
13.00	=	11 ½
15.0	=	13 ½

Handy Metric Conversion Factor

litres per hectare × 0.4 = litres per acre
kilograms per hectare × 0.4 = kilograms per acre

Conversion Table – Metric to Imperial (approximate)

Length

1 millimetre (mm)	=	0.04 inch
1 centimetre (cm)	=	0.4 inch
1 metre (m)	=	39.4 inches
1 metre (m)	=	3.28 feet
1 metre (m)	=	1.09 yards
1 kilometre (km)	=	0.62 mile

Area

1 square centimetre (cm^2)	=	0.16 square inch
1 square metre (m^2)	=	10.77 square feet
1 square metre (m^2)	=	1.2 square yards
1 square kilometre (km^2)	=	0.39 square mile
1 hectare (ha)	=	107,636 square feet
1 hectare (ha)	=	2.5 acres

Volume (dry)

1 cubic centimetre (cm^3)	=	0.061 cubic inch
1 cubic metre (m^3)	=	1.31 cubic yards
1 cubic metre (m^3)	=	35.31 cubic feet
1,000 cubic metres (m^3)	=	0.81 acre-foot
1 hectolitre (hL)	=	2.8 bushels

Volume (liquid)

1 millilitre (mL)	=	0.035 fluid ounce (Imp.)
1 litre (L)	=	1.76 pints (Imp.)
1 litre (L)	=	0.88 quart (Imp.)
1 litre (L)	=	0.22 gallon (Imp.)
1 litre (L)	=	0.26 gallon (U.S.)

Weight

1 gram (g)	=	0.035 ounce
1 kilogram (kg)	=	2.21 pounds
1 tonne (t)	=	1.1 short tons
1 tonne (t)	=	2,205 pounds

Pressure

1 kilopascal (kPa)	=	0.15 pounds/in^2

Speed

1 metre per second	=	3.28 feet per second
1 metre per second	=	2.24 miles per hour
1 kilometre per hour	=	0.62 mile per hour

Temperature

$$°F = (°C \times 9/5) + 32$$

Conversion Tables – Imperial to Metric (approximate)

Length

1 inch	=	2.54 cm
1 foot	=	0.3 m
1 yard	=	0.91 m
1 mile	=	1.61 km

Area

1 square foot	=	0.09 m^2
1 square yard	=	0.84 m^2
1 acre	=	0.4 ha

Volume (dry)

1 cubic yard	=	0.76 m^3
1 bushel	=	36.37 L

Volume (liquid)

1 fluid ounce (Imp.)	=	28.41 mL
1 pint (Imp.)	=	0.57 L
1 gallon (Imp.)	=	4.55 L
1 gallon (U.S.)	=	3.79 L

Weight

1 ounce	=	28.35 g
1 pound	=	453.6 g
1 ton	=	0.91 tonne

Pressure

1 pound per square inch	=	6.90 kPa

Temperature

$$°C = (°F - 32) \times 5/9$$

Abbreviations

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

Emergency and First-Aid Procedures for Pesticide Poisoning

For pesticide poisonings and pesticide injuries, call the Ontario Poison Centre: Toronto 1-800-268-9017

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 Safety Data Sheets (SDS) 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 Ontario Poison Centre.
- Start first aid. This is not a substitute for professional medical help.
- **Provide the label, SDS sheet, container or a clear photo of the 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 Ontario Poison Centre IMMEDIATELY.

To obtain a digital copy of this publication visit ontario.ca and search for the publication number and title.

To order a print copies of this or any other OMAFRA publication, visit ontario.ca/publications

Published by the Ministry of Agriculture, Food and Rural Affairs

ISSN 2563-1004 (Print)
ISSN 2563-1012 (Online)

04-21

Cette publication est aussi disponible en français.

Agricultural Information Contact Centre

1-877-424-1300
1-855-696-2811 (TTY)
email: ag.info.omafra@ontario.ca
ontario.ca/omafra

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

Call the Ontario Ministry of the Environment, Conservation and Parks **Spills Action Centre** at **1-800-268-6060** (24 hr a day, 7 days a week).

Notify your municipality.