



Publication 360C

# Crop Protection Guide for Grapes

2021

**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.

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## 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.**

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## 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.

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### 1. Full Registration

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

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### 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.

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## 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.

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## 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](http://www.healthcanada.gc.ca/pmra) or call 1-800-267-6315.

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## 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](http://ontario.ca/laws) or by calling the ServiceOntario Publications Toll-Free number: 1-800-668-9938 or 416-326-5300.

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## 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](http://ontario.ca/pesticides).

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## CERTIFICATION AND LICENSING

### Growers and Their Assistants

For information about farmer training and certification requirements, visit the MECP website at [ontario.ca/pesticides](http://ontario.ca/pesticides) and for information on courses check the Ontario Pesticide Education Program website at [www.opep.ca](http://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](http://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](http://www.horttrades.com/pesticide-technician) or call 1-800-265-5656 or e-mail [pic@hort-trades.com](mailto:pic@hort-trades.com)
- the Pesticide Industry Regulatory Council (PIRC) at [www.oipma.ca](http://www.oipma.ca).



Publication 360C

# Crop Protection Guide for Grapes

2021

### **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](mailto:ag.info.omafra@ontario.ca)

### **Looking for fruit production information on the Internet?**

Check the OMAFRA website at [ontario.ca/crops](https://ontario.ca/crops)

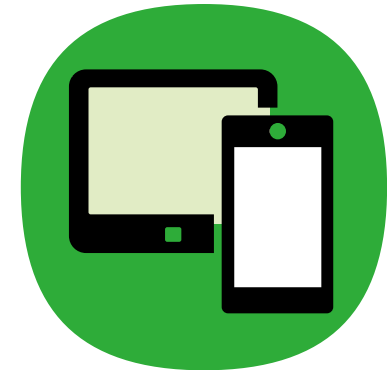
This publication contains pesticide control products that have been registered as of October 31, 2020, on fruit crops. Any updates to this information will be posted on the OMAFRA website at [ontario.ca/crops](https://ontario.ca/crops)

### **Cover Images**

Sporulating downy mildew infection on grape berries at fruit set

# 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**





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## Products Listed in This Publication

Products listed in this publication are registered for use on grapes 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 pest. Many products are under re-evaluation by the Pest Management Regulatory Agency (PMRA) and may change within the lifetime of this publication. Consult 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/lr-re/index-eng.php>.

## Levels of Control for Fungicides and Insecticides/Miticides

The value of all insecticides, miticides and fungicides is evaluated by PMRA prior to registration, and 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*.

### 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.

**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.

# 1. Using Pesticides in Ontario

Visit [www.ontario.ca/usingpesticides](http://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.**

- 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](http://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.

## 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:

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](http://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](http://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](http://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](https://ontario.ca/pesticides) and for information on courses visit the University of Guelph's Ontario Pesticide Education Program website at [www.opecp.ca](https://www.opecp.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](http://ontario.ca/pesticides). For information on the IPM Course visit the University of Guelph's website at [IPMCertified.ca](http://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](http://Ontario Pesticide Training and Certification)

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

Email: [rcoptc@uoguelph.ca](mailto:rcoptc@uoguelph.ca)

Website: [www.ontariopesticide.com](http://www.ontariopesticide.com)

For further information on pesticide licensing please refer to the document Guide to Pesticide Licensing available at [ontario.ca/pesticides](http://ontario.ca/pesticides).

For information on technician training, visit:

- the Ontario Pesticide Training and Certification website at [www.ontariopesticide.com](http://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](http://www.horttrades.com/pesticide-technician) or call 1-800-265-5656 or email [pic@hort-trades.com](mailto:pic@hort-trades.com)
- the Pesticide Industry Regulatory Council (PIRC) at [www.oipma.ca](http://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

- 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](http://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/](http://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](http://www.healthcanada.gc.ca/pmra), search for Restricted Entry Interval

## 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

## 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.

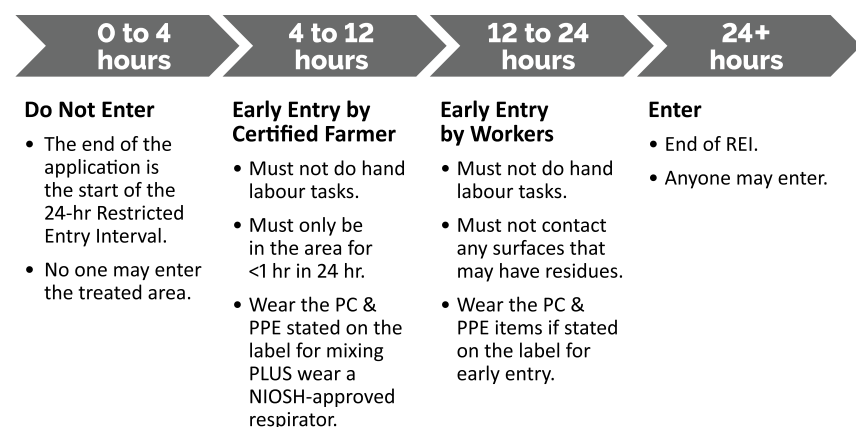


Figure 1-1. Example of a 24-hr REI on a pesticide label.

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](http://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](http://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](http://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](http://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](http://www.sprayers101.com)
- OMAFRA website: [ontario.ca/spraydrift](http://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.opecp.ca/resources](http://www.opecp.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](http://www.cleanfarms.ca), call your local dealer or contact Cleanfarms at 416-622-4460 (toll-free at 877-622-4460) or [info@cleanfarms.ca](mailto: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](mailto: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](mailto: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](http://www.cleanfarms.ca)), contact Cleanfarms at 416-622-4460 (toll-free at 877-622-4460) or [info@cleanfarms.ca](mailto: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](http://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.opec.ca](http://www.opec.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](http://ontario.ca/laws) (for Ontario legislation) and [www.laws-lois.justice.gc.ca](http://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.opec.ca](http://www.opec.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 detailed information on IPM for grapes can be found at Ontario CropIPM, [ontario.ca/cropIPM](https://ontario.ca/cropIPM)**

**Current information is also available on the Ontario fruit blog at [onfruit.ca](https://onfruit.ca)**

### 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 — Choose sites less favourable for pest development. Avoid planting in poorly drained locations.
- Resistant/tolerant cultivars — Select cultivars less susceptible to disease or insect pressure.
- Clean, certified nursery stock — Use vines tested and determined to be free from virus and grown according to guidelines that minimize the presence of other pests.
- Vineyard sanitation — Chop and plow under or remove all sources of pests, such as prunings, dead vines, and mummified fruit from the vineyard.
- Elimination of alternative hosts — Eliminate wild grapevines adjacent to the vineyard. They can act as alternate hosts for many pests.
- Maintain good weed control — This promotes air movement in the vineyard to facilitate drying of leaves and fruit.
- Encouraging natural enemies — Modify insect habitat through the introduction of cover crops, border crops or naturalized hedgerows to promote beneficial organisms.
- Training and canopy management — Manipulate the canopy to improve air movement within the canopy to facilitate drying and to improve spray coverage.

- Water management — Use trickle irrigation or schedule overhead irrigation so that plants are not wet overnight.
- Nutrient management — Avoid excessively lush growth, which is more susceptible to some diseases and more attractive to some insect pests.

## 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 eliminate damage by pests. However, once they are established, they can maintain pest populations at lower levels. They are generally effective against indirect pests such as aphids, leafhoppers and mites, but may be 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. Caterpillars are routinely infected by cycles of viral or fungal disease, which thrive when the environment is moist.

Follow these practices to conserve and encourage beneficial insects in fruit crops:

- Avoid use of pesticides that are toxic to beneficials in a cropping system.
- Encourage a diverse habitat within and/or around the perimeter of the vineyard 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](http://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 vineyard 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, see OMAFRA Factsheet 03—079, *Mating Disruption for Management of Insect Pests*.

## 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 (e.g., Regalia Maxx) 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 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.

All organic pest control products must be registered by the Pest Management Regulatory Agency (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 for conventional producers include:

- lower potential for pest resistance
- providing 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

## Managing Pest Resistance

### *Pest Resistance to Fungicides, Insecticides and Miticides*

Random natural mutation may result in a small proportion of a population that is resistant to a particular chemical, or group of chemicals with similar modes of action. When a population is exposed to a pesticide with a specific mode of action, the resistant individuals survive and the susceptible individuals are killed. The resistant survivors then multiply and pass their resistant traits on to the next generation. When the same pesticide is applied again, the proportion of resistant individuals increases, replacing the susceptible ones in the population. Once the resistant population dominates, the pesticide has lost efficacy. A pest population is considered resistant when it is able to survive exposure to rates of a pesticide that previously controlled it.

Resistance to one pesticide can result in resistance to a different pesticide or a group of pesticides, in which pesticides have similar action sites. This is called **cross-resistance**. It develops when exposure to one pesticide causes selection for resistance in other related ones and is the result of a single mechanism or genetic mutation.

**Multiple resistance** involves 2 or more mechanisms acquired independently through exposure to pesticides with different action sites. Pests with multiple resistance are resistant to pesticides from 2 or more groups at the same time.

**Multiple resistance** and **cross-resistance** create serious challenges to the success of integrated resistance management strategies.

Pest control failures are not necessarily caused by resistance. Factors such as product selection, timing, rate, spray coverage, spray water pH and weather conditions also affect the success or failure of a pesticide application.

### Assessing Resistance Risk

The development of resistance depends on characteristics of both the pest and the group of pesticides involved, as well as the way in which the pesticides are used. Table 2–1. *Factors Favouring the Development of Resistance* describes situations where resistance is most likely to occur.

**Table 2–1. Factors Favouring the Development of Resistance**

Pests most likely to develop resistance:	Pesticides or use patterns where resistance is likely to develop:
<ul style="list-style-type: none"> <li>• have a prolific life cycle with many generations per year, produce lots of spores or offspring, or multiply very quickly</li> <li>• have a pre-existing resistance to other products in the same group</li> <li>• do not migrate between crops/regions, so gene pool is not diluted</li> </ul>	<ul style="list-style-type: none"> <li>• are used repeatedly or have persistent residues, exposing many generations or life stages to these residues</li> <li>• are toxic to beneficial insects as well as the pest</li> <li>• have a specific mode of action that works on a single site</li> <li>• are used at deficient rates or improper times</li> </ul>

## Resistance Management Strategies

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.

- Follow an integrated pest management program that makes use of a variety of different pest control strategies, including resistant varieties when available, monitoring, 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 permethrin is marketed under the brand names Perm-Up and Pounce.

- Know the product group. Choose products from different groups when possible in your spray rotation. For example, both Assail and Admire are in the same insecticide group (Group 4A). To use Assail after Admire is equivalent to using Assail after Assail, since resistance to both chemicals develops in the same way.
- For a list of groups and their modes of action, see Table 2–2. *Fungicide Groups*, Table 2–3. *Insecticide/Miticide Groups* or Table 3–2. *Products Used on Grapes*.
- In addition to these general resistance management strategies for all products, more specific strategies have been developed for fungicides, insecticides and miticides.

## 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.
- Know which disease is targeted by which fungicide group. For combination products, know which fungicide component is controlling which disease.
- Apply fungicides before disease occurs. Applications of fungicides after the disease is established are more likely to select for resistant populations of the pathogen.
- Make use of Group M fungicides. These fungicides are known as multi-site inhibitors (Table 2–2. *Fungicide Groups*). They affect a wide range of metabolic processes in fungi and are less prone to the development of resistance. While there is no risk of resistance development, integrated pest management should still be applied.

- Tank-mix products from different groups. Wherever possible, one of the tank-mix partners should be a fungicide from Group M, with a multi-site mode of action. This is an accepted resistance management strategy for fungicides, although not recommended for insecticides.

### Resistance management strategies by fungicide group and disease for Ontario grapes

Resistance management strategies are important for diseases like botrytis, powdery mildew and downy mildew because these pathogens have characteristics which favour the development of resistance (see Table 2–1. *Factors Favouring the Development of Resistance*).

The suggested strategies for preventing fungicide resistance were developed using the recommendations of the Fungicide Resistance Action Committee (FRAC), which is a working group of Crop Life International. They were then adapted specifically for Ontario based on:

- the resistance risk of the pathogen to a particular fungicide group.
- the number of rotational options registered for use at the time.

Two components of a resistance management strategy for a fungicide group are:

- limiting the number of consecutive applications before rotating to a different group
- observing a maximum number of applications per season.

The following strategies reduce the risk for resistance development and may be more stringent than label guidelines:

- For high-risk pathogens with fungicide options from many groups, rotate to a different group 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.

When a product contains active ingredients from more than one group, each application counts as a single use for each group. For example, one application of Pristine counts as a single use of boscalid (Group 7) and a single use of pyraclostrobin (Group 11).

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 are based on the pathogen with the highest risk of developing resistance.

Solo products have one active ingredient. Combination products have more than one active ingredient and are indicated with an asterisk (\*).

#### **Group 3: Aprovia Top \*, Cevya, Fullback, Inspire Super \*, Mettle, Nova**

- For powdery mildew, use once then rotate to a different fungicide group. Use fungicides from this group no more than 2 times per season as a solo or mixture product.

#### **Group 4: Ridomil Gold MZ \***

- For downy mildew use once prebloom and once postbloom

#### **Group 5: Priwen**

- For powdery mildew, use once then rotate to a different fungicide group. Use fungicides from this group no more than 2 times per season.

**Group 7: Aprovia Top \*, Cantus, Kenja, Luna Tranquility \*, Pristine \*, Sercadis, Miravis Prime \*;**

**Group 9: Inspire Super \*, Luna Tranquility \*, Scala, Switch \***

- For powdery mildew and botrytis bunch rot, use once then rotate to a different fungicide group. Use fungicides from these groups no more than 2 times per season as a solo or mixture product.

**Group 11: Flint, Intuity, Pristine\*, Sovran**

- For powdery mildew and downy mildew, use once then rotate to a different fungicide group. Use fungicides from this group no more than 2 times per season as a solo or mixture product.

**Group 12: Switch \*, Miravis Prime \***

- For botrytis bunch rot, use once then rotate to a different fungicide group. Use fungicides from this group no more than 2 times per season.

**Group 13: Quintec**

- For powdery mildew, use once then rotate to a different fungicide group. Use no more than 2 times per season.

**Group 17: Elevate**

- For botrytis bunch rot, use once then rotate to a different fungicide group. Use no more than 2 times per season.

**Group 21: Torrent;**

**Group P7: Aliette, Confine Extra, Phostrol, Rampart**

- For downy mildew, use once then rotate to a different fungicide group. Use fungicides from these groups no more than 3 times per season.

**Group 40 & 45: Forum, Revus, Zampro \***

- For downy mildew, use once then rotate to a different fungicide group. Use Revus or Forum no more than 2 times per season and Zampro no more than 3 times per season.

**Group 50: Vivando, Property**

- For powdery mildew, use once then rotate to a different fungicide group. Use no more than 2 times per season.

**Table 2–2. Fungicide Groups**

Group	Chemical Group	Product Name	Active Ingredient <sup>1</sup>	Resistance Risk <sup>2</sup>
3	DMI (demethylation inhibitors)  Note: sometimes loosely known as sterol inhibitors (SI)	Aprovia Top 195 EC	difenoconazole <sup>1</sup> + benzovindiflupyr	Medium
		Cevya	mefentrifluconazole	Medium
		Fullback 125 SC	flutriafol	Medium
		Inspire Super	difenoconazole <sup>1</sup> + cyprodinil	Medium
		Mettle 125 ME	tetraconazole	Medium
		Nova	myclobutanil	Medium
4	PA (phenylamides)	Ridomil Gold MZ 68 WG	metalaxyl <sup>1</sup> + mancozeb	Low
5	Amines (morpholines)	Priwen	spiroxamine	Low–Medium
7	SDHI (succinate dehydrogenase inhibitors)	Aprovia Top 195 EC	difenoconazole + benzovindiflupyr <sup>1</sup>	Medium
		Cantus WDG	boscalid	Medium–High
		Kenja 400 SC	isofetamid	Medium–High
		Luna Tranquility	fluopyram <sup>1</sup> + pyrimethanil	Medium
		Miravis Prime	fludioxonil + pydiflumetofen <sup>1</sup>	Medium
		Pristine WG	boscalid <sup>1</sup> + pyraclostrobin	Medium
		Sercadis	fluxapyroxad	Medium–High
9	AP (anilinopyrimidines)	Inspire Super	difenoconazole + cyprodinil <sup>1</sup>	Medium
		Luna Tranquility	fluopyram + pyrimethanil <sup>1</sup>	Medium
		Scala SC	pyrimethanil	Medium
		Switch 62.5 WG	cyprodinil <sup>1</sup> + fludioxonil	Low
11	QoI (quinone outside inhibitors)  Note: sometimes loosely known as strobilurins	Flint	trifloxystrobin	High
		Intuity	mandestrobin	High
		Pristine WG	boscalid + pyraclostrobin <sup>1</sup>	Medium
		Sovran	kresoxim-methyl	High
12	PP (phenylpyrroles)	Miravis Prime	fludioxonil <sup>1</sup> + pydiflumetofen	Medium–High
		Switch 62.5 WG	cyprodinil + fludioxonil <sup>1</sup>	Medium
13	Aza naphthalenes	Quintec	quinoxifen	Medium
17	Hydroxyanilides	Elevate 50 WDG	fenhexamid	Low–Medium
19	Polyoxins	Diplomat 5 SC	polyoxin D Zinc Salt	Medium
21	Qil (quinone inside inhibitors)	Torrent 400 SC	cyazofamid	Medium–High

M = Multi-site fungicides. BM = Biologicals with multiple modes of action. NC = Not classified by FRAC, or group not indicated on product label. P = Plant defence inducers.

<sup>1</sup> Indicates the active ingredient (a.i.) that puts it in this group.

<sup>2</sup> According to Fungicide Resistance Action Committee (FRAC) [www.frac.info](http://www.frac.info) and search "FRAC Code List 2020".

In coformulations, the resistance risk listed is for the combination of active ingredients, not for the individual components.



**Table 2–2. Fungicide Groups (cont'd)**

Group	Chemical Group	Product Name	Active Ingredient <sup>1</sup>	Resistance Risk <sup>2</sup>
22	B3 Benzamide	Gavel 75 DF	mancozeb + zoxamide <sup>1</sup>	Low
40	CAA (carboxylic acid amides)	Forum	dimethomorph	Low–Medium
		Revus	mandipropamid	Low–Medium
		Zampro	dimethomorph <sup>1</sup> + ametoctradin	Medium
45	QxI (quinone x inhibitor)	Zampro	dimethomorph + ametoctradin <sup>1</sup>	Medium
46	Cell membrane disruption	Timorex Gold	tea tree oil	Low
50	aryl-phenylketones	Property 300 SC	pyriofenone	Medium
		Vivando SC	metrafenone	Medium
M1	Inorganic	Copper 53 W	tri-basic copper sulphate	Low
		Guardsman Copper Oxychloride 50	copper oxychloride	Low
		Copper Spray	copper oxychloride	Low
		Cueva	copper octanoate	Low
		Kocide 2000-0	copper hydroxide	Low
M2	Inorganic	Cosavet Edge DF	sulphur	Low
		Kumulus DF	sulphur	Low
		Lime Sulphur	lime sulphur	Low
		Microscopic Sulphur WP	sulphur	Low
		Microthiol Disperss	sulphur	Low
M3	Dithiocarbamates	Dithane Rainshield	mancozeb	Low
		Ferbam 76 WDG	ferbam	Low
		Gavel 75 DF	mancozeb <sup>1</sup> + zoxamide	Low
		Manzate Pro-Stick	mancozeb	Low
		Penncozeb 75 DF Raincoat	mancozeb	Low
		Polyram DF	metiram	Low
		Ridomil Gold MZ 68 WG	metalaxyl + mancozeb <sup>1</sup>	Low
M4	Phthalimides	Folpan 80 WDG	folpet	Low
		Maestro 80 WSP	captan	Low
		Supra Captan 80 WSP	captan	Low

M = Multi-site fungicides. BM = Biologicals with multiple modes of action. NC = Not classified by FRAC, or group not indicated on product label. P = Plant defence inducers.

