

Crop Protection Guide for Ginseng

Publication 847

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Discard old editions of this publication. Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication.

To the best knowledge of the committee, at the time of printing, the pesticide products listed in this publication were:

- federally registered
- classified by the Ministry of the Environment and Climate Change (MOECC)

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

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

The Pesticide Label

Consult each product label before you use a pesticide.

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

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

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 merit and value, and the human health and environmental risks associated with its proposed use are acceptable.

1. Full Registration

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

2. Conditional Registration

Conditional registration may be granted for a specified, limited time period, where the registrant agrees to produce additional scientific or technical information.

3. Emergency Registration

An emergency registration is a temporary, time-limited registration of no more than 1 year, approved to deal with serious pest outbreaks that have limited control options.

Maximum Residue Limits

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

Supplemental Labels

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

Examples of when you must use a supplemental label include:

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

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

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

Regulation of Pesticides in Ontario

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

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

Classification of Pesticides

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

Certification and Licensing

Growers and Their Assistants

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

Commercial Applicators (Exterminators) and Their Assisting Technicians

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

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

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Introduction

PRODUCTS LISTED IN THIS PUBLICATION

Products listed in this publication are registered for use on ginseng in Ontario as of October 31, 2016. The information contained in this publication has been prepared in consultation with the Ginseng Technical Working Group under the Ontario Pest Management