<sup>1</sup> Indicates the active ingredient (a.i.) that puts it in this group.

<sup>2</sup> According to Fungicide Resistance Action Committee (FRAC) [www.frac.info](http://www.frac.info) and search "FRAC Code List 2020".

In coformulations, the resistance risk listed is for the combination of active ingredients, not for the individual components.

**Table 2–2. Fungicide Groups (cont'd)**

Group	Chemical Group	Product Name	Active Ingredient <sup>1</sup>	Resistance Risk <sup>2</sup>
BM1	Polypeptides	Fracture	BLAD polypeptide	Low
		ProBlad PLUS	BLAD polypeptide	Low
BM2	Microbials	Actinovate SP	<i>Streptomyces lydicus</i>	Unknown
		Double Nickel LC	<i>Bacillus amyloliquefaciens</i> strain D-747	Unknown
		Serenade OPTI	<i>Bacillus subtilis</i> strain QST 713	Unknown
		Serifel	<i>Bacillus amyloliquifaciens</i> strain MBI 600	Unknown
		Stargus	<i>Bacillus amyloliquifaciens</i> strain F727	Unknown
NC	Biological	Botector	<i>Aureobasidium pullulans</i>	Low
	Bicarbonates	MilStop	potassium bicarbonate	Low
		Sirocco	potassium bicarbonate	Low
	Oils	Purespray Green Spray Oil 13 E	mineral oil	Unknown
		SuffOil-X	mineral oil	Unknown
		Vegol Crop Oil	canola oil	Unknown
	Not classified	Buran	garlic powder	Unknown
P5	Plant extract	Regalia Maxx	<i>Reynoutria sachalinensis</i> extract	Unknown
P6	Microbial elicitor	LifeGard WG	<i>Bacillus mycoides</i> isolate J	Unknown
P7	Phosphonates	Aliette WDG	fosetyl al	Low
		Confine Extra	mono- and dipotassium salts of phosphorous acid	Low
		Phostrol	mono- and dibasic sodium, potassium and ammonium phosphites	Low
		Rampart	mono- and dipotassium salts of phosphorous acid	Low

M = Multi-site fungicides. BM = Biologicals with multiple modes of action. NC = Not classified by FRAC, or group not indicated on product label. P = Plant defence inducers.

<sup>1</sup> Indicates the active ingredient (a.i.) that puts it in this group.

<sup>2</sup> According to Fungicide Resistance Action Committee (FRAC) [www.frac.info](http://www.frac.info) and search "FRAC Code List 2020".

In coformulations, the resistance risk listed is for the combination of active ingredients, not for the individual components.

## 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.
- For insects with multiple, discrete generations (e.g., grape berry 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., leafhoppers, mites), rotate among 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 3–4 years.
- Consider annual delayed dormant oil or summer oils to suppress mite populations and reduce the need for miticides when numbers exceed the treatment threshold(s).
- 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.
- Use mixtures with caution. Tank-mixes and pre-formulated mixtures are pest management tools, not insecticide resistance management tools. Mixtures can provide a broader range of target pest control; however, their repeated use increases the probability that the target pest population(s) will develop multiple resistances. Alternating or rotating among products with one active ingredient, rather than mixing them, is the preferred strategy for insecticides and miticides in most situations.
- 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.

## Resistance management strategies by insecticide group for Ontario grapes

Solo products have one active ingredient. Combination products have more than one active ingredient and are indicated with an asterisk (\*).

### Group 1B: Imidan, Malathion

- Resistance to these older, broad-spectrum insecticides has occurred in various fruit pest populations in Ontario. Documented cases include resistance to organophosphates in grape berry moth.
- Repeated use (more than once per season) is discouraged because of the potential for further resistance development and toxicity to beneficial insects and mites.

### Group 3: Matador, Perm-UP, Pounce, Pyganic, UP-Cyde

- Repeated use (more than once per season) is discouraged because of the potential for further resistance development and toxicity to beneficial insects and mites.

### Group 4: 4A – Aceta, Admire, Assail, Clutch; 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 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 among subgroups only if it is clear that cross-resistance does not exist in the target populations.

**Group 5: Delegate, Entrust, Success;**

**Group 11: Bioprotec, Dipel, XenTari;**

**Group 18: Intrepid;**

**Group 28: Altacor, Harvanta, Vayego**

- There are no documented cases of resistance to these groups in Ontario for grapes. Use the basic principles of resistance management to ensure that insecticides in these groups work well in the future.

## Resistance management strategies by miticide group for Ontario fruit crops

### Group 6: Agri-Mek

- There are no documented cases of resistant mite populations in Ontario to this group. Use resistance management principles. Apply this product early before threshold numbers are reached.

**Group 20D: Acramite;**

**Group 21: Nexter;**

**Group 25: Nealta;**

There are no documented cases of resistant mite populations in Ontario. Use resistance management principles.

### Group 23: Envidor, Movento

- There are no documented cases of resistant mite populations in Ontario. Use resistance management principles. These products work slowly, so patient and careful monitoring is needed to assess the results.

**Table 2–3. Insecticide/Miticide Groups**

Group	Type of Action	Chemical Sub-group or Exemplifying Active Ingredient	Product Name	Active Ingredient
1	nerve	1B Organophosphates	Imidan WP	phosmet
			Malathion 85 E	malathion
3	nerve	3A Pyrethroids Pyrethrins	Perm-UP EC	permethrin
			Pounce 384 EC	permethrin
			Pyganic EC 1.4 II	pyrethrins
			UP-Cyde 2.5 EC	cypermethrin
4	nerve	4A <sup>1</sup> Neonicotinoids	Aceta 70 WP	acetamiprid
			Admire 240 Flowable	imidacloprid
			Assail 70 WP	acetamiprid
			Clutch 50 WDG	clothianidin
		4C <sup>1</sup> Sulfoxafimines	Closer	sulfoxaflor
		4D <sup>1</sup> Butenilides	Sivanto Prime	flupyradifurone

NC = Not classified by Insecticide Resistance Action Committee (IRAC), or group not indicated on product label. UN = Mode of action has not been determined.

<sup>1</sup> 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 is low. If there are no other alternatives, then compounds from Groups 4A, 4C and 4D may be rotated.

**Table 2–3. Insecticide/Miticide Groups (cont'd)**

Group	Type of Action	Chemical Sub-group or Exemplifying Active Ingredient	Product Name	Active Ingredient
5	nerve	Spinosyns	Delegate	spinetoram
			Entrust	spinosad
			Success	spinosad
6	nerve and muscle	Avermectins	Agri-Mek SC	abamectin
11	disrupt midgut membrane	11A B.t. microbial (and the insecticidal proteins they produce)	Bioprotec PLUS	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>
			Dipel 2X DF	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>
			XenTari WG	<i>Bacillus thuringiensis</i> , subsp. <i>aizawai</i>
18	growth regulation	Diacylhydrazine	Intrepid 240 F	methoxyfenozide
20D	energy metabolism	Bifenazate	Acramite 50 WS	bifenazate
21	energy metabolism	21A Mitochondrial complex I electron transport inhibitors (METI)	Nexter SC, Nexter WP	pyridaben
23	lipid synthesis, growth regulation	Tetronic and tetramic acid derivatives	Envidor 240 SC	spirodiclofen
			Movento 240 SC	spirotetramat
25	energy metabolism	Beta-ketonitrile derivatives	Nealta	cyflumetofen
28	nerve and muscle	Diamides	Altacor	chlorantraniliprole
			Harvanta 50 SL	cyclaniliprole
			Vayego 200 SC	tetraniliprole

NC = Not classified by Insecticide Resistance Action Committee (IRAC), or group not indicated on product label. UN = Mode of action has not been determined.

<sup>1</sup> 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 is low. If there are no other alternatives, then compounds from Groups 4A, 4C and 4D may be rotated.

## Handling and Mixing Pesticides

### Water Volume and Coverage

When the pesticide label does not prescribe a water volume or concentration, the sprayer operator must decide the appropriate volume. Use sufficient water 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 water 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 water 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 deep in unpruned canopies).

To understand the relationship between water 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<sup>2</sup>.

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 Sprayers 101 website ([www.sprayers101.com](http://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 water pH, hardness and any requirement for adjuvants. Defer to label instructions should they differ from the following mixing steps.
2. *Shake any liquid products.* This ensures the active ingredient and inert ingredients are thoroughly mixed.
3. Fill the tank with 50% of the required volume of water.

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 Table 2–4. *Tank-mix Order for Pesticide Compatibility Test*). 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 water.*
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

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.

- 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 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 includes an adjuvant only 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/lr-re/index-eng.php>. Search for the following keywords:

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

To avoid well-known incompatibilities include, do the following:

- Add captan fungicides (e.g., Maestro, Supra Captan) before EC formulations of pyrethroids. Apply immediately with constant agitation.
- Do not mix pesticides with lime sulphur.

**Jar Test for Pesticide Compatibility**

If labels do not include comments on compatibility, or you are considering a new tank-mix, use a *Jar Test* to determine compatibility. Note, this will not reveal a chemical incompatibility or potential phytotoxicity. 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 water into a 1 litre glass jar. Be sure to use the same water at the same temperature used in the sprayer.
2. Add ingredients according to Table 2–4. *Tank-Mix Order for Pesticide Compatibility Test*, stirring after each addition.



- 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.
- 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 2–4. 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 <sup>2</sup> 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)

## Factors Impacting Pesticide Performance

Water quality can affect pesticide performance. The four variables are: pH (acidity & alkalinity), dissolved minerals (water hardness or softness), suspended particles (dirty water) and temperature. For more information, see [sprayers101.com](http://sprayers101.com), OMAFRA Factsheet 09–037, *How Weather Conditions Affect Spray Applications* and OMAFRA Factsheet 09–039, *Six Elements of Effective Spraying in Orchards and Vineyards*.

### Spray drift

Do you know what pesticide drift looks like or what you can do about it? OMAFRA and CropLife Canada have created videos with innovative visual demonstrations using dyes and night-spraying to show what drift looks like. See how spray particles behave and discover what changes can be made to your spray program to greatly reduce the risk of pesticide drift. Learn more at [ontario.ca/spraydrift](http://ontario.ca/spraydrift).

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

- Keeping pesticide from binding to minerals suspended in water.
- Adjusting water pH so pesticide is less likely to break down.
- Manipulating droplet size to reduce on-target and off-site movement of pesticide.
- Improving odds that a spray droplet will stay on the target by reducing factors that cause droplets to bounce and roll off.
- Modifying or reducing surface tension to enhance the ability of a droplet to be retained on or spread across the target surface.

- Minimizing spray droplet evaporation.
- Preventing spray deposit from being washed off the leaf surface.
- Protecting the active ingredient from degrading in sunlight.
- Improving 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. This includes the use of oils. Penetrants should not be used with contact or surface pesticides. Consult pesticide and adjuvant labels for minimum interval for rotations including adjuvants.
- 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](http://sprayers101.com).

## 3. Crop Protection

### In this chapter:

<b>Table 3–1.</b>	Grape Crop Protection
<b>Table 3–2.</b>	Products used on Grapes
<b>Table 3–3.</b>	Relative Susceptibility of Grape Cultivars to Diseases
<b>Table 3–4.</b>	Activity of Fungicides on Grape Diseases and Impact on Honeybees
<b>Table 3–5.</b>	Activity of Insecticides and Miticides on Grape Pests and Impact on Honeybees

Read the product label and follow all safety precautions. Labels for registered pest control products are available on the Pest Management Regulatory Agency (PMRA) website at <http://pr-rp.hc-sc.gc.ca/is-re/index-eng.php>. Many pesticides are in various stages of re-evaluation by PMRA and their status may change within the lifetime of this publication. Consult the PMRA website and/or the registrant to verify actual dates of last sale and last use. Updates will also be available on the OMAFRA Fruit Blog at [ONFruit.ca](http://ONFruit.ca).

- For preharvest intervals, restricted entry intervals and maximum number of applications, see Table 3–2. *Products Used on Grapes*.
- Some grape varieties are sensitive to sulphur, copper, Flint, Pristine, or other products. See Table 3–3. *Relative Susceptibility of Grape Cultivars to Diseases* for specific information.
- **Products are listed by chemical group and in alphabetical order within each group. The order does not reflect efficacy.** See Table 3–4. *Activity of Fungicides on Grape Diseases and Honeybees* and Table 3–5. *Activity of Insecticides and Miticides on Grape Pests and Honeybees* for efficacy ratings.
- Where a product in the calendar is followed by a “\*”, it is potentially acceptable for organic use based on MAPAQ. *Réseau d’avertissements phytosanitaires. 2020. RAP – Réseau Général. Bulletin d’information N° 1, Spécial 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.
- Not all varieties have been tested with all possible tank-mix combinations, especially with new products. Prior to tank-mixing any unfamiliar chemical combinations (fungicides, insecticides, liquid fertilizers, biological control products, adjuvants, and additives), conduct a jar test to determine if there are any physical incompatibilities (Table 2–4. *Tank-mix Order for Pesticide Compatibility Test*). Before applying the tank-mix to the crop, also test the combination on a small portion of the crop to be treated to ensure that a phytotoxic response will not occur as a result of application.

## 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 not prone to resistance and do not have to be rotated. Some products are not classified to mode of action (NC) and others have unknown modes of action (U or UN). Plant defence inducers (P) and biological fungicides with multiple modes of action (BM) are not known to be prone to resistance.

### 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.
- Use co-formulations or products that must be tank-mixed with another chemical group no more than 3 times per season.
- Use products containing only one chemical family no more than twice per season.
- Use sufficient water to provide thorough coverage.
- Do not use Cevya, Fullback, Mettle, Nova, Inspire Super, Priwen, Aprovia Top, Cantus, Kenja, Sercadis, Luna Tranquility, Miravis Prime, Pristine, Scala, Switch, Flint, Intuity, Sovran, Quintec, Elevate, Forum, Revus, Torrent, Zampro, Property or Vivando when sporulating lesions of the target disease are present.

### Insecticide resistance management

Take the following steps to avoid development of insecticide resistance:

- For pests with discrete generations (grape berry 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 rapidly building and overlapping generations (mites, leafhoppers), do not use products containing the same chemical group in consecutive applications.
- For pests with only a single generation per year (e.g., Japanese Beetle), insecticide rotation is not necessary. Be sure to use full label rates and re-apply if populations persist for more than 14 days.

## Bee Toxicity

Some insecticides are toxic to bees and other pollinating insects. Use of insecticides on flowering crops requires careful management to avoid negative effects on pollinators. Do not apply insecticides during bloom. Before and after bloom, bees may still be present on flowering cover crops and weeds — do not allow drift of insecticides onto these or other flowering crops. Always follow label precautions regarding avoiding impacts on bees. For more information, see honeybee toxicity ratings in Table 3–4. *Activity of Fungicides on Grape Diseases and Honeybees* and Table 3–5. *Activity of Insecticides and Miticides on Grape Pests and Honeybees*.

## Buffer Zones

Leave a suitable buffer zone between treatment area and adjacent sensitive areas, such as hedgerows, woodlots and freshwater habitats. Zones may vary depending on the product used, growth stage of the crop and method of application including the use of drift-reducing technology. Check the pesticide label for requirements.

Use Health Canada's online spray drift calculator to modify the buffer zone specified on the label based on weather conditions, category of spray equipment and droplet size. For more information, see the Buffer Zone Calculator at [www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/drift-derive/calculator-calculatrice-eng.php](http://www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/drift-derive/calculator-calculatrice-eng.php).

Unfortunately, this model does not account for water volume, travel speed or crop stage.

Observing buffer zones is a legal requirement. A record of the buffer zone modification, if any, must be retained for at least one year from the time of application.

### Preharvest Intervals

Contact the processors and wineries directly regarding their preharvest interval policy. Preharvest intervals listed in Table 3–1, *Grape Crop Protection* and Table 3–2, *Products Used on Grapes* are taken from product labels. In some cases, regulations on residues in finished products are much more stringent. For some products, processors and wineries may require longer preharvest intervals than stated on product labels or have special restrictions for certain pest control products regarding number of applications or application after a certain crop stage. Consult the grape purchaser for more details.

### Spray Water Volumes

Sufficient water volumes are necessary to provide complete coverage with grape fungicides, miticides and insecticides. Increased water volumes are necessary as the season progresses and canopies grow. Canopy management through hedging, leaf-pulling and shoot thinning, as well as proper sprayer calibration, is critical to ensure proper spray coverage. Sufficient coverage and efficacy are not possible if water volumes are inadequate. Some types of sprayers are able to provide sufficient coverage with less water than others. Consult equipment dealers or professional crop consultants about the amount of water needed to ensure adequate coverage. Where the product rate is listed in amount per 1,000 L and if a water volume is not provided on the label, use enough water to wet the foliage. Read and follow water volume requirements on all product labels.

### Pesticide 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.

### Crop Nutrition

Crop nutrition is important for plant growth and fruit quality on grape 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 the *Soil Management, Fertilizer Use, Crop Nutrition and Cover Crops for Fruit Production* webpage at [http://www.omafra.gov.on.ca/english/crops/hort/soil\\_fruit.htm](http://www.omafra.gov.on.ca/english/crops/hort/soil_fruit.htm) and see OMAFRA Publication 611, *Soil Fertility Handbook*.

**Table 3–1. Grape Crop Protection**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>Dormant to bud swell</b>						
Powdery mildew	M	Lime sulphur *	73 L in 1,000 L water	48 hours	120 days	Apply in a high-volume spray to ensure thorough coverage of canes, head and trunk. <b>Suppression</b> of overwintering inoculum. May also suppress Anthracnose and Scale insects. <b>Do not use later than delayed dormant.</b>
Mealybug, Scale	<b>General Comments:</b> <ul style="list-style-type: none"> <li>If grape leafroll-associated virus has been confirmed by an accredited lab and scale has been confirmed in the vineyard, this spray may reduce insect vector pressure and spread of the virus.</li> <li>Apply when crawlers are present on canes. Controls only exposed scales, not ones hidden under bark.</li> <li>May also suppress Mealybug if populations are low and nymphs are exposed on canes.</li> </ul>					
	1B	Malathion 85 E	880 mL/1,000 L water	12 hours <sup>1</sup> / 4 days <sup>2</sup>	3 days/ 4 days <sup>3</sup>	If Malathion is used at this growth stage, it cannot be used preharvest for MALB management.
	NC	Vegol Crop Oil *	2% v/v	12 hours	0 days	Apply in a high-volume spray to ensure thorough coverage at a rate of 2% v/v (20 L/1,000 L water). Tolerance has not been determined for all 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 vines. Do not use within 14 days of Maestro, other captan products, Folpan or copper and 30 days of sulphur. Do not apply to wet foliage.
<b>Bud burst to first leaf</b>						
Climbing cutworm	<b>General Comments:</b> <ul style="list-style-type: none"> <li>Apply in the evening at first sign of cutworm feeding on buds.</li> <li>Apply in a high-volume spray to ensure thorough coverage on trunks, cordons, canes, unopened buds and tender shoots.</li> </ul>					
	3	Perm-UP EC or Pounce 384 EC	180 mL/ha	12 hours	21 days	Increase rate to 360 mL/ha if cutworms are large (2–3 cm). Apply in a minimum of 450 L of water/ha. Spray trunk and soil surface within 0.5 m of the trunk. Do not disturb the soil for 5 days after spraying.
	18	Intrepid 240 F	600 mL/ha	12 hours	30 days	<b>Maximum of 2 applications per season.</b>
	28	Altacor	285 g/ha	12 hours	14 days	<b>Maximum of 2 applications per season.</b>
Mealybug, Scale	See General comments and products listed for scale under <b>Dormant to bud swell</b> .					

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>First leaf, shoot length 1.25–5 cm</b>						
Anthracnose	<b>General Comments:</b> <ul style="list-style-type: none"> <li>• Apply in a high-volume spray to ensure thorough coverage.</li> <li>• Alternate row spraying will not give adequate protection from anthracnose.</li> </ul>					
	3	Nova	340 g/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	<b>Suppression only.</b>
	3+9	Inspire Super	836–1,161 mL/ha	7 days	14 days	Use high rate under high disease pressure.
Phomopsis cane and leaf spot	<b>General Comments:</b> <ul style="list-style-type: none"> <li>• Spray susceptible varieties, especially if the weather is wet and there is a history of phomopsis. See Table 3–3. <i>Relative Susceptibility of Grape Cultivars to Diseases</i>.</li> <li>• Alternate row spraying will not give adequate protection from phomopsis.</li> </ul>					
	M	Folpan 80 WDG	1.25 kg/ha	24 hours	1 day	No product specific comments.
		Maestro 80 WSP or Supra Captan 80 WSP	2.0 kg/ha	12 hours <sup>1</sup> / 55 days <sup>2</sup>	7 days/ 55 days <sup>3</sup>	Do not use within 14 days of oil or as a tank-mix or sequential application with products such as Timorex Gold. <b>Maximum of 2 applications of Maestro or other captan products per year for Phomopsis.</b>
	NC	Oxidate 2.0 *	1% v/v	4 hours or when dry	0 days	<b>Suppression only.</b>
<b>3–5 leaves unfolded, shoot length 10–15 cm</b>						
Erineum mite	<b>General Comments:</b> <ul style="list-style-type: none"> <li>• Apply immediately after the first evidence of erineum mite activity and again prebloom.</li> <li>• Do not use on Concord, Marechal Foch or deChaunac varieties.</li> </ul>					
	NC	Cosavet DF Edge * or Kumulus DF * or Microthiol Disperss *	3.4 kg/ha	24 hours	1 day/ 21 days <sup>4</sup>	Do not use within 14 days of Purespray Green Spray Oil or SuffOil-X and 30 days of Vegol Crop Oil.
Phomopsis cane and leaf spot	<ul style="list-style-type: none"> <li>• Use one of the products listed for Phomopsis cane and leaf spot at <b>First leaf, shoot length 1.25–5 cm</b>.</li> <li>• <b>Maximum of 2 applications of Maestro or other captan product per year for Phomopsis.</b></li> </ul>					
Anthracnose	3	Nova	340 g/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	<b>Suppression only.</b>
	3+9	Inspire Super	836–1,161 mL/ha	7 days	14 days	Use high rate under high disease pressure. May cause damage to Concord.
	7+11	Pristine WG	735 g/ha	when dry <sup>1</sup> / 21 days <sup>2</sup>	14 days/ 21 days <sup>3</sup>	Do not use on Sovereign Coronation, Concord, Fredonia or related labrusca varieties.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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



Table 3–1. Grape Crop Protection (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>3–5 leaves unfolded, shoot length 10–15 cm (cont'd)</b>						
Downy mildew	<b>General Comments:</b> <ul style="list-style-type: none"> <li>Unless otherwise indicated, apply at 7–10-day intervals to protect developing leaves and fruit clusters. Apply at shorter intervals if weather is conducive to disease.</li> <li>Alternate row spraying will not give adequate protection from downy mildew.</li> <li>Group 4, 11, 40, 45 and P7 fungicides are locally or fully systemic. Consult labels for information on drying time required before rain.</li> </ul>					
	M	Copper 53 W *	3 kg + 6 kg lime in 1,000 L water	48 hours	2 days <sup>5</sup>	Do not apply to Vidal, Concord or Niagara varieties.
		Copper Spray * or Guardsman Copper Oxychloride 50 *				
		Cueva *	1% v/v in 470–940 L water/ha	4 hours	1 day <sup>5</sup>	Do not mix with lime. Certain <i>Vitis vinifera</i> and French hybrid varieties may be sensitive to copper sprays resulting in marginal leaf burn (See Table 3–3. <i>Relative Susceptibility of Grape Cultivars to Diseases</i> ). Test a small area of each variety prior to spraying the whole block
		Dithane Rainshield or Manzate Pro-Stick or Penncozeb 75 DF Raincoat	7.2 kg/ha	12 hours 24 hours 24 hours	30 days	<b>Dithane Rainshield: Maximum of 1 prebloom and 3 postbloom applications.</b>
		Folpan 80 WDG	1.25 kg/ha	24 hours	1 day	No product specific comments.
		Kocide 2000-O *	1.6 kg/ha	48 hours	2 days <sup>5</sup>	Always test for sensitivity. The addition of 454–1,360 g hydrated lime/454 g of Kocide may reduce phytotoxicity.
		Maestro 80 WSP or Supra Captan 80 WSP	2.0–3.0 kg/ha 3.0 kg/ha	12 hours <sup>1</sup> / 55 days <sup>2</sup>	7 days/ 55 days <sup>3</sup>	Do not use within 14 days of oils or as a tank-mix or sequential application with products such as Timorex Gold. <b>Maximum of one application Maestro or other captan products per year for downy mildew.</b>
		Polyram DF	2 kg in 1,000 L water	12 hours	45 days	<b>Cannot be used after June 21, 2021.</b>
	4+M	Ridomil Gold MZ 68 WG	2.5 kg/ha	24 hours	66 days	This product is fully systemic and will redistribute to young leaves and fruit as they develop. <b>Maximum of 1 prebloom and 1 postbloom application.</b>
	7+11	Pristine WG	675–735 g/ha	when dry <sup>1</sup> / 21 days <sup>2</sup>	14 days/ 21 days <sup>3</sup>	Do not use on Sovereign Coronation, Concord, Fredonia or related varieties. This product is locally systemic.
	11	Sovran	300 g/ha	48 hours	14 days	<b>Do not tank-mix with EC pesticide formulations.</b> Phytotoxic to some cherry varieties. See label for details. Do not let product drift onto sensitive crops. This product is locally systemic.
	21	Torrent 400 SC	150–200 mL/ha	12 hours	30 days	Do not use with a surfactant. Spray volume to be used will vary with the amount of plant growth and should be at least 400 L/ha.
	22+M	Gavel DF	2.25 kg/ha	48 hours	66 days	Do not apply with any other additive, pesticide or fertilizer except as recommended on label.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>3–5 leaves unfolded, shoot length 10–15 cm (cont'd)</b>						
Downy mildew (cont'd)	40	Forum	450 mL/ha	12 hours	14 days	Tank-mix with another protectant downy mildew fungicide from Group M. Do not use less than 200 L water/ha. This product is fully systemic and will redistribute to young leaves and fruit as they develop.
		Revus	500 mL/ha	12 hours	14 days	Use with a non-ionic adjuvant at 0.25% v/v (2.5 L/1,000 L water). Do not use Revus plus adjuvant tank-mixed with sulphur on sulphur-sensitive varieties. This product is locally systemic.
	40+45	Zampro	0.8–1.0 L/ha	12 hours	14 days	Do not use less than 200 L water/ha. This product is fully systemic and will redistribute to young leaves as they develop.
	46	Timorex Gold *	3.0 L/ha	4 hours	2 days	<b>Suppression only.</b> Do not tank-mix or alternate with Maestro, other captan products, or sulphur. See label for precautions on compatibility.
	BM2	Stargus *	2.0–4.0 L/ha	4 hours	0 days/4 hours <sup>3</sup>	<b>Suppression only.</b> Use the higher rate when conditions are favourable for disease. Use a minimum of 500 L of water/ha. Avoid application when heavy rain is forecast. Use 50-mesh nozzle screens or larger.
	NC	Oxidate 2.0 *	1% v/v	4 hours or when dry	0 days/4 hours <sup>3</sup>	<b>Suppression only.</b>
	P6	LifeGard WG	167–333 g/ha	4 hours	0 days/4 hours <sup>3</sup>	Use the lower rate in 500 L of water and the higher rate in 1,000 L of water. LifeGard works by activating the grapevine's defence mechanisms and is most effective when applied before disease develops or when added to a rotation where disease control has been maintained. Initial inducement of plant resistance response occurs soon after application; however, 3–5 days are required to attain maximum level of protection.
	P7	Aliette	3.75 kg/ha	6 days	15 days	This product is fully systemic and will redistribute to young leaves as they develop.
		Confine Extra or Phostrol or Rampart	2.9–5.8 L/ha 2.9–5.8 L/ha 2.5–5.0 L/ha	12 hours 12 hours 4 hours	1 day 0 days/12 hours <sup>3</sup> 1 day	Use the lower rate in 500 L of water and the higher rate in 1,000 L of water. Phytotoxicity may occur if concentration is increased above the label rate or products are tank-mixed with a surfactant. Apply at 1–3-week intervals, using the high rate and short interval under high disease pressure. These products are fully systemic and will redistribute to young leaves and fruit as they develop.
Black rot	<b>General Comments:</b> <ul style="list-style-type: none"> <li>Spray susceptible varieties, especially where there is a history of black rot and conditions are wet.</li> <li>Alternate row spraying will not give adequate protection from black rot.</li> <li>Group 3 fungicides are locally systemic. Consult labels for information on drying time required before rain.</li> </ul>					
	M	Copper 53 W *	3 kg + 6 kg lime in 1,000 L water	48 hours	2 days <sup>5</sup>	<b>Suppression only.</b> Do not apply to Vidal, Concord or Niagara varieties.
		Ferbam 76 WDG	2 kg in 1,000 L water	12 hours	7 days	<b>Cannot be used after December 14, 2021.</b>

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

Table 3–1. Grape Crop Protection (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>3–5 leaves unfolded, shoot length 10–15 cm (cont'd)</b>						
Black rot (cont'd)	M (cont'd)	Manzate Pro-Stick or Penncozeb 75 DF Raincoat	7.2 kg/ha	24 hours	30 days	No product specific comments.
		Polyram DF	2 kg in 1,000 L water	12 hours	45 days	<b>Cannot be used after June 21, 2021.</b>
	3	Fullback 125 SC	585–731 mL/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	No product specific comments.
		Mettle 125 ME	292–365 mL/ha	12 hours <sup>1</sup> / 15 days <sup>2</sup>	15 days	Use high rate under high disease pressure.
		Nova	200 g/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	No product specific comments.
	3+9	Inspire Super	836 mL/ha	7 days	14 days	May cause damage to Concord.
	11	Flint	140 g/ha	12 hours <sup>1</sup> / 5 days <sup>2</sup>	14 days	Do not apply to Concord grapes. Do not apply with organosilicate surfactants
	BM2	Stargus *	2.0–4.0 L/ha	4 hours or when dry	0 days	<b>Suppression only.</b> Use the higher rate under high disease pressure. Use a minimum 500 L of water/ha. Avoid application when heavy rain is forecast. Use 50-mesh nozzle screens or larger.
	NC	Oxidate 2.0 *	1% v/v	4 hour or when dry	0 days	<b>Partial suppression only.</b>
Powdery mildew	<b>General Comments:</b> <ul style="list-style-type: none"> <li>Unless otherwise indicated, apply at 7–10-day intervals to protect expanding leaves and developing fruit clusters before symptoms appear. Apply at 7-day intervals if weather is conducive to disease or if rapid shoot growth is occurring.</li> <li>Alternate row spraying will not give adequate protection from powdery mildew.</li> <li>Group 3, 5, 7, 9, 11, 13 and 50 fungicides are locally systemic. Consult labels for information on drying time required before rain.</li> </ul>					
	M	Cosavet DF Edge * or Kumulus DF * or Microscopic Sulphur WP * or Microthiol Disperss *	12.6 kg/ha 12.6 kg/ha 4.5 kg in 1,000 L water 12.6 kg/ha	24 hours	1 day/ 21 days <sup>4</sup>	Do not use within 14 days of Purespray Green Spray Oil or SuffOil-X and 30 days of Vegol Crop Oil.
		Cueva *	1% v/v in 470–940 L water/ha	4 hours	1 day <sup>5</sup>	Do not mix with lime. Certain <i>Vitis vinifera</i> and French hybrid varieties may be sensitive to copper sprays resulting in marginal leaf burn (See Table 3–3. <i>Relative Susceptibility of Grape Cultivars to Diseases</i> ). Test a small area of each variety prior to spraying the whole block.
	3	Cevya	190–250 mL/ha	12 hours	14 days	Under high disease pressure or rapid growth, use higher rate.
		Fullback 125 SC	585–731 mL/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	No product specific comments.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>3–5 leaves unfolded, shoot length 10–15 cm (cont'd)</b>						
Powdery mildew (cont'd)	3 (cont'd)	Mettle 125 ME	219–365 mL/ha	12 hours <sup>1</sup> / 15 days <sup>2</sup>	15 days	No product specific comments.
		Nova	200 g/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	No product specific comments.
	3+7	Aprovia Top 195 EC	643 mL/ha	12 hours <sup>1</sup> / 2 days <sup>2</sup>	21 days	No product specific comments.
	3+9	Inspire Super	836 mL/ha	7 days	14 days	May cause damage to Concord.
	5	Priwen 500 EC	400–600 mL/ha	12 hours <sup>1</sup> / 17 days <sup>2</sup>	35 days	<b>Do not use on table grapes.</b>
	7	Cantus WDG	315 g/ha	12 hours	14 days	Will also suppress Botrytis.
		Sercadis	250 mL/ha	12 hours	14 days	No product specific comments.
	7+9	Luna Tranquility	600 mL/ha	12 hours <sup>1</sup> / 24 hours <sup>2</sup>	7 days	Will also control Botrytis at higher rate.
	7+11	Pristine WG	420–735 g/ha	when dry <sup>1</sup> / 21 days <sup>2</sup>	14 days/ 21 days <sup>3</sup>	Do not use on Sovereign Coronation, Concord, Fredonia or related varieties. Will also suppress Botrytis and help reduce Anthracnose.
	11	Flint	140 g/ha	12 hours <sup>1</sup> / 5 days <sup>2</sup>	14 days	Do not apply to Concord grapes. Do not apply with organosilicate surfactants.
		Intuity	439–877 mL/ha	12 hours	10 days	<b>Suppression only.</b>
		Sovran	300 g/ha	48 hours	14 days	<b>Do not tank-mix with EC pesticide formulations.</b> Phytotoxic to some cherry varieties. See label for details. Do not allow product drift onto sensitive crops.
	13	Quintec	300 mL/ha	12 hours	14 days	<b>Cannot be used after June 30, 2021.</b>
	19	Diplomat 5 SC	259–926 mL/ha	when dry	0 days	Will also suppress Botrytis.
	46	Timorex Gold *	1.5–2.0 L/ha	4 hours	2 days	Do not tank-mix or alternate with Maestro, other captan products or sulphur. See label for precautions on compatibility.
	50	Property 300 SC	300–366 mL/ha	12 hours	0 days	No product specific comments.
		Vivando SC	750 mL/ha	12 hours	14 days	Do not apply at intervals of less than 14 days.
	BM1	Fracture	1.5–3.3 L/ha	when dry	0 days	<b>Suppression only.</b> Use high rate with high disease pressure. Do not mix with foliar fertilizers.
	BM2	Actinovate SP *	425–840 g/ha	when dry	—	<b>Suppression only.</b> Apply in 500–1,000 L water/ha. Do not combine with other pesticides (especially copper products), adjuvants, surfactants or foliar fertilizers.
		Double Nickel LC *	2.5–5.0 L/ha	when dry	0 days	<b>Suppression only.</b> Use 5.0–10 L/ha with high disease pressure.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

Table 3–1. Grape Crop Protection (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>3–5 leaves unfolded, shoot length 10–15 cm (cont'd)</b>						
Powdery mildew (cont'd)	BM2 (cont'd)	Serenade OPTI *	1.7–3.3 kg/ha	when dry	0 days	<b>Suppression only.</b>
		Serifel *	250–500 g/ha	4 hours or when dry	0 days	<b>Suppression only.</b> Should be applied shortly after mixing. Do not store mixed suspension overnight. For information on the potential to tank-mix with other products, contact your local distributor or BASF representative.
	NC	Buran *	1.8% v/v	when dry	0 days	<b>Suppression only.</b> This is a new product in Ontario and little evidence of its efficacy is available. Apply no more than 18 L/ha per spray. Reapply every 7–10 days if needed. Do not apply if rain is forecast within 48 hours.
		MilStop * or Sirocco *	2.8–5.6 kg/ha	4 hours	0 days	Work post-infection as eradicants and have little protective activity. Use the lower rate in 500 L of water and the higher rate in 1,000 L of water. Create a mildly alkaline solution. Do not tank-mix with pH adjusters, oil or products not compatible with mild alkaline solutions.
		Oxidate 2.0 *	1% v/v	4 hours or when dry	0 days	<b>Partial suppression only.</b>
		Purespray Green Spray Oil 13 E *	1% v/v	12 hours	14 days/ 12 hours <sup>4</sup>	<b>Suppression only.</b> Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all 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), just prior to rain or to heat- or moisture-stressed vines. Multiple applications, especially after cluster closure, may cause Brix reduction. May remove waxy bloom on berries. <b>Do not use on table grapes within 2 weeks of harvest.</b> <b>Purespray Green Spray Oil, SuffOil-X:</b> Do not use within 14 days of Maestro, other captan products, Folpan, Perm-Up, Pounce or sulphur. Do not tank-mix with copper more than once per season. <b>Vegol:</b> Do not use within 14 days of Maestro, other captan products, Folpan or copper and 30 days of sulphur. Do not apply to wet foliage.
		SuffOil-X *	1.3% v/v	12 hours	14 days/ 12 hours <sup>4</sup>	
		Vegol Crop Oil *	2% v/v	12 hours	14 days/ 0 days <sup>4</sup>	
	P5	Regalia Maxx *	0.125–0.25% v/v in 500–1,500 L water	when dry	0 days	
	P6	LifeGard WG	167–333 g/ha	4 hours	0 days/4 hours <sup>4</sup>	<b>Suppression only.</b> Use the lower rate in 500 L and the higher rate in 1,000 L of water. LifeGard WG works by activating the grapevine's resistance response and is most effective if applied before infection occurs or when added to a rotation where disease control has been maintained by an effective fungicide program.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
Special sprays						
Mealybug, Scale	<b>General Comments:</b> <ul style="list-style-type: none"><li>• If grape leafroll-associated virus has been confirmed by an accredited lab and scale has been confirmed in the vineyard, this spray may reduce vector pressure and spread of the virus.</li><li>• Apply when crawlers are present. Control only exposed scales, not those under bark.</li><li>• May also suppress exposed Mealybug crawlers.</li></ul>					
	1B	Malathion 85 E	880 mL in 1,000 L water	12 hours <sup>1</sup> / 4 days <sup>2</sup>	3 days /4 days <sup>3</sup>	No product specific comments.
	NC	Kopa Insecticidal Soap * or Opal Insecticidal Soap *	2% v/v 1% v/v	12 hours	0 days	Begin applications when populations are low and reapply every 1–3 weeks as needed. Test a small area of each variety prior to spraying the whole block. Applying soaps more than 3 times may cause plant injury. See label for details. Avoid application in direct sunlight or to vines under stress. Application within 3 days of sulphur may increase plant injury on sensitive varieties.
		Vegol Crop Oil *	2% v/v	12 hours	0 days	See comments on this product for Mealybug and Scale at <b>Dormant to bud swell</b> .
Shoot length 20–25 cm						
Erineum mite	• Use one of the products listed for Erineum mite at <b>3–5 leaves unfolded, shoot length 10–15 cm</b> .					
Grape berry moth	NC	Isomate-GBM Plus *	500 dispensers/ha	—	—	Reduces mating of grape berry moth. Apply prior to first flight of the second generation (early- to mid-June, depending on location and season). Border sprays of insecticide or higher rates of pheromone (1,000 dispensers/ha) may be required where pressure is high. Dispensers last up to 150 days. For more information on mating disruption, see OMAFRA Factsheet 03–079, <i>Mating Disruption for Management of Insect Pests</i> .
Phylloxera (leaf form)	<b>General Comments:</b> <ul style="list-style-type: none"><li>• Apply when galls are first observed.</li></ul>					
	4A	Aceta 70 WP or Assail 70 WP	80 g/ha	12 hours <sup>1</sup> / 5 days <sup>2</sup>	3 days/ 5 days <sup>3</sup>	No product specific comments.
	23	Movento 240 SC	365 mL/ha	12 hours	7 days	Will redistribute to young leaves as they develop. Control may not be apparent for 2–3 weeks. Consecutive applications should be at least 30 days apart. Tank-mix with a non-ionic surfactant at 0.2% v/v (2 L/ 1,000 L). See label for further details. Do not tank-mix or apply in sequential applications with Maestro or other captan products when using surfactant. <b>Do not use on table grapes</b> . This timing will also control mealybug and suppress scale. Refer to Mealybug and Scale at <b>Immediate prebloom</b> .

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

Table 3–1. Grape Crop Protection (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>Shoot length 20–25 cm (cont'd)</b>						
Phomopsis cane and leaf spot		<ul style="list-style-type: none"> <li>Use one of the products listed for Phomopsis cane and leaf spot at <b>First leaf, shoot length 1.25–5 cm.</b></li> <li><b>Maximum of 2 applications of Maestro or other captan products per year for Phomopsis.</b></li> </ul>				
Anthrachnose		Use one of the products listed for Anthracnose at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b>				
Black rot		<b>General Comments:</b> <ul style="list-style-type: none"> <li>Spray susceptible varieties, especially where there is a history of black rot and conditions are wet.</li> <li>Alternate row spraying will not give adequate protection from black rot.</li> <li>Group 3, 7, 9 and 11 fungicides are locally systemic. Consult labels for information on drying time required before rain.</li> </ul>				
	M	Copper 53 W *	3 kg + 6 kg lime in 1,000 L water	48 hours	2 days <sup>5</sup>	<b>Suppression only.</b> Do not apply to Vidal, Concord or Niagara varieties.
		Dithane Rainshield or Manzate Pro-Stick or Penncozeb 75 DF Raincoat	7.2 kg/ha	12 hours 24 hours 24 hours	30 days	<b>Dithane Rainshield: Maximum of 1 prebloom and 3 postbloom applications.</b>
		Polyram DF	2 kg in 1,000 L water	12 hours	45 days	<b>Cannot be used after June 21, 2021.</b>
	3	Fullback 125 SC	585–731 mL/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	No product specific comments.
		Mettle 125 ME	292–365 mL/ha	12 hours <sup>1</sup> / 15 days <sup>2</sup>	15 days	Use high rate under high disease pressure.
		Nova	200 g/ha	12 hours <sup>1</sup> / 7 days <sup>2</sup>	14 days	No product specific comments.
	3+9	Inspire Super	1.48 L/ha	7 days	14 days	May cause damage to Concord.
	7+11	Pristine WG	735 g/ha	when dry <sup>1</sup> / 21 days <sup>2</sup>	14 days/ 21 days <sup>3</sup>	When used as directed, will also help to reduce Anthracnose. Do not use on Sovereign Coronation, Concord, Fredonia or related varieties.
	11	Flint 50 WG	140 g/ha	12 hours <sup>1</sup> / 5 days <sup>2</sup>	14 days	Do not apply to Concord grapes. Do not apply with organosilicate surfactants.
		Sovran	240 g/ha	48 hours	14 days	Do not tank-mix with EC pesticide formulations. Phytotoxic to some cherry varieties. See label for details. Do not allow product drift onto sensitive crops.
	BM2	Stargus *	2.0–4.0 L/ha	4 hours or when dry	0 days	<b>Suppression only.</b> Use the higher rate under high disease pressure. Use a minimum of 500 L of water/ha. Avoid application when heavy rain is forecast. Use 50-mesh nozzle screens or larger.
	NC	Oxidate 2.0 *	1% v/v	4 hours or when dry	0 days	<b>Partial suppression only.</b>

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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



**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
Shoot length 20–25 cm (cont'd)						
Powdery mildew	<ul style="list-style-type: none"><li>Use one of the products listed for Powdery mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li><li><b>Do not use Quintec after June 30, 2021.</b></li></ul>					
Downy mildew	<ul style="list-style-type: none"><li>Use one of the products listed for Downy mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li><li>Unless otherwise indicated, apply at 7–10-day intervals to protect developing leaves and fruit clusters. Apply at shorter intervals if weather is conducive to disease.</li><li><b>Maximum of 1 prebloom application of Ridomil Gold-MZ 68 WDG.</b></li><li><b>Maximum of 1 application Maestro or other captan product per year for downy mildew.</b></li><li><b>Maximum of 1 prebloom application of Dithane Rainshield.</b></li><li><b>Polyram DF cannot be used after June 21, 2021.</b></li></ul>					
Immediate prebloom						
Erineum mite	<ul style="list-style-type: none"><li>Use one of the products listed for Erineum mite at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li></ul>					
Japanese beetle	<b>General Comments:</b> <ul style="list-style-type: none"><li>Japanese beetle is a sporadic pest in Ontario.</li><li>Monitor presence and extent of feeding damage. Where damage is localized, spot treatment may be adequate.</li></ul>					
	1	Imidan WP	1.36 kg/ha	14 days <sup>1</sup> / 30 days <sup>2</sup>	14 days /30 days <sup>3</sup>	No product specific comments. <b>Cannot be used after October 30, 2022.</b>
	4	Aceta 70 WP or Assail 70 WP	80 g/ha	12 hours <sup>1</sup> / 5 days <sup>2</sup>	3 days/ 5 days <sup>3</sup>	No product specific comments.
	28	Altacor	285 g/ha	12 hours	14 days	<b>Suppression only.</b> Apply when feeding is first observed and reapply in 10–14 days, if needed.
Leafhoppers	<b>General Comments:</b> <ul style="list-style-type: none"><li>Grape leafhopper, potato leafhopper, three-banded leafhopper and Virginia creeper leafhopper are the main species of leafhoppers that feed on grapes in Ontario.</li></ul>					
	3	Perm-UP EC or Pounce 384 EC	175 mL/ha 175 mL/ha	12 hours 12 hours	21 days 21 days	No product specific comments.
		Pyganic EC 1.4 II *	2.32–4.65 L/ha	12 hours	0 days/12 hours <sup>3</sup>	Apply when leafhoppers are first observed. Do not wait until plants are heavily infested. Reapply if necessary after 7 days. For best results, use high rate, adjust spray solution to pH of 5.5–7.0, and apply promptly after mixing. If possible, apply in the early morning or evening. Before making widespread applications, treat a small area and observe for phytotoxicity over a 10-day period.
		UP-Cyde 2.5 EC	240 mL/ha	12 hours	7 days	<b>Do not use on table grapes.</b>
	4A	Admire 240 Flowable	200 mL/ha	24 hours	0 days	Where possible, rotate with products outside of Group 4.
Aceta 70 WP or Assail 70 WP		80 g/ha	12 hours <sup>1</sup> / 5 days <sup>2</sup>	3 days/ 5 days <sup>3</sup>		
Clutch 50 WDG		100–140 g/ha	12 hours	1 day		

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>Immediate prebloom (cont'd)</b>						
Leafhoppers (cont'd)	4C	Closer	200–240 mL/ha	12 hours	7 days	Where possible, rotate with products outside of Group 4.
	4D	Sivanto Prime	500–750 mL/ha	12 hours	0 days	<b>Closer: Suppression only.</b>
	NC	Surround WP *	50 kg/ha	12 hours	bloom/0 days <sup>4</sup>	Apply at first sign of leafhoppers. Use 50 kg/ha for the initial 2 applications to establish the protectant layer, followed by 25 kg/ha in subsequent sprays. Light to moderate rain will help distribute product. Reapply after heavy rain, strong wind or overhead irrigation. Do not use with anti-foaming agents, spreader/stickers or oil. Closely monitor harvest parameters to determine best time to harvest. <b>Do not apply postbloom on table grapes.</b>
Phylloxera (leaf form)	4A	Aceta 70 WP or Assail 70 WP	80 g/ha	12 hours <sup>1</sup> / 5 days <sup>2</sup>	3 days/ 5 days <sup>3</sup>	Where possible, rotate with products outside of Group 4. <b>Clutch:</b> Will also control exposed mealybug crawlers and suppress exposed scales.
		Clutch 50 WDG	140–210 g/ha	12 hours	1 day	
	23	Movento 240 SC	365 mL/ha	12 hours	7 days	Will redistribute to young leaves as they develop. Control may not be apparent for 2–3 weeks. Consecutive applications should be at least 30 days apart. Tank-mix with a permitted adjuvant/additive with spreading and penetrating properties at a suggested rate of 0.2% v/v (2 L/1,000 L water). See label for further details. Do not tank-mix or apply in sequential applications with Maestro or other captan products when using surfactant. <b>Do not use on table grapes.</b>
Mealybug, Scale	23	Movento 240 SC	365–585 mL/ha	12 hours	7 days	This timing is appropriate if Phylloxera is a problem in the vineyard. <b>Suppression only for scale.</b> If grape leafroll-associated virus has been confirmed by an accredited lab and mealybug or scale has been confirmed in the vineyard, this spray may reduce insect vector pressure and spread of the virus. Reapply 30 days later. Tank-mix with a permitted non-ionic surfactant at 0.2% v/v (2 L/1,000 L water). See label for further details. Do not tank-mix or apply in sequential applications with Maestro or other captan products when using surfactant. <b>Do not use on table grapes.</b>
<b>Trace bloom (first cap fall)</b>						
<b>DO NOT APPLY INSECTICIDES WHILE GRAPES ARE IN BLOOM. SEE BEE POISONING, Chapter 1.</b>						
Black rot	<ul style="list-style-type: none"> <li>Use one of the products listed for Black rot at <b>Shoot length 20–25 cm.</b></li> <li>Fruit clusters are highly susceptible to black rot from bloom to 4 weeks postbloom.</li> <li>Apply at 7–10-day intervals to protect expanding leaves and developing fruit clusters. Apply at shorter intervals if weather is conducive to disease.</li> <li><b>Do not use Polyram after June 21, 2021.</b></li> </ul>					
Anthracnose	Use one of the products listed for Anthracnose at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b>					

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
Trace bloom (first cap fall) (cont'd)						
Downy mildew	<ul style="list-style-type: none"><li>• Use one of the products listed for Downy mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li><li>• Rotate among groups for resistance management.</li><li>• Fruit clusters are very susceptible to downy mildew from bloom to 4–6 weeks postbloom.</li><li>• Unless otherwise indicated, spray at 7–10-day intervals to protect developing leaves and fruit clusters. Spray at 7-day intervals if weather is conducive to disease, unless otherwise specified on label.</li><li>• <b>Maximum of 1 application of Maestro or other captan products per year for downy mildew.</b></li><li>• <b>Maximum of 1 application of Ridomil Gold MZ prebloom and 1 application postbloom.</b></li><li>• <b>Maximum of 3 postbloom applications of Dithane Rainshield.</b></li><li>• <b>Do not use Polyram after June 21, 2021.</b></li></ul>					
Powdery mildew	<ul style="list-style-type: none"><li>• Use one of the products listed for Powdery mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li><li>• Rotate among fungicide groups for resistance management.</li><li>• Fruit clusters are very susceptible to powdery mildew from bloom to 4–6 weeks postbloom.</li><li>• Unless otherwise indicated, spray at 7–10-day intervals to protect developing leaves and fruit clusters. Spray at 7-day intervals if weather is conducive to disease, unless otherwise specified on label.</li><li>• <b>Do not use Quintec after June 30, 2021.</b></li></ul>					
Immediate postbloom to early fruit set						
Leafhoppers	<ul style="list-style-type: none"><li>• Use one of the products listed for Leafhoppers at <b>Immediate prebloom.</b></li><li>• Surround may reduce Brix accumulation.</li></ul>					
Japanese beetle	<ul style="list-style-type: none"><li>• Use one of the products listed for Japanese beetle at <b>Immediate prebloom.</b></li></ul>					
Phylloxera (leaf form)	<ul style="list-style-type: none"><li>• Use one of the products listed for Phylloxera at <b>Immediate prebloom.</b></li><li>• Do not apply Movento within 30 days of first application.</li></ul>					
Mealybug, Scale	23	Movento 240 SC	365–585 mL/ha	12 hours	7 days	This is the preferred timing if Phylloxera is not a problem in the vineyard. <b>Suppression only for scale.</b> If grape leafroll-associated virus has been confirmed by an accredited lab and mealybug or scale has been confirmed in the vineyard, this spray may reduce insect vector pressure and spread of the virus. Reapply 30 days later. Tank-mix with a non-ionic surfactant at 0.2% v/v (2 L/1,000 L water). See label for further details. Do not tank-mix or apply in sequential applications with Maestro or other captan products when using surfactant. <b>Do not use on table grapes.</b>
Black rot	<ul style="list-style-type: none"><li>• Use one of the products listed for Black rot at <b>Shoot length 20–25 cm.</b></li><li>• Fruit clusters are highly susceptible to black rot from bloom to 4 weeks postbloom.</li><li>• Apply at 7–10-day intervals to protect expanding leaves and developing fruit clusters. Apply at shorter intervals if weather is conducive to disease unless otherwise specified on label.</li><li>• <b>Do not use Polyram after June 21, 2021</b></li><li>• <b>Maximum of 3 postbloom applications of Dithane Rainshield.</b></li></ul>					

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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Table 3–1. Grape Crop Protection (cont'd)

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>Immediate postbloom to early fruit set (cont'd)</b>						
Powdery mildew		<ul style="list-style-type: none"> <li>• Use one of the products listed for Powdery mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li> <li>• Rotate among fungicide groups for resistance management.</li> <li>• Fruit clusters are highly susceptible to powdery mildew from bloom to 4–6 weeks postbloom.</li> <li>• Unless otherwise indicated, spray at 7–10-day intervals to protect developing leaves and fruit clusters. Spray at 7-day intervals if weather is conducive to disease unless otherwise specified on label.</li> <li>• <b>Do not use Quintec after June 30, 2021.</b></li> </ul>				
Downy mildew		<ul style="list-style-type: none"> <li>• Use one of the products listed for Downy mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li> <li>• Rotate among fungicide groups for resistance management.</li> <li>• Fruit clusters are highly susceptible to downy mildew until 4–6 weeks after bloom.</li> <li>• Unless otherwise indicated, spray at 7–10-day intervals to protect developing leaves and fruit clusters. Spray at 7-day intervals if weather is conducive to disease unless otherwise specified on label.</li> <li>• <b>Maximum of 1 application of Maestro or other captan products per year for downy mildew.</b></li> <li>• <b>Maximum of 1 application of Ridomil Gold MZ prebloom and 1 application postbloom.</b></li> <li>• <b>Maximum of 3 postbloom applications of Dithane Rainshield.</b></li> <li>• <b>Do not use Polyram after June 21, 2021.</b></li> </ul>				
Botrytis bunch rot		<ul style="list-style-type: none"> <li>• Apply if a Botrytis-active spray was not applied at <b>Trace Bloom.</b> See Table 3–4. <i>Activity of Fungicides on Grape Diseases and Impact on Honeybees.</i></li> <li>• If the bloom/postbloom period is wet, spray immediately to control latent infections in susceptible varieties (Baco Noir, Marechal Foch Gamay Noir, Pinot Noir, Pinot Gris, Riesling, Chardonnay, Gewurztraminer, Sauvignon Blanc and Seyval Blanc). See Table 3–3. <i>Relative Susceptibility of Grape Cultivars to Diseases.</i></li> <li>• Direct this spray at the fruiting zone.</li> <li>• Rotate among fungicide groups for resistance management.</li> <li>• Group 3, 7, 9, 11, 12, and 17 fungicides are locally systemic. Consult labels for information on drying time required before rain.</li> </ul>				
	3+9	Inspire Super	1.03–1.48 L/ha	7 days	14 days	May cause damage to Concord. Will also control Powdery mildew and Black rot at high rate.
	7	Kenja 400 SC	1.46–1.61 L/ha	12 hours	14 days	No product specific comments.
	7+9	Luna Tranquility	1.2 L/ha	12 hours <sup>1</sup> / 24 hours <sup>2</sup>	7 days	Will also control Powdery mildew.
	7+11	Pristine WG	420–735 g/ha	when dry <sup>1</sup> / 21 days <sup>2</sup>	14 days/ 21 days <sup>3</sup>	<b>Suppression only.</b> Do not use on Sovereign Coronation, Concord, or Fredonia. This product is locally systemic.
	7+12	Miravis Prime	0.8–1.0 L/ha	12 hours	14 days	Do not apply at less than 21-day treatment interval.
	9	Scala SC	2 L/ha	12 hours <sup>1</sup> / 24 hours <sup>2</sup>	7 days	Phytotoxic to some cherry varieties. Do not let product drift onto sensitive crops.
	9+12	Switch 62.5 WG	775–975 g/ha	12 hours <sup>1</sup> / 48 hours <sup>2</sup>	7 days	No product specific comments.
	11	Intuity	439–877 mL/ha	12 hours	10 days	No product specific comments.
	17	Elevate 50 WDG	1.12 kg/ha	4 hours	7 days	Tank-mix with Agral 90 at 0.02% v/v (200 mL/1,000 L water).

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>Immediate postbloom to early fruit set (cont'd)</b>						
Botrytis bunch rot (cont'd)	19	Diplomat 5 SC	463–926 mL/ha	when dry	0 days	<b>Suppression only.</b>
	46	Timorex Gold *	1.5–2.0 L/ha	4 hours	2 days	Do not tank-mix or alternate with Maestro, other captan products or sulphur. See label for precautions on compatibility.
	BM1	Fracture	1.5–3.3 L/ha	when dry	0 days	<b>Suppression only.</b> Use high rate for high disease pressure. Do not mix with foliar fertilizers.
	BM2	Double Nickel LC *	3.0–6.25 L/ha	when dry	0 days	<b>Suppression only.</b> Under high disease pressure, use 6.25–25 L/ha
		Serenade OPTI *	1.7–3.3 kg/ha	when dry	0 days	<b>Suppression only.</b>
		Serifel *	250–500 g/ha	4 hours or when dry	0 days	<b>Suppression only.</b> Should be applied shortly after mixing. Do not store mixed suspension overnight. For information on the potential to tank-mix with other products, contact your local distributor or BASF representative.
	NC	Botector *	1 kg in 1,000 L water	4 hours	0 days	<b>Suppression only.</b> Adjust water volume according to vine growth stage. Not compatible with some fungicides, such as Flint, Kumulus and Switch. See <a href="http://www.bio-ferm.com">www.bio-ferm.com</a> for product compatibilities. For products that are not compatible, keep a 3-day interval before and after application. Avoid application when heavy rain is forecast.
	NC	Sirocco *	2.8–5.6 kg/ha	4 hours	0 days	<b>Suppression only.</b> Works as eradicant and has little protective activity. Use the lower rate in 500 L of water and the higher rate in 1,000 L of water. Create a mildly alkaline solution. Do not tank-mix with pH adjusters, oil or products not compatible with mild alkaline solutions.
	P5	Regalia Maxx *	0.25% v/v in 500 L water	when dry	0 days	<b>Suppression only.</b> Apply before symptoms develop. Use 0.25% (1.25 L in 500 L water) in rotation with other fungicides.
<b>Berries pea-sized</b>						
Grape berry moth (second generation)	<b>General Comments:</b> <ul style="list-style-type: none"> <li>• Where mating disruption is in place and monitoring indicates good control, an insecticide is not needed at this time.</li> <li>• Where there is a history of damage, apply at the appropriate timing as indicated by monitoring adult moth numbers in pheromone traps (listed in product specific comments below). Reapply if flight is extended.</li> <li>• Direct spray at the fruiting zone.</li> <li>• Apply in sufficient water to ensure thorough coverage on all sides of the cluster.</li> </ul>					
	1	Imidan WP	2.2 kg/ha	14 days <sup>1</sup> / 30 days <sup>2</sup>	14 days	Apply 5–7 days following peak flight. <b>Cannot be used after October 30, 2022.</b>
	3	Perm-UP EC or Pounce 384 EC	360 mL/ha 360 mL/ha	12 hours 12 hours	21 days 21 days	Apply 5–7 days following peak flight. <b>UP-Cyde: Do not use on table grapes.</b>
		UP-Cyde 2.5 EC	240 mL/ha	12 hours	7 days	

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
Berries pea-sized (cont'd)						
Grape berry moth (second generation) (cont'd)	5	Delegate	280 g/ha	12 hours	7 days	Apply immediately following peak flight. <b>Entrust, Success: Suppression only.</b>
		Entrust * or Success	364 mL/ha 182 mL/ha	when dry <sup>1</sup> / 7 days <sup>2</sup>	7 days	
	11	BioProtec PLUS * or Dipel 2X DF *	1.8 L/ha 1.125 kg/ha	4 hours	0 days/4 hours <sup>3</sup>	Apply immediately following peak flight. Reapply 7–10 days later, if needed.
		XenTari WG *	0.5–1.0 kg/ha	12 hours	0 days/12 hours <sup>3</sup>	
	18	Intrepid 240 F	600 mL/ha	12 hours	30 days	Apply immediately following peak flight. Maximum of 3 applications.
	28	Altacor	285 g/ha	12 hours	14 days	Apply immediately following peak flight.
		Harvanta 50 SL	1.2–1.6 L/ha	12 hours	7 days	
Vayego 200 SC		225 mL/ha	12 hours	14 days		
Japanese beetle	<ul style="list-style-type: none"><li>Use one of the products listed for Japanese beetle at <b>Immediate prebloom</b>.</li></ul>					
Mealybug, Scale	<ul style="list-style-type: none"><li>Use one of the products listed for Mealybug at <b>Immediate prebloom</b>.</li><li>Do not apply Movento within 30 days of first application.</li></ul>					
Phylloxera (leaf form)	<ul style="list-style-type: none"><li>Use one of the products listed for Phylloxera at <b>Immediate prebloom</b>.</li><li>Do not apply Movento within 30 days of first application.</li></ul>					
Powdery mildew	<ul style="list-style-type: none"><li>Use one of the products listed for Powdery mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm</b>.</li><li>Rotate among fungicide groups for resistance management.</li><li>Fruit clusters are highly susceptible to powdery mildew from bloom to 4–6 weeks postbloom.</li><li>Unless otherwise indicated, spray at 7–10-day intervals to protect developing leaves and fruit clusters. Spray at 7-day intervals if weather is conducive to disease.</li><li>Increase rate of Microscopic Sulphur to 6 kg in 1,000 L water.</li><li>Increase rate of Sercadis to 333 mL/ha.</li><li>Oil products may remove the waxy bloom on grape berries.</li><li><b>Do not use Quintec after June 30, 2021.</b></li><li><b>Do not use Luna Tranquility within 45 days of harvest.</b></li></ul>					
Downy mildew	<ul style="list-style-type: none"><li>Use one of the products listed for Downy mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm</b>.</li><li>Rotate among fungicide groups for resistance management.</li><li>Fruit clusters are highly susceptible to downy mildew until 4–6 weeks postbloom.</li><li>Unless otherwise indicated, spray at 7–10-day intervals to protect developing leaves and fruit clusters. Spray at 7-day intervals if weather is conducive to disease.</li><li><b>Maximum of 1 postbloom application of Ridomil Gold MZ.</b></li><li><b>Maximum of 1 application of Maestro or other captan products per year for downy mildew; 55-day REI for hand leaf removal and hand harvest.</b></li><li><b>Maximum of 3 postbloom applications of Dithane Rainshield.</b></li><li><b>Do not use Polyram after June 21, 2021.</b></li></ul>					

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
Berries pea-sized (cont'd)						
Black rot	<ul style="list-style-type: none"><li>• Use one of the products listed for Black rot at <b>Shoot length 20–25 cm.</b></li><li>• Fruit clusters are highly susceptible to black rot from bloom to 4 weeks postbloom.</li><li>• <b>Do not use Polyram after June 21, 2021.</b></li><li>• <b>Maximum of 3 postbloom applications of Dithane Rainshield.</b></li></ul>					
Berry touch to cluster closure						
Check product labels and Table 3–2. <i>Products Used on Grapes, for preharvest intervals.</i>						
European red mite, Two-spotted spider mite	<b>General Comments:</b> <ul style="list-style-type: none"><li>• Monitor where there has been a history of mite damage.</li><li>• Monitor for foliar injury and apply a miticide when 3–5 mites are found per mid-shoot leaf.</li><li>• Thorough spray coverage is essential for good control.</li><li>• For resistance management, do not use any product more than once per season.</li><li>• Two spotted spider mite is a problem only in very hot, dry growing seasons when cover crops die off.</li></ul>					
	6	Agri-Mek SC	130–265 mL/ha	12 hours <sup>1</sup> / 13 days <sup>2</sup>	28 days	Apply when mites first appear. Use low rate for low to moderate infestations and high rate for severe infestations. Use with a non-ionic surfactant in a minimum of 470 L of water/ha. Do not apply within 10 days of Maestro, other captan products or Folpan. Monitor and evaluate control 7–10 days after application.
	20D	Acramite 50 WS	851 g/ha	12 hours <sup>1</sup> / 24 hours <sup>2</sup>	14 days	If only two-spotted spider mite is a problem, use 567 g/ha.
	21	Nexter SC or Nexter WP	500 mL/ha 300 g/ha	24 hours <sup>1</sup> / 30 days <sup>2</sup>	25 days/ 30 days <sup>3</sup>	Effective against nymphs only.
	23	Envidor 240 SC	750 mL/ha	12 hours	14 days	Control may not be apparent for 2–3 weeks. Active on all life stages, including eggs, nymphs and adults.
	25	Nealta	1 L/ha	12 hours	14 days	Provides knock-down and residual control. The addition of a surfactant registered on the crop may improve activity. Active on all life stages, including eggs, nymphs and adults. See label for further details.
	NC	Kopa Insecticidal Soap *	2% v/v	12 hours	12 hours	Begin applications when populations are low and reapply every 1–3 weeks as needed. Test a small area of each variety prior to spraying the whole block. These products must coat the bodies of mites 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 details. Avoid applications in direct sunlight or to vines under stress. Application within 3 days of sulphur may increase plant injury on sensitive varieties. <b>Do not use on table grapes once they become 6–7 mm in diameter (removes waxy bloom).</b>
		Opal Insecticidal Soap *	1% v/v	12 hours	12 hours	

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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



**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
Berry touch to cluster closure (cont'd)						
Check product labels and Table 3–2. <i>Products Used on Grapes, for preharvest intervals.</i>						
European red mite, Two-spotted spider mite (cont'd)	NC (cont'd)	Purespray Green Spray Oil 13 E *	1% v/v	12 hours	14 days/ 12 hours <sup>4</sup>	<b>Suppression only.</b> Apply in a high-volume spray to ensure thorough coverage. Tolerance has not been determined for all 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), just prior to rain or to heat- or moisture-stressed vines. Multiple applications, especially after cluster closure, may cause Brix reduction. May remove waxy bloom on berries. <b>Do not use on table grapes within 2 weeks of harvest.</b> <b>Purespray Green Spray Oil, SuffOil-X:</b> Do not use within 14 days of Maestro, other captan products, Perm-Up, Pounce or sulphur. <b>Vegol:</b> Do not use within 14 days of Maestro, other captan products, Folpan or copper and 30 days of sulphur. Do not apply to wet foliage.
		SuffOil-X *	1.3% v/v	12 hours	14 days/ 12 hours <sup>4</sup>	
		Vegol Crop Oil *	2% v/v	12 hours	0 days	
Powdery mildew	<ul style="list-style-type: none"><li>• Use one of the products listed for Powdery mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm.</b></li><li>• Rotate among fungicide groups for resistance management.</li><li>• Fruit clusters are highly susceptible to powdery mildew from bloom to 4–6 weeks postbloom.</li><li>• Increase rate of Microscopic Sulphur to 6 kg in 1,000 L water.</li><li>• Increase rate of Sercadis to 333 mL/ha.</li><li>• <b>Purespray Green Spray Oil, SuffOil-X and Vegol Crop Oil may remove the waxy bloom on grape berries.</b></li><li>• <b>Do not use Luna Tranquility within 45 days of harvest.</b></li><li>• <b>Do not use Quintec after June 30, 2021.</b></li></ul>					
Downy mildew	<ul style="list-style-type: none"><li>• Use one of the products listed for Downy mildew at <b>3–5 leaves unfolded, 10–15 cm shoot length.</b></li><li>• Rotate among fungicide groups for resistance management.</li><li>• Fruit clusters are highly susceptible to downy mildew until 4–6 weeks after bloom.</li><li>• <b>Maximum of 1 application of Maestro or other captan products per year for downy mildew; 55-day REI for hand leaf removal and hand harvest.</b></li><li>• <b>Maximum of 3 postbloom applications of Dithane Rainshield.</b></li><li>• <b>Do not use Polyram after June 21, 2021.</b></li></ul>					
Black rot	<ul style="list-style-type: none"><li>• This spray is necessary only if black rot is severe and new infections continue to occur.</li><li>• Use one of the products listed for Black rot at <b>Shoot length 20–25 cm.</b></li><li>• <b>Maximum of 3 postbloom applications of Dithane Rainshield.</b></li><li>• <b>Do not use Polyram after June 21, 2021.</b></li></ul>					
Botrytis bunch rot	<ul style="list-style-type: none"><li>• Use one of the products listed for Botrytis bunch rot at <b>Immediate postbloom</b>, ensuring rotation among groups for resistance management.</li><li>• This is a critical spray for Botrytis bunch rot.</li><li>• Many of the vinifera and French hybrid varieties with tight clusters are susceptible to botrytis bunch rot (e.g., Baco Noir, Marechal Foch, Gamay Noir, Pinot Noir, Pinot Gris, Riesling, Chardonnay, Gewurztraminer, Sauvignon Blanc and Seyval Blanc).</li><li>• Direct Botrytis-specific sprays at the fruiting zone.</li><li>• Ensure complete coverage of berries before clusters close.</li><li>• <b>Do not use Luna Tranquility within 45 days of harvest.</b></li></ul>					

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>Beginning of ripening (veraison) through harvest</b> <b>Check product labels and Table 3-2. Products Used on Grapes for preharvest intervals.</b>						
Grape berry moth (about mid to late August)		<ul style="list-style-type: none"> <li>In blocks without mating disruption, use one of the products listed for Grape berry moth at <b>Berries pea-sized</b>.</li> <li>Rotate among insecticide groups between generations for resistance management.</li> <li>Border sprays of conventional insecticides may be very effective in blocks with low pressure.</li> <li>Direct spray at fruiting zone.</li> <li>Where mating disruption is in place and monitoring indicates good control, an insecticide may not be needed at this time.</li> </ul>				
Powdery mildew		<ul style="list-style-type: none"> <li>Use one of the products listed for Powdery mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm</b>.</li> <li>Rotate among fungicide groups for resistance management.</li> <li>Foliage of vinifera and some French hybrid varieties are more susceptible and may require extra sprays.</li> <li>Increase rate of Microscopic Sulphur to 6 kg in 1,000 L water.</li> <li>Increase rate of Sercadis to 333 mL/ha.</li> <li><b>Purespray Green Spray Oil, Suffoil-X and Vegol Crop Oil may remove the waxy bloom on grapes; not recommended for table grapes within 14 days of harvest.</b></li> <li><b>Do not use Quintec after June 30, 2021.</b></li> <li><b>Do not use Luna Tranquility within 45 days of harvest.</b></li> </ul>				
Downy mildew		<ul style="list-style-type: none"> <li>Use one of the products listed for Downy mildew at <b>3–5 leaves unfolded, shoot length 10–15 cm</b>.</li> <li>Rotate among fungicide groups for resistance management.</li> <li>Foliage of vinifera and some French hybrid varieties are more susceptible and may require extra sprays.</li> <li><b>Maximum of 1 postbloom application of Ridomil Gold MZ.</b></li> <li><b>Maximum of 1 application of Maestro or other captan products per year for downy mildew; 55-day REI for hand leaf removal and hand harvest.</b></li> <li><b>Do not use Polyram after June 21, 2021.</b></li> <li><b>Maximum of 3 postbloom sprays of Dithane Rainshield.</b></li> </ul>				
Botrytis bunch rot		<ul style="list-style-type: none"> <li>Use one of the products listed for Botrytis bunch rot at <b>Immediate postbloom</b>. Rotate among fungicide groups for resistance management.</li> <li>Many of the vinifera and French hybrid varieties with tight clusters are susceptible to botrytis bunch rot (e.g., Baco Noir, Marechal Foch, Gamay Noir, Pinot Noir, Pinot Gris, Riesling, Chardonnay, Gewurztraminer, Sauvignon Blanc and Seyval Blanc). See Table 3–3. <i>Relative Susceptibility of Grape Cultivars to Diseases</i>.</li> <li>Direct Botrytis-specific sprays at the fruiting zone.</li> <li><b>Do not use Luna Tranquility within 45 days of harvest.</b></li> </ul>				
Slug, snail	NC	Sluggo Professional	25 kg/ha	12 hours	—	No product specific comments.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

**Table 3–1. Grape Crop Protection (cont'd)**

Disease or Insect	Group	Product	Rate	Restricted Entry Interval	Preharvest Interval	Product Specific Comments
<b>Special sprays (when monitoring indicates the need)</b>						
Multi-coloured Asian lady beetle	<b>General Comments:</b> <ul style="list-style-type: none"> <li>Lady beetles are not a problem until very close to harvest. Begin monitoring around mid-August and continue for each cultivar until harvested.</li> <li>Early presence of lady beetles is not an immediate concern because they can arrive and leave an area rapidly. Discuss beetle thresholds and product restrictions with the proposed purchaser of grapes before taking action. Continue to monitor after treatment.</li> <li>Re-infestation may occur before harvest.</li> </ul>					
	1	Malathion 85 E	880 mL/ha	12 hours <sup>1</sup> / 4 days <sup>2</sup>	3 days	No product specific comments.
	3	UP-Cyde	245 mL/ha	12 hours	2 days/ 7 days <sup>3</sup>	<b>Do not use on table grapes.</b>
Yellow jacket wasps	3	UP-Cyde	245 mL/ha	12 hours	2 days/ 7 days <sup>3</sup>	<b>Do not use on table grapes.</b>
Spotted wing drosophila	<b>General Comments:</b> <ul style="list-style-type: none"> <li>Spotted wing drosophila has not been confirmed to be a major pest of grapes in Ontario.</li> <li>However, all <i>Drosophila</i> species can vector the organisms that cause sour rot so controlling this insect may help reduce sour rot.</li> <li>Apply products with sufficient water to ensure complete coverage.</li> <li>See Table 3–5. <i>Activity of Insecticides and Miticides on Grape Pests and Honeybees</i> for other products that have activity on spotted wing drosophila.</li> </ul>					
	1	Malathion 85 E	880 mL in 1,000 L water	12 hours <sup>1</sup> / 4 days <sup>2</sup>	3 days/ 4 days <sup>3</sup>	<b>Suppression only.</b>
	5	Delegate	350 g/ha	12 hours	7 days	No product specific comments.
		Entrust *	364 mL/ha	when dry <sup>1</sup> / 7 days <sup>2</sup>	7 days	
		Success	182 mL/ha	when dry <sup>1</sup> / 7 days <sup>2</sup>	7 days	
	28	Harvanta 50 SL	1.2–1.6 L/ha	12 hours	7 days	No product specific comments.
Brown marmorated stink bug	<b>General Comments:</b> <ul style="list-style-type: none"> <li>Breeding populations of this pest are present in Ontario. The impact on grapes in Ontario has not been confirmed. Check <a href="http://ontario.ca/stinkbug">ontario.ca/stinkbug</a> for updates on pest development, registered products and management strategies.</li> <li>There are currently no thresholds established. Apply when insects are first detected or early damage found.</li> </ul>					
	4A	Clutch 50 WDG	210 g/ha	12 hours	1 day	<b>Suppression only.</b> This product is toxic to beneficial insects and should be used only when necessary.
Botrytis bunch rot	<ul style="list-style-type: none"> <li>Use one of the products listed for Botrytis bunch rot at <b>Immediate postbloom</b>.</li> <li>Rotate among fungicide groups for resistance management. This spray is necessary for tight-clustered, thin-skinned varieties.</li> <li>If conditions are warm and wet through the preharvest period, a second spray may be needed.</li> <li>Direct this spray to the fruiting zone.</li> <li><b>Do not use Luna Tranquility within 45 days of harvest.</b></li> </ul>					

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval for table grapes / wine grapes.

<sup>5</sup> Check with processor and winery for wine grapes for accepted preharvest interval.

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

## Preharvest Intervals

Contact processors and wineries directly regarding their preharvest interval policy. Preharvest intervals listed in Table 3–2. *Products Used on Grapes* are taken from product labels. In some cases, regulations on residues in finished products are much more stringent. Many processors require longer preharvest intervals than stated on product labels. Some processors and wineries also have special restrictions for certain pest control products regarding number of applications or application after a certain crop stage. Consult the grape purchaser for more details.

**Table 3–2. Products Used on Grapes**

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 the 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. **When the REI for hand harvest exceeds the PHI, follow the REI.**

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

Products listed as potentially organic may be acceptable for organic use based on MAPAQ. Réseau d'avertissements phytosanitaires. 2020. RAP – Réseau Général. Bulletin d'information N° 1, Spécial 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	Restricted Entry Interval	Maximum Applications	Potentially Organic
<b>Products used for insect and mite control or suppression</b>							
Aceta 70 WP	33298	acetamiprid	4A	3 days/5 days <sup>3</sup>	12 hours <sup>1</sup> /5 days <sup>2</sup>	max. 160 g/ha	—
Acramite 50 WS	27925	bifenazate	20D	14 days	12 hours <sup>1</sup> /24 hours <sup>2</sup>	1	—
Admire 240 Flowable	24094	imidacloprid	4A	0 days/24 hours <sup>3</sup>	24 hours	2	—
Agri-Mek SC	31607	abamectin	6	28 days	12 hours <sup>1</sup> /13 days <sup>2</sup>	2	—
Altacor	28981	chlorantraniliprole	28	14 days	12 hours	max. 645 g/ha	—
Assail 70 WP	27128	acetamiprid	4A	3 days/5 days <sup>3</sup>	12 hours <sup>1</sup> /5 days <sup>2</sup>	max. 160 g/ha	—
BioProtec PLUS	32425	<i>Bacillus thuringiensis subsp. kurstaki</i>	11	0 days	4 hours	6	*
Closer	30826	sulfoxaflor	4C	7 days	12 hours	2	—
Clutch 50 WDG	29382	clothianidin	4A	1 day	12 hours	1 (max. 210 g/ha)	—
Cosavet DF Edge	31869	sulphur	M	1 day/21 days <sup>4</sup>	24 hours	8	*
Delegate	28778	spinetoram	5	7 days	12 hours	3	—
Dipel 2X DF	26508	<i>Bacillus thuringiensis subsp. kurstaki</i>	11	0 days	12 hours	6	*
Entrust	30382	spinosad	5	7 days	when dry <sup>1</sup> /7 days <sup>2</sup>	3	*

M = Multi-site fungicides. BM = Biologicals with multiple modes of action. NC = Not classified by FRAC/IRAC, or group not indicated on product label. P = Plant defence inducers.

UN = Mode of action has not been determined. — = Information is not specified on the product label. \* = Potentially organic. Check with certifying body.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval table/wine grape <sup>5</sup> For use on wine grapes only. Do not use on table grapes. <sup>6</sup> Maximum of 3 applications per year for mechanical harvest or 2 applications for hand harvest. <sup>7</sup> Maximum of 6 applications per season with no more than 2 dormant applications. <sup>8</sup> Check with processor and winery for wine grapes. <sup>9</sup> Maximum of 2 applications for phomopsis, 1 application for downy mildew. <sup>10</sup> Depends on rate. See label. <sup>11</sup> Company recommendation.

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

Product Name	Registration Number	Common Name	Group	Preharvest Interval	Restricted Entry Interval	Maximum Applications	Potentially Organic
<b>Products used for insect and mite control or suppression (cont'd)</b>							
Envidor 240 SC	28051	spirodiclofen	23	14 days	12 hours	1	—
Harvanta 50 SL	32889	cyclaniliprole	28	7 days	12 hours	max 4.8 L/ha	—
Imidan WP	29064	phosmet	1B	14 days	14 days <sup>1</sup> /30 days <sup>2</sup>	3	—
Intrepid 240 F	27786	methoxyfenozide	18	30 days	12 hours	3	—
Isomate-GBM Plus	27525	pheromone, grape berry moth	NC	—	—	1	*
Kopa Insecticidal Soap	31433	potassium salts of fatty acids	NC	0 days /12 hours <sup>3</sup>	12 hours	—	*
Kumulus DF	18836	sulphur	NC	1 day/21 days <sup>4</sup>	24 hours	8	*
Lime Sulphur	16465	calcium polysulphide	UN	120 days	48 hours	1 (delayed dormant)	*
Malathion 85 E	8372	malathion	1B	3 days/4 days <sup>3</sup>	24 hours <sup>1</sup> /4 days <sup>2</sup>	1	—
Microthiol Disperss	29487	sulphur	M	1 day/21 days <sup>4</sup>	24 hours	8	*
Movento 240 SC <sup>5</sup>	28953	spirotetramat	23	7 days	12 hours	max. 920 mL/ha	—
Nealta	31284	cyflumetofen	25	14 days	12 hours	2	—
Nexter SC	33433	pyridaben	21	25 days/30 days <sup>3</sup>	24 hours <sup>1</sup> /30 days <sup>2</sup>	1	—
Nexter WP	25135	pyridaben	21	25 days/30 days <sup>3</sup>	24 hours <sup>1</sup> /30 days <sup>2</sup>	1	—
Opal Insecticidal Soap	28146	potassium salts of fatty acids	NC	0 days/12 hours <sup>3</sup>	12 hours	—	*
Perm-UP EC	28877	permethrin	3	21 days	12 hours	2	—
Pounce 384 EC	16688	permethrin	3	21 days	12 hours	2	—
Purespray Green Spray Oil 13 E	27666	mineral oil	NC	14 days/12 hours <sup>4</sup>	12 hours	8 (summer)	*
Pyganic EC 1.4 II	30164	pyrethrins	3	0 days/12 hours <sup>3</sup>	12 hours	8	*
Sivanto Prime	31452	flupyradifurone	4D	0 days/12 hours <sup>3</sup>	12 hours	max. 2 L/ha	—
Sluggo Professional	30025	ferric phosphate	NC	—	12 hours	—	—
Success	26835	spinosad	5	7 days	when dry <sup>1</sup> /7 days <sup>2</sup>	3	—
SuffOil-X	33099	mineral oil	NC	14 days/0 days <sup>4</sup>	12 hours	8	*
Surround WP	27469	kaolin	NC	prebloom/12 hours <sup>4</sup>	12 hours	—	*
UP-Cyde 2.5 EC <sup>5</sup>	28795	cypermethrin	3	2 days/7 days <sup>3</sup>	12 hours	3/2 <sup>6</sup>	—
Vayego 200 SC	33711	tetraniliprole	28	14 days	12 hours	max. 900 mL/ha	—

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<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval table/wine grape <sup>5</sup> For use on wine grapes only. Do not use on table grapes. <sup>6</sup> Maximum of 3 applications per year for mechanical harvest or 2 applications for hand harvest. <sup>7</sup> Maximum of 6 applications per season with no more than 2 dormant applications. <sup>8</sup> Check with processor and winery for wine grapes. <sup>9</sup> Maximum of 2 applications for phomopsis, 1 application for downy mildew. <sup>10</sup> Depends on rate. See label. <sup>11</sup> Company recommendation.

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

Product Name	Registration Number	Common Name	Group	Preharvest Interval	Restricted Entry Interval	Maximum Applications	Potentially Organic
<b>Products used for insect and mite control or suppression (cont'd)</b>							
Vegol Crop Oil	32408	canola oil	NC	14 days/0 days <sup>4</sup>	12 hours	2/4	*
XenTari	31557	<i>Bacillus thuringiensis subsp. aizawai</i>	11	0 days/12 hours <sup>3</sup>	12 hours	6	*
<b>Products used for disease control or suppression</b>							
Actinovate SP	28672	<i>Streptomyces lydicus</i>	BM2	—	when dry	—	*
Aliette	27688	fosetyl-al	P7	15 days	6 days	7	—
Aprovia Top 195 EC	31526	difenoconazole + benzovindiflupyr	3+7	21 days	2 days	max. 3.9 L/ha	—
Botector	31248	<i>Aureobasidium pullulans</i>	NC	0 days/4 hours <sup>3</sup>	4 hours	4	*
Buran	30601	garlic powder	NC	0 days	when dry	—	*
Cantus WDG	30141	boscalid	7	14 days	12 hours	5	—
Cevya	33405	mefentrifluconazole	3	14 days	12 hours	max 1.125 L/ha	—
Confine Extra	30648	mono- and di-potassium salts of phosphorus acid	P7	1 day	12 hours	9	—
Copper 53 W	9934	tri-basic copper sulphate	M	2 days <sup>8</sup>	48 hours	7	*
Copper Spray	19146	copper oxychloride	M	2 days <sup>8</sup>	48 hours	7	*
Cosavet DF Edge	31869	sulphur	M	1 day/21 days <sup>4</sup>	24 hours	8	*
Cueva	31825	copper octanoate	M	1 day	4 hours	15	*
Diplomat 5 SC	32918	polyoxin D salt	19	0 days/12 hours <sup>3</sup>	12 hours	max. 3 L/ha	—
Dithane Rainshield	20553	mancozeb	M	30 days	12 hours	1 (prebloom) 3 (postbloom)	—
Double Nickel LC	31887	<i>Bacillus amyloliquefaciens</i> strain D747	BM2	0 days	when dry	—	*
Elevate 50 WDG	25900	fenhexamid	17	7 days	4 hours	3	—
Ferbam 76 WDG	20136	ferbam	M	7 days	12 hours	—	—
Flint	30619	trifloxystrobin	11	14 days	12 hours <sup>1</sup> /5 days <sup>2</sup>	4	—
Folpan 80 WDG	27733	folpet	M	1 day	24 hours	4	—
Forum	32026	dimethomorph	40	14 days	12 hours <sup>1</sup> /12 days <sup>2</sup>	4	—
Fracture	32139	BLAD polypeptide	BM1	0 days	when dry	5	—
Fullback 125 SC	31679	flutriafol	3	14 days	12 hours <sup>1</sup> /7 days <sup>2</sup>	max. 2.048 L/ha	—
Gavel DF	26842	zoxamide + mancozeb	22+M	66 days	48 hours	6	—
Guardsman Copper Oxychloride 50	13245	copper oxychloride	M	2 days <sup>8</sup>	48 hours	7	*

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<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval table/wine grape <sup>5</sup> For use on wine grapes only. Do not use on table grapes. <sup>6</sup> Maximum of 3 applications per year for mechanical harvest or 2 applications for hand harvest. <sup>7</sup> Maximum of 6 applications per season with no more than 2 dormant applications. <sup>8</sup> Check with processor and winery for wine grapes. <sup>9</sup> Maximum of 2 applications for phomopsis, 1 application for downy mildew. <sup>10</sup> Depends on rate. See label. <sup>11</sup> Company recommendation.

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

Product Name	Registration Number	Common Name	Group	Preharvest Interval	Restricted Entry Interval	Maximum Applications	Potentially Organic
<b>Products used for disease control or suppression (cont'd)</b>							
Inspire Super	30827	difenoconazole + cyprodinil	3+9	14 days	7 days	2 (max. 3.0 L/ha)	—
Intuity	32288	mandestrobin	11	10 days	12 hours	max. 2.631 L/ha	—
Kenja 400 SC	31758	isofetamid	7	14 days	12 hours	3	—
Kocide 2000-O	33441	copper hydroxide	M	2 days <sup>8</sup>	48 hours	7	*
Kumulus DF	18836	sulphur	M	1 day/21 days <sup>4</sup>	24 hours	8	*
LifeGard	32526	<i>Bacillus mycoides</i> isolate J	P6	0 days/4 hours <sup>3</sup>	4 hours	—	*
Lime Sulphur	16465	calcium polysulphide	M	120 days	48 hours	1 (delayed dormant)	*
Luna Tranquility	30510	fluopyram + pyrimethanil	7+9	7 days/45 days <sup>11</sup>	12 hours <sup>1</sup> /24 hours <sup>2</sup>	max. 4 L/ha	—
Maestro 80 WSP	33488	captan	M	7 days/55 days <sup>3</sup>	12 hours <sup>1</sup> /55 days <sup>2</sup>	2/1 <sup>9</sup>	—
Manzate Pro-Stick	28217	mancozeb	M	30 days	24 hours	4	—
Mettler 125 ME	30673	tetraconazole	3	15 days	12 hours <sup>1</sup> /15 days <sup>2</sup>	max. 730 mL/ha	—
Microscopic Sulphur WP	14653	sulphur	M	1 day/21 days <sup>4</sup>	24 hours	8	*
Microthiol Disperss	29487	sulphur	M	1 day/21 days <sup>4</sup>	24 hours	8	*
MilStop	28095	potassium bicarbonate	NC	0 days/4 hours <sup>3</sup>	4 hours	10	*
Miravis Prime	33207	fludioxonil + pydiflumetofen	7+12	14 days	12 hours	2	—
Nova	22399	myclobutanil	3	14 days	12 hours <sup>1</sup> /7 days <sup>2</sup>	5	—
Oxidate 2.0	32907	hydrogen peroxide + peroxyacetic acid	NC	0 days	4 hours or when dry	max. 93.5 L/ha	*
Penncozeb 75 DF Raincoat	30241	mancozeb	M	30 days	24 hours	4	—
Phostrol	30449	mono- and di-basic sodium, potassium and ammonium phosphites	P7	0 days/12 hours <sup>3</sup>	12 hours	4	—
Polyram DF	20087	metiram	M	45 days	12 hours	3	—
Pristine WG	27985	boscalid + pyraclostrobin	7+11	14 days/21 days <sup>3</sup>	when dry <sup>1</sup> / 21 days <sup>2</sup>	2/6 <sup>10</sup>	—
Priwen 500 EC <sup>5</sup>	31959	spiroxamine	5	35 days	12 hours <sup>1</sup> /17 days <sup>2</sup>	max. 1.2 L/ha	—
ProBlad	31782	BLAD polypeptide	BM1	0 days	when dry	—	—
Property 300 SC	32534	pyriofenone	50	0 days/12 hours <sup>3</sup>	12 hours	max. 1.2 L/ha	—
Purespray Green Spray Oil 13 E	27666	mineral oil	NC	14 days/12 hours <sup>4</sup>	12 hours	8 (summer)	*
Quintec	29755	quinoxifen	13	14 days	12 hours	5	—

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UN = Mode of action has not been determined. — = Information is not specified on the product label. \* = Potentially organic. Check with certifying body.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval table/wine grape. <sup>5</sup> For use on wine grapes only. Do not use on table grapes. <sup>6</sup> Maximum of 3 applications per year for mechanical harvest or 2 applications for hand harvest. <sup>7</sup> Maximum of 6 applications per season with no more than 2 dormant applications. <sup>8</sup> Check with processor and winery for wine grapes. <sup>9</sup> Maximum of 2 applications for phomopsis, 1 application for downy mildew. <sup>10</sup> Depends on rate. See label. <sup>11</sup> Company recommendation.



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

Product Name	Registration Number	Common Name	Group	Preharvest Interval	Restricted Entry Interval	Maximum Applications	Potentially Organic
<b>Products used for disease control or suppression (cont'd)</b>							
Rampart	30654	mono- and di-potassium salts of phosphorous acid	P7	1 day	4 hours	5	—
Regalia Maxx	30199	extract of <i>Reynoutria sachalinensis</i>	P5	0 days	when dry	—	*
Revus	29074	mandipropamid	40	14 days	12 hours	4	—
Ridomil Gold MZ 68 WG	28893	metalaxyl + mancozeb	4+M	66 days	24 hours	1 (prebloom) 1 (postbloom)	—
Scala SC	28011	pyrimethanil	9	7 days	12 hours <sup>1</sup> /24 hours <sup>2</sup>	3	—
Sercadis	31697	fluxapyroxad	7	14 days	12 hours	6	—
Serenade OPTI	31666	<i>Bacillus subtilis</i> strain QST 713	BM2	0 days	when dry	—	*
Serifel	30054	<i>Bacillus amyloliquifaciens</i> strain MBI 600	BM2	0 days	4 hours or when dry	—	*
Sirocco	31091	potassium bicarbonate	NC	0 days	4 hours	10	*
Sovran	26257	kresoxim-methyl	11	14 days	48 hours	4	—
Stargus	33246	<i>Bacillus amyloliquifaciens</i> strain F727	BM2	0 days	4 hours or when dry	—	—
SuffOil-X	33099	mineral oil	NC	14 days/0 days <sup>4</sup>	12 hours	8	*
Supra Captan 80 WSP	33641	captan	M	7 days/55 days <sup>3</sup>	12 hours <sup>1</sup> /55 days <sup>2</sup>	2/1 <sup>9</sup>	—
Switch 62.5 WG	28189	cyprodinil + fludioxonil	9+12	7 days	12 hours <sup>1</sup> /48 hours <sup>2</sup>	2	—
Timorex Gold	30910	tea tree oil	46	2 days	4 hours	—	*
Tivano	30468	citric acid + lactic acid	NC	—	when dry	—	*
Torrent 400 SC	30392	cyazofamid	21	30 days	12 hours	6	—
Vegol Crop Oil	32408	canola oil	NC	0 days/12 hours <sup>3</sup>	12 hours	2/4	*
Vivando SC	29765	metrafenone	50	14 days	12 hours	6	—
Zampro	30321	dimethomorph + ametoctradin	40+45	14 days	12 hours	4	—

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UN = Mode of action has not been determined. — = Information is not specified on the product label. \* = Potentially organic. Check with certifying body.

<sup>1</sup> General re-entry. <sup>2</sup> Hand labour (e.g., training, thinning, leaf pulling, hand harvest). <sup>3</sup> Preharvest interval for mechanical harvest / hand harvest. <sup>4</sup> Preharvest interval table/wine grape <sup>5</sup> For use on wine grapes only. Do not use on table grapes. <sup>6</sup> Maximum of 3 applications per year for mechanical harvest or 2 applications for hand harvest. <sup>7</sup> Maximum of 6 applications per season with no more than 2 dormant applications. <sup>8</sup> Check with processor and winery for wine grapes. <sup>9</sup> Maximum of 2 applications for phomopsis, 1 application for downy mildew. <sup>10</sup> Depends on rate. See label. <sup>11</sup> Company recommendation.

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## Notes on Grape Pests

### In this section:

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| <b>Table 3-3.</b> | Relative Susceptibility of Grape Cultivars to Diseases.                       |
| <b>Table 3-4.</b> | Activity of Fungicides on Grape Diseases and Impact on Honeybees.             |
| <b>Table 3-5.</b> | Activity of Insecticides and Miticides on Grape Pests and Impact on Honeybees |

**Table 3–3. Relative Susceptibility of Grape Cultivars to Diseases<sup>A</sup>**

Cultivar	Phomopsis cane blight	Black rot	Downy mildew	Powdery mildew	Botrytis bunch rot	Phytotoxic chemical sensitivity
<b>Vinifera wine<sup>B</sup></b>						
Auxerrois	MS	MS	MS	HS	HS	—
Cabernet Franc	MS	HS	MS	HS	SS	—
Cabernet Sauvignon	MS	HS	MS	HS	SS	—
Chardonnay	MS	HS	ES	ES	HS	—
Gamay	SS	MS	MS	HS	MS	—
Gewurztraminer	SS	HS	MS	HS	HS	—
Merlot	SS	HS	MS	HS	MS	2
Pinot Blanc	UN	HS	MS	HS	HS	—
Pinot Gris	SS	HS	MS	HS	HS	—
Pinot Noir	SS	HS	MS	HS	HS	—
Riesling	SS	HS	MS	HS	HS	—
Sauvignon Blanc	SS	MS	MS	MS	HS	—
Syrah/Shiraz	MS	HS	HS	HS	MS	—
Zweigeltrebe	MS	HS	MS	HS	SS	—
<b>French hybrid wine</b>						
Baco Noir	MS	SS	SS	MS	HS	1
Chambourcin	SS	MS	MS	MS	SS	1
De Chaunac	HS	SS	SS	MS	SS	1
Marechal Foch	MS	SS	SS	MS	SS	1
Seyval Blanc	MS	MS	MS	HS	HS	—
S.V. 23-512	SS	SS	MS	MS	SS	—
Vidal 256	SS	SS	MS	MS	HS	2

UN = Relative susceptibility is unknown. R = Resistant. SS = Slightly susceptible. MS = Moderately susceptible. HS = Highly susceptible. ES = Extremely susceptible. L = Leaves. F = Fruit.

<sup>A</sup> These notes are based on observations in Ontario and northeast United States under average conditions. Under adverse weather conditions, such as extended warm, wet weather, any given variety may be more seriously affected.

<sup>B</sup> Vinifera varieties not included in this chart are considered susceptible to powdery mildew, downy mildew and black rot.

<sup>C</sup> Based on ratings from <https://apsjournals.apsnet.org/doi/pdf/10.1094/PDIS-01-17-0022-RE>.

<sup>D</sup> All juice and table varieties are labrusca species with exception of Himrod (American hybrid).

1 = Sulphur-sensitive. 2 = Copper-sensitive. 3 = Flint- and Pristine-sensitive. 4 = Inspire Super-sensitive. — = No chemical sensitivity has been observed. † No more than 2 apps/season.

**Table 3–3. Relative Susceptibility of Grape Cultivars to Diseases<sup>A</sup> (cont'd)**

Cultivar	Phomopsis cane blight	Black rot	Downy mildew	Powdery mildew	Botrytis bunch rot	Phytotoxic chemical sensitivity
<b>American hybrid wine<sup>C</sup></b>						
Frontenac	SS	MS (L) / HS (F)	SS (L) / R (F)	MS	SS	2 <sup>†</sup>
Frontenac gris	SS	MS (L) / HS (F)	SS (L) / R (F)	MS	SS	2 <sup>†</sup>
GR 7 (Geneva Red)	SS	SS	MS	MS	MS	—
La Crescent	SS	SS (L) / R (F)	HS (L) / R (F)	SS	SS	1 <sup>†</sup>
Marquette	SS	MS (L) / HS (F)	SS (L) / R (F)	HS	SS	2 <sup>†</sup>
St. Croix	HS	SS (L) / SS (F)	HS (L) / R (F)	SS	SS	1, 2 <sup>†</sup>
<b>Juice and table grapes<sup>D</sup></b>						
Concord	MS	MS	MS	MS	SS	1, 2, 3, 4
Elvira	HS	MS	SS	MS	MS	3
Fredonia	MS	MS	HS	MS	SS	3
Himrod	SS	MS	SS	MS	MS	—
Niagara	MS	HS	HS	MS	SS	2
N.Y. Muscat	SS	SS	SS	MS	SS	—
Sovereign Coronation	SS	SS	HS	HS	MS	3

UN = Relative susceptibility is unknown. R = Resistant. SS = Slightly susceptible. MS = Moderately susceptible. HS = Highly susceptible. ES = Extremely susceptible. L = Leaves. F = Fruit.

<sup>A</sup> These notes are based on observations in Ontario and northeast United States under average conditions. Under adverse weather conditions, such as extended warm, wet weather, any given variety may be more seriously affected.

<sup>B</sup> Vinifera varieties not included in this chart are considered susceptible to powdery mildew, downy mildew and black rot.

<sup>C</sup> Based on ratings from <https://apsjournals.apsnet.org/doi/pdf/10.1094/PDIS-01-17-0022-RE>.

<sup>D</sup> All juice and table varieties are labrusca species with exception of Himrod (American hybrid).

1 = Sulphur-sensitive. 2 = Copper-sensitive. 3 = Flint- and Pristine-sensitive. 4 = Inspire Super-sensitive. — = No chemical sensitivity has been observed. † No more than 2 apps/season.

**Table 3–4. Activity of Fungicides on Grape Diseases and Impact on Honeybees**

See the product label or crop calendars for registered uses. Use fungicides only for diseases listed on the product label for the crop. The information provided in this table is based on information from other areas. It 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. Efficacy can be affected by rate of the product.

Group	Fungicide	Anthraco	Phomopsis cane and leaf spot	Black rot	Downy mildew	Powdery mildew	Botrytis bunch rot	Honeybee Toxicity <sup>1</sup>	Activity
M	Copper 53 W	0	1 *	1 *	3 *	2	0	MT	Contact
M	Copper Spray	0	1	1	2 *	2 *	0	NT	Contact
M	Cosavet DF Edge	1	1	0	0	3 *	0	NT	Contact
M	Cueva	0	1	1	2 *	2 *	0	NT	Contact
M	Dithane Rainshield	2	3	3 *	3 *	0	0	NT	Contact
M	Ferbam 76 WDG	2	3	3 *	2	0	0	NT	Contact
M	Folpan 80 WDG	2	3 *	1 *	3 *	0	0	NT	Contact
M	Guardman Copper Oxychloride 50	0	1 *	1	2 *	2 *	0	NT	Contact
M	Kocide 2000-O	0	1	0	2	2	0	NT	Contact
M	Kumulus DF	1	1	0	0	3 *	0	NT	Contact
M	Lime Sulphur (dormant)	2	0	0	0	1 *	0	NT	Contact
M	Maestro 80 WSP	2	3 *	1 *	3 *	0	0	MT	Contact
M	Manzate Pro-Stick	2	3	3 *	3 *	0	0	NT	Contact
M	Microscopic Sulphur WP	1	1	0	0	3 *	0	NT	Contact
M	Microthiol Disperss	1	1	0	0	3 *	0	NT	Contact
M	Penncozeb 75 DF Raincoat	2	3	3 *	3 *	0	0	NT	Contact
M	Polyram DF	2	3	3 *	3 *	0	0	NT	Contact
M	Supra Captan 80 WSP	2	3 *	1 *	3 *	0	0	MT	Contact
3	Cevya	0	0	3	0	3 *	0	NT	Locally systemic
3	Fullback 125 SC	0	0	3 *	0	3 *	0	MT	Locally systemic
3	Mettle 125 ME	3	0	3 *	0	3 *	0	NT	Locally systemic
3	Nova	3 *	0	3 *	0	3 *	0	NT	Locally systemic
3+7	Aprovia Top 195 EC	1	0	1	0	3 *	0	NT	Locally systemic
3+9	Inspire Super	3 *	0	3 *	0	3 *	3 *	NT	Locally systemic

M = Multi-site fungicides. BM = Biologicals with multiple modes of action. NC = Not classified by FRAC, or group not indicated on product label. P = Plant defence inducers.

<sup>1</sup> Source: PMRA Environmental Assessment Division. For more detailed information on the toxicity of specific pesticides to honeybees, refer to the pesticide label.

MT = Moderately toxic to bees. Can be used around bees if dosage, timing and method of application are correct, but do not apply them directly on bees, in the field or at the colonies.

NT = Relatively non-toxic to bees.

Contact = Stays on the surface of plant. Locally systemic = Moves into plant but does not move to other plant parts. Systemic = Moves into plant and to unsprayed plant parts as they develop.

Fungicide activity adapted from New York and Pennsylvania *Pest Management Guidelines for Grapes* and other published fungicide efficacy reports.

0 = Ineffective. 1 = Slightly effective/suppression, not recommended for very susceptible varieties or at critical stages of infection. 2 = Moderately effective. 3 = Very effective.

– = No information is available. \* (shaded area) = The disease is listed on the product label for control or suppression.

**Table 3–4. Activity of Fungicides on Grape Diseases and Impact on Honeybees (cont'd)**

See the product label or crop calendars for registered uses. Use fungicides only for diseases listed on the product label for the crop. The information provided in this table is based on information from other areas. It 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. Efficacy can be affected by rate of the product.

Group	Fungicide	Anthraco	Phomopsis cane and leaf spot	Black rot	Downy mildew	Powdery mildew	Botrytis bunch rot	Honeybee Toxicity <sup>1</sup>	Activity
4+M	Ridomil Gold MZ 68 WG	0	1	1	3 *	0	0	NT	Systemic
5	Priwen 500 EC	0	0	0	0	3 *	0	NT	Locally systemic
7	Cantus WDG	3	0	0	0	3 *	1	NT	Locally systemic
7	Kenja 400 SC	0	0	0	0	2	3 *	NT	Locally systemic
7	Sercadis	0	0	0	0	3 *	1 *	NT	Locally systemic
7+9	Luna Tranquility	0	0	0	0	3 *	3 *	NT	Locally systemic
7+11	Pristine WG	3 *	1	3 *	3 *	3 *	1 *	NT	Locally systemic
7+12	Miravis Prime	0	0	0	0	3	3 *	NT	Locally systemic
9	Scala SC	0	0	0	0	0	3 *	NT	Locally systemic
9+12	Switch 62.5 WG	0	0	0	0	0	3 *	NT	Locally systemic
11	Flint	0	1	3 *	1	3 *	1	NT	Locally systemic
11	Intuity	0	0	0	0	3 *	0	NT	Locally systemic
11	Sovran	3	1	3 *	2 *	2 *	1	NT	Locally systemic
13	Quintec	0	0	0	0	3 *	0	MT	Locally systemic
17	Elevate 50 WDG	0	0	0	0	1	3 *	NT	Locally systemic
19	Diplomat 5 SC	0	1	1	0	2 *	1 *	NT	Contact
21	Torrent 400 SC	0	0	0	3 *	0	0	NT	Locally systemic
22	Gavel DF	0	0	0	3 *	0	0	NT	Contact
40	Forum	0	0	0	3 *	0	0	NT	Systemic
40	Revus	0	0	0	3 *	0	0	NT	Locally systemic
40+45	Zampro	0	0	0	3 *	0	0	NT	Systemic
46	Timorex Gold	0	0	0	1 *	2 *	2 *	NT	Locally systemic
50	Property 300 SC	0	0	0	0	3 *	0	NT	Locally systemic
50	Vivando SC	0	0	0	0	3 *	0	NT	Locally systemic

M = Multi-site fungicides. BM = Biologicals with multiple modes of action. NC = Not classified by FRAC, or group not indicated on product label. P = Plant defence inducers.

<sup>1</sup> Source: PMRA Environmental Assessment Division. For more detailed information on the toxicity of specific pesticides to honeybees, refer to the pesticide label.

MT = Moderately toxic to bees. Can be used around bees if dosage, timing and method of application are correct, but do not apply them directly on bees, in the field or at the colonies.

NT = Relatively non-toxic to bees.

Contact = Stays on the surface of plant. Locally systemic = Moves into plant but does not move to other plant parts. Systemic = Moves into plant and to unsprayed plant parts as they develop.

Fungicide activity adapted from New York and Pennsylvania *Pest Management Guidelines for Grapes* and other published fungicide efficacy reports.

0 = Ineffective. 1 = Slightly effective/suppression, not recommended for very susceptible varieties or at critical stages of infection. 2 = Moderately effective. 3 = Very effective.

– = No information is available. \* (shaded area) = The disease is listed on the product label for control or suppression.

**Table 3–4. Activity of Fungicides on Grape Diseases and Impact on Honeybees (cont'd)**

See the product label or crop calendars for registered uses. Use fungicides only for diseases listed on the product label for the crop. The information provided in this table is based on information from other areas. It 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. Efficacy can be affected by rate of the product.

Group	Fungicide	Anthraco	Phomopsis cane and leaf spot	Black rot	Downy mildew	Powdery mildew	Botrytis bunch rot	Honeybee Toxicity <sup>1</sup>	Activity
BM1	Fracture	0	0	0	0	1 *	1 *	NT	Contact
BM1	ProBLAD Plus	0	0	0	0	1 *	1 *	NT	Contact
BM2	Actinovate SP	—	—	—	—	2 *	1 *	NT	Contact
BM2	Double Nickel LC	0	0	0	0	1 *	1 *	NT	Contact
BM2	Serenade OPTI	0	0	0	0	1 *	2 *	NT	Contact
BM2	Serifel	0	0	0	0	2 *	2 *	NT	Contact
NC	Botector	0	0	0	0	0	1 *	NT	Contact
NC	Buran	0	0	0	0	1 *	0	NT	Contact
NC	MilStop	0	0	0	1	2 *	1	NT	Contact
NC	Oxidate 2.0	1	1 *	1 *	1 *	1 *	1	MT	Contact
NC	Purespray Green Spray Oil 13 E	0	0	0	0	2 *	0	—	Contact
NC	Sirocco	0	0	0	1	2 *	1 *	NT	Contact
NC	SuffOil-X	0	0	0	0	2 *	0	NT	Contact
NC	Tivano	0	0	0	1 *	0	0	NT	Contact
NC	Vegol Crop Oil	0	0	0	0	2 *	0	—	Contact
P5	Regalia Maxx	0	0	0	0	1 *	1 *	NT	Systemic
P6	LifeGard	—	3	3	3 *	1 *	0	NT	Systemic
P7	Aliette	0	0	0	3 *	0	0	NT	Systemic
P7	Confine Extra	0	0	0	3 *	0	0	NT	Systemic
P7	Phostrol	0	0	0	3 *	0	0	NT	Systemic
P7	Rampart	0	0	0	3 *	0	0	NT	Systemic

M = Multi-site fungicides. BM = Biologicals with multiple modes of action. NC = Not classified by FRAC, or group not indicated on product label. P = Plant defence inducers.

<sup>1</sup> Source: PMRA Environmental Assessment Division. For more detailed information on the toxicity of specific pesticides to honeybees, refer to the pesticide label.

MT = Moderately toxic to bees. Can be used around bees if dosage, timing and method of application are correct, but do not apply them directly on bees, in the field or at the colonies.

NT = Relatively non-toxic to bees.

Contact = Stays on the surface of plant. Locally systemic = Moves into plant but does not move to other plant parts. Systemic = Moves into plant and to unsprayed plant parts as they develop.

Fungicide activity adapted from New York and Pennsylvania *Pest Management Guidelines for Grapes* and other published fungicide efficacy reports.

0 = Ineffective. 1 = Slightly effective/suppression, not recommended for very susceptible varieties or at critical stages of infection. 2 = Moderately effective. 3 = Very effective.

— = No information is available. \* (shaded area) = The disease is listed on the product label for control or suppression.



**Table 3–5. Activity of Insecticides and Miticides on Grape Pests and Impact on Honeybees**

Use insecticides only for insects listed on the product label for the crop. Some of the information provided in this table is based on information from other areas. It 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.

Group	Product Name	Grape berry moth	Leafhoppers	Phylloxera	Japanese beetle	Erineum mite	MALB	Wasps	European red mite	Climbing cutworm	Flea beetle	Grape mealybug	Soft Scales	Spotted wing drosophila	Honeybee Toxicity <sup>1</sup>
1B	Imidan WP	3 *	3	—	2 *	—	—	—	—	—	1	—	2 exp	3 *	HT
1B	Malathion 85 E	1	2 *	—	—	—	3 *	3	2 *	—	—	2 *exp	2 *exp	1 *	HT
3	Perm-UP EC	3 *	2 *	—	2	—	—	—	0	3	3	—	2 exp	2	HT
3	Pounce 384 EC	3 *	2 *	—	2	—	—	—	0	3 *	3	—	2 exp	2	HT
3	Pyganic EC 1.4 II	2	2 *	—	1	—	—	—	0	—	—	—	—	2	HT
3	UP-Cyde 2.5 EC	3 *	2 *	—	—	—	3 *	3 *	0	—	3	—	2 exp	2	HT
4A	Aceta 70 WP	1 *	3 *	2 *	2 *	—	—	—	0	—	2	2 exp	2 exp	2	MT
4A	Admire 240 Flowable	—	3 *	2	—	—	—	—	0	—	2	2 exp	2 exp	2	HT
4A	Assail 70 WP	1 *	3 *	2 *	2 *	—	—	—	0	—	2	2 exp	2 exp	2	MT
4A	Clutch 50 WDG	—	3 *	2 *	—	—	—	—	0	—	2	2 *exp	2 exp	2	HT
4C	Closer	—	1 *	—	—	—	—	—	0	—	—	—	0	2	HT
4D	Sivanto Prime	—	3 *	—	—	—	—	—	—	—	—	2 exp	—	—	MT
5	Delegate	3 *	—	—	—	—	—	—	0	3	2	—	0	3 *	HT
5	Entrust	2 *	—	—	—	—	—	—	0	—	2	—	0	2 *	HT
5	Success	2 *	—	—	—	—	—	—	0	—	2	—	0	3 *	HT
6	Agri-Mek SC	0	—	—	—	1	—	—	2 *	—	—	—	0	0	HT
11	BioProtec PLUS	2 *	0	0	0	0	0	0	0	—	0	0	0	0	NT
11	Dipel 2X DF	2 *	0	0	0	0	0	0	0	—	0	0	0	0	NT
11	XenTari	2 *	0	0	0	0	0	0	0	—	0	0	0	0	NT
18	Intrepid 240 F	3 *	—	—	—	—	—	—	0	3 *	—	—	0	0	NT

NC = Not classified by IRAC, or group not indicated on product label. UN = Mode of action has not been determined.

HT = Highly toxic to bees. Severe losses may be expected if used when bees are present at treatment time or within a few days thereafter.

MT = Moderately toxic to bees. Can be used around bees if dosage, timing and method of application are correct, but do not apply them directly on bees, in the field or at the colonies.

NT = Relatively non-toxic to bees.

I = Irritant. White film barrier on plant tissue may act as a repellent to bees when foraging.

<sup>1</sup> Source: PMRA Environmental Assessment Division. For more detailed information on the toxicity of specific pesticides to honeybees, refer to the pesticide label.

<sup>2</sup> May be toxic to bee colonies exposed to direct treatment, drift or residues on flowering crops or weeds.

Insecticide activity adapted from New York and Pennsylvania *Pest Management Guidelines for Grapes*, Michigan State University and BC Ministry of Agriculture recommendations, *Arthropod Management Tests*, and other sources.

0 = Ineffective. 1 = Slightly effective/suppression, not recommended for very susceptible varieties or at critical stages of infection. 2 = Moderately effective. 3 = Very effective.

— = No information is available. \* (shaded area) = The pest is listed on the product label for control or suppression. exp = Works only on exposed early instars, not on any growth stage under bark.

**Table 3–5. Activity of Insecticides and Miticides on Grape Pests and Impact on Honeybees (cont'd)**

Use insecticides only for insects listed on the product label for the crop. Some of the information provided in this table is based on information from other areas. It 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.

Group	Product Name	Grape berry moth	Leafhoppers	Phylloxera	Japanese beetle	Erineum mite	MALB	Wasps	European red mite	Climbing cutworm	Flea beetle	Grape mealybug	Soft Scales	Spotted wing drosophila	Honeybee Toxicity <sup>1</sup>
20D	Acramite 50 WS	0	0	0	0	—	0	0	2 *	0	0	0	0	0	MT
21	Nexter WP, Nexter SC	0	0	0	0	1	0	0	2 *	0	0	0	0	0	HT
23	Envidor 240 SC	0	0	0	0	3	0	0	3 *	0	0	—	0	0	MT
23	Movento 240 SC	0	—	3 *	0	2	0	0	—	0	0	3 *	1 *	0	HT <sup>2</sup>
25	Nealta	0	0	0	0	0	0	0	3 *	0	0	0	0	0	NT
28	Altacor	3 *	—	—	1 *	0	—	—	0	3 *	—	—	0	0	NT
28	Harvanta 50 SC	3 *	2	0	1	0	0	0	0	2	2	0	0	3 *	HT
28	Vayego 200 SC	3 *	0	0	0	0	0	0	0	2	0	0	0	0	HT
NC	Cosavet Edge	0	0	0	0	2 *	0	0	—	0	0	0	0	0	NT
NC	Kopa Insecticidal Soap	0	1	—	0	0	0	0	1 *	0	0	1 *exp	1 *exp	0	NT
NC	Kumulus DF	0	0	0	0	2 *	0	0	—	0	0	0	0	0	NT
NC	Lime Sulphur	—	—	—	—	2	—	—	—	—	—	1 exp	1 exp	0	NT
NC	Microthiol Disperss	0	0	0	0	2 *	0	0	—	0	0	0	0	0	NT
NC	Opal Insecticidal Soap	0	1	—	0	0	0	0	1 *	0	0	1 *exp	1 *exp	0	NT
NC	Purespray Green Spray Oil 13 E	0	1	—	—	1 *	0	0	2 *	—	—	1 exp	1 exp	0	—
NC	SuffOil-X	0	1	—	—	1 *	0	0	2 *	—	—	1 exp	1 exp	0	NT
NC	Surround WP	—	2 *	—	1	—	—	—	—	—	1	—	0	0	I
NC	Vegol Crop Oil	—	1 *	1 *	—	1 *	—	—	2 *	—	—	1 *exp	1 *exp	—	—

NC = Not classified by IRAC, or group not indicated on product label. UN = Mode of action has not been determined.

HT = Highly toxic to bees. Severe losses may be expected if used when bees are present at treatment time or within a few days thereafter.

MT = Moderately toxic to bees. Can be used around bees if dosage, timing and method of application are correct, but do not apply them directly on bees, in the field or at the colonies.

NT = Relatively non-toxic to bees.

I = Irritant. White film barrier on plant tissue may act as a repellent to bees when foraging.

<sup>1</sup> Source: PMRA Environmental Assessment Division. For more detailed information on the toxicity of specific pesticides to honeybees, refer to the pesticide label.

<sup>2</sup> May be toxic to bee colonies exposed to direct treatment, drift or residues on flowering crops or weeds.

Insecticide activity adapted from New York and Pennsylvania *Pest Management Guidelines for Grapes*, Michigan State University and BC Ministry of Agriculture recommendations, *Arthropod Management Tests*, and other sources.

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— = No information is available. \* (shaded area) = The pest is listed on the product label for control or suppression. exp = Works only on exposed early instars, not on any growth stage under bark.



## 4. Appendices

### 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](http://ontario.ca/publications)
- In person or by appointment at any OMAFRA Resource Centre.

#### OMAFRA Publications

- *Guide to Weed Control, Hort Crops* – Publication 75B
- *Growing Strawberries in Ontario* – Publication 513
- *Growing Red Raspberries in Ontario* – Publication 105
- *Fruit Crop Protection Guide* – Publication 360 (includes Apples, Berries, Grapes, Tender Fruit, Tree Nuts)
- *Integrated Pest Management for Ontario Apples* – Publication 310
- *Soil Fertility Handbook* – Publication 611
- *Vegetable Crop Protection Guide* – Publication 838

For a complete list of publications from OMAFRA: [ontario.ca/omafra](http://ontario.ca/omafra)

#### Websites

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

- OMAFRA gateway to information on crops: [ontario.ca/crops](http://ontario.ca/crops)
- Spotted wing drosophila: [ontario.ca/spottedwing](http://ontario.ca/spottedwing)
- Brown marmorated stink bug: [ontario.ca/stinkbug](http://ontario.ca/stinkbug)
- CropIPM (integrated pest management) modules: [ontario.ca/cropipm](http://ontario.ca/cropipm)
- ONFruit blog: [onfruit.ca](http://onfruit.ca)
- Label Search Tool to find labels for pesticides and products registered for use in Canada: <http://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>
- Information on pesticide application technology: [www.sprayers101.com](http://www.sprayers101.com)
- Specialty Cropproportunities to find information on specialty berries and fruit: [ontario.ca/crops](http://ontario.ca/crops) (search on “cropproportunities”)

#### Resources on Application Technology

Ontario Pesticide Education Program: [www.opep.ca](http://www.opep.ca)

#### 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 publications in the BMP series visit: [ontario.ca/agbestpractices](http://ontario.ca/agbestpractices).

#### Pesticide Drift

In case of pesticide drift concern, please contact the Ministry's local District or Area office. The local District Office contact information can be found from the Government of Ontario Employee and Organization Directory at [www.infogo.gov.on.ca/infogo/home.html#orgProfile/-270/en](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 B: Suppliers of Pest Monitoring Equipment and Biological Control Agents

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

Company	Address	Telephone/Fax/Email	Products
Anatis Bioprotection <a href="http://www.anatisbioprotection.com">www.anatisbioprotection.com</a>	278 rang Saint-André Saint-Jacques-le-Mineur, QC J0J 1Z0	Toll-free: 1-800-305-7714 Email: <a href="mailto:info@anatisbioprotection.com">info@anatisbioprotection.com</a>	<ul style="list-style-type: none"> <li>beneficial insects and mites</li> </ul>
Biobest Canada Ltd. <a href="http://www.biobestgroup.com">www.biobestgroup.com</a>	2020 Foxrun Rd. R.R. #4 Leamington, ON N8H 3V7	Tel: 519-322-2178 Fax: 519-322-1271 Email: <a href="mailto:info@biobest.ca">info@biobest.ca</a>	<ul style="list-style-type: none"> <li>beneficial insects, mites, nematodes</li> <li>pheromone lures and traps</li> <li>bumblebee hives for pollination</li> </ul>
Cooper Mill Ltd. <a href="http://www.coopermill.com">www.coopermill.com</a>	31 Hastings Rd. R.R. #3 Madoc, ON K0K 2K0	Tel: 613-473-4847 Fax: 613-473-5080 Email: <a href="mailto:ipm@coopermill.com">ipm@coopermill.com</a>	<ul style="list-style-type: none"> <li>pheromone lures and traps</li> </ul>
Distributions Solida Inc. <a href="http://www.solida.ca">www.solida.ca</a>	480 rang St-Antoine St. Ferreol-les-Neiges, QC G0A 3R0	Tel: 418-826-0900 Fax: 418-826-0901 Email: <a href="mailto:info@solida.ca">info@solida.ca</a>	<ul style="list-style-type: none"> <li>pheromone lures and traps</li> <li>tangle traps, insect trap coating</li> <li>hand lens magnifiers</li> <li>tally counters</li> </ul>
Gempler's <a href="http://www.gemplers.com">www.gemplers.com</a>	P.O. Box 5175 Janesville, WI USA 53547-5175	Toll-free: 1-800-382-8473 Fax: 1-800-551-1128 Email: <a href="mailto:customerservice@gempler.com">customerservice@gempler.com</a>	<ul style="list-style-type: none"> <li>weather monitoring equipment</li> <li>pheromone lures and traps</li> <li>tangle traps</li> <li>hand lens magnifiers</li> <li>tally counters</li> </ul>
Great Lakes IPM, Inc. <a href="http://www.greatlakesipm.com">www.greatlakesipm.com</a>	7563 N. Crystal Rd. Vestaburg, MI USA 48891	Tel: 989-268-5693 Toll-free: 1-800-235-0285 Fax: 989-268-5311 Email: <a href="mailto:glipm@greatlakesipm.com">glipm@greatlakesipm.com</a>	<ul style="list-style-type: none"> <li>apple scab monitoring equipment</li> <li>pheromone lures and traps</li> <li>tangle traps</li> <li>hand lens magnifiers</li> <li>tally counters</li> <li>insect sweep nets</li> <li>field diagnostic equipment</li> </ul>
Koppert Canada Ltd. <a href="http://www.koppert.ca">www.koppert.ca</a>	50 Ironside Cres. Unit 3 Scarborough, ON M1X 1G4	Tel: 1-800-567-4195 Fax: 416-291-0902 Email: <a href="mailto:info@koppert.ca">info@koppert.ca</a>	<ul style="list-style-type: none"> <li>beneficial insects, mites</li> <li>insect traps</li> <li>BioWorks products</li> </ul>
Natural Insect Control <a href="http://www.naturalinsectcontrol.com">www.naturalinsectcontrol.com</a>	3737 Netherby Rd. Stevensville, ON L0S 1S0	Tel: 905-382-2904 Fax: 905-382-4418 Email: <a href="mailto:info@nicniagara.com">info@nicniagara.com</a>	<ul style="list-style-type: none"> <li>beneficial insects, mites and nematodes (Canadian strains)</li> <li>pheromone lures and traps</li> <li>mating disruption devices</li> <li>bird houses</li> </ul>

Company	Address	Telephone/Fax/Email	Products
N.M. Bartlett Inc. <a href="http://www.bartlett.ca">www.bartlett.ca</a>	4509 Bartlett Rd. Beamsville, ON L0R 1B1	Tel: 905-563-8261 Toll-free: 1-800-767-8658 Fax: 905-563-7882 Email: <a href="mailto:info@bartlett.ca">info@bartlett.ca</a>	<ul style="list-style-type: none"> <li>• pheromone lures and traps</li> <li>• mating disruption devices</li> </ul>
Plant Products Inc. <a href="http://www.plantproducts.com">www.plantproducts.com</a>	50 Hazelton St. Leamington, ON N8H 1B8	Tel: 519-326-9037 Toll-free: 1-800-387-2449 Fax: 519-326-9290 Email: <a href="mailto:info@plantproducts.com">info@plantproducts.com</a>	<ul style="list-style-type: none"> <li>• pheromone lures and traps</li> <li>• mating disruption devices</li> <li>• rodent and tangle traps</li> <li>• sticky tape and cards</li> <li>• beneficial insects</li> </ul>

## APPENDIX C: Diagnostic Services

The following labs provide diagnostic services in Ontario. Refer to their web sites for information on sample collection and submission.

A & L Canada Laboratories Inc.  
2136 Jetstream Rd.  
London, ON N5V 3P5  
Tel: 519-457-2575  
Fax: 519-457-2664  
Email: [aginfo@alcanada.com](mailto:aginfo@alcanada.com)  
[www.alcanada.com](http://www.alcanada.com)

Agriculture and Food Laboratory  
Laboratory Services Division  
University of Guelph  
95 Stone Rd. W.,  
Guelph, ON N1H 8J7  
Tel: 519-767-6299  
Fax: 519-767-6240  
Website: [www.afl.uoguelph.ca](http://www.afl.uoguelph.ca)  
Email: [aflinfo@uoguelph.ca](mailto:aflinfo@uoguelph.ca)

Cool Climate Oenology and Viticulture Institute  
Grapevine Virology Lab  
Brock University  
1812 Sir Isaac Brock Way  
St. Catharines, ON, Canada L2S 3A1  
Ph: 905-688-5550 Ext. 3510  
Email: [virustesting@brocku.ca](mailto:virustesting@brocku.ca)

Norgen Biotek Corp.  
Grapevine Virus Testing  
3430 Schmon Parkway  
Thorold, ON L2V 4Y6  
Tel: 905-227-8848  
(Toll-free) 1-866-667-4362  
Fax: 905-227-1061  
Email: [info@norgenbiotek.com](mailto:info@norgenbiotek.com)  
[norgenbiotek.com](http://norgenbiotek.com)



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

Application Technology Specialist	Jason Deveau	Tel: 519-209-1883	<a href="mailto:jason.deveau@ontario.ca">jason.deveau@ontario.ca</a>
Crop Protection Specialist	Denise Beaton	Tel: 519-400-3636	<a href="mailto:denise.beaton@ontario.ca">denise.beaton@ontario.ca</a>
Entomologist, Horticulture	Hannah Fraser	Tel: 905-708-8014	<a href="mailto:hannah.fraser@ontario.ca">hannah.fraser@ontario.ca</a>
Fresh Market Quality Specialist	Jennifer R. DeEll	Tel: 519-410-1806	<a href="mailto:jennifer.deell@ontario.ca">jennifer.deell@ontario.ca</a>
Fruit Crop Specialist (berry)	Erica Pate	Tel: 519-410-0624	<a href="mailto:erica.pate@ontario.ca">erica.pate@ontario.ca</a>
Fruit Crop Specialist (tender fruit, grape)	Kathryn Carter	Tel: 905-687-1280	<a href="mailto:kathryn.carter@ontario.ca">kathryn.carter@ontario.ca</a>
Horticulture IPM Specialist (pome fruit)	Kristy Grigg-McGuffin	Tel: 519-420-9422	<a href="mailto:kristy.grigg-mcguffin@ontario.ca">kristy.grigg-mcguffin@ontario.ca</a>
Horticulture IPM Specialist (specialty crops)	Melanie Filotas	Tel: 519-428-4340	<a href="mailto:melanie.filotas@ontario.ca">melanie.filotas@ontario.ca</a>
Horticulture IPM Specialist (tender fruit, grape)	Wendy McFadden-Smith	Tel: 905-932-8965	<a href="mailto:wendy.mcfadden-smith@ontario.ca">wendy.mcfadden-smith@ontario.ca</a>
Horticulture Sustainability Specialist	vacant	—	—
Maple, Tree Nut and Agroforestry Specialist	Jenny Liu	Tel: 519-835-5872	<a href="mailto:jenny.liu2@ontario.ca">jenny.liu2@ontario.ca</a>
Minor Use Coordinator	Jim Chaput	Tel: 519-546-2482	<a href="mailto:jim.chaput@ontario.ca">jim.chaput@ontario.ca</a>
New Crop Development Specialist	Evan Elford	Tel: 519-420-9343	<a href="mailto:evan.elford@ontario.ca">evan.elford@ontario.ca</a>
Pathologist, Horticulture	Katie Goldenhar	Tel: 519-835-5792	<a href="mailto:katie.goldenhar@ontario.ca">katie.goldenhar@ontario.ca</a>
Soil Fertility Specialist, Horticulture	Tejendra Chapagain	Tel: 519-835-5794	<a href="mailto:tejendra.chapagain@ontario.ca">tejendra.chapagain@ontario.ca</a>
Soil Management Specialist, Horticulture	Anne Verhallen	Tel: 519-359-6707	<a href="mailto:anne.verhallen@ontario.ca">anne.verhallen@ontario.ca</a>
Surveillance Coordinator & Data Analyst	Cora Loucks	Tel: 519-546-8245	<a href="mailto:cora.loucks@ontario.ca">cora.loucks@ontario.ca</a>
Tree Fruit Specialist	Erika DeBrouwer	Tel: 226-931-4098	<a href="mailto:erika.debrouwer@ontario.ca">erika.debrouwer@ontario.ca</a>
Weed Management Specialist, Horticulture	Kristen Obeid	Tel: 519-965-0107	<a href="mailto:kristen.obeid@ontario.ca">kristen.obeid@ontario.ca</a>

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](https://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](mailto:ag.info.omafra@ontario.ca)

## APPENDIX E: Production Insurance

Production Insurance (PI) covers production losses and yield reductions caused by insured perils. This includes adverse weather, disease, wildlife and insect infestations. Depending on the plan, coverage is available on a total-yield, dollar-value or acreage-loss basis. Producers can choose the type and level of coverage that best meets their needs. When enrolled in PI, producers are guaranteed a level of production, based on their yield history and their chosen coverage level. Claims are paid when an insured peril causes a yield to fall below the guaranteed production.

In Ontario, Agricorp administers PI on behalf of the Government of Ontario and Agriculture and Agri-Food Canada. More than 15,000 producers and 2 million hectares (5 million acres) of Ontario farmland are insured each year.

PI is available to all Ontario farmers, landlords and sharecroppers who grow or manage eligible agricultural products.

For more information, contact Agricorp.

### **Agricorp**

1 Stone Rd. W.  
Box 3660, Stn. Central  
Guelph, ON N1H 8M4  
Open weekdays, 7 a.m. - 5 p.m.  
Tel: 1-888-247-4999  
TTY: 1-877-275-1380  
Fax: 519-826-4118  
Email: [contact@agricorp.com](mailto:contact@agricorp.com)  
Web: [www.agricorp.com](http://www.agricorp.com)

APPENDIX F: The Metric System

Metric Units

<b>Linear Measures (length)</b>		
10 millimetres (mm)	=	1 centimetre (cm)
100 centimetres (cm)	=	1 metre (m)
1,000 metres	=	1 kilometre (km)
<b>Square Measures (area)</b>		
100 m × 100 m	=	10,000 m <sup>2</sup> = 1 hectare (ha)
100 ha	=	1 square kilometre (km <sup>2</sup> )
<b>Cubic Measures (volume)</b>		
<b>DRY MEASURE</b>		
1,000 cubic millimetres (mm <sup>3</sup> )	=	cubic centimetre (cm <sup>3</sup> )
1,000,000 cm <sup>3</sup>	=	1 cubic metre (m <sup>3</sup> )
<b>LIQUID MEASURE</b>		
1,000 millilitres (mL)	=	1 litre (L)
100 L	=	1 hectolitre (hL)
<b>Weight-Volume Equivalents (for water)</b>		
(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)
<b>Weight Measures</b>		
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)
<b>Dry-Liquid Equivalents</b>		
1 cm <sup>3</sup>	=	1 mL
1 m <sup>3</sup>	=	1,000 L

Approximate Metric Conversions

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

Application Rate Conversions

<b>Metric to Imperial or U.S. (approximate)</b>		
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
<b>Imperial or U.S. to Metric (approximate)</b>		
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)

<b>Liquid Equivalents</b>		
LITRES/HECTARE	APPROXIMATE GALLONS/ACRE	
IMPERIAL GALLONS	U.S. GALLONS	
50	=	4.45
100	=	8.9
150	=	13.53
200	=	17.8
250	=	22.25
300	=	26.7

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 ½
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 <sup>2</sup> )	=	0.16 square inch
1 square metre (m <sup>2</sup> )	=	10.77 square feet
1 square metre (m <sup>2</sup> )	=	1.2 square yards
1 square kilometre (km <sup>2</sup> )	=	0.39 square mile
1 hectare (ha)	=	107,636 square feet
1 hectare (ha)	=	2.5 acres

**Volume (dry)**

1 cubic centimetre (cm <sup>3</sup> )	=	0.061 cubic inch
1 cubic metre (m <sup>3</sup> )	=	1.31 cubic yards
1 cubic metre (m <sup>3</sup> )	=	35.31 cubic feet
1,000 cubic metres (m <sup>3</sup> )	=	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 <sup>2</sup>
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**Speed**

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

**Temperature**

$$^{\circ}\text{F} = (^{\circ}\text{C} \times \frac{9}{5}) + 32$$

**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 <sup>2</sup>
1 square yard	=	0.84 m <sup>2</sup>
1 acre	=	0.4 ha

**Volume (dry)**

1 cubic yard	=	0.76 m <sup>3</sup>
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
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**Temperature**

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times \frac{5}{9}$$

**Abbreviations**

%	=	percent (by weight)
ai	=	active ingredient
cm	=	centimetre
cm <sup>2</sup>	=	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 <sup>2</sup>	=	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.

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## Agricultural Information Contact Centre

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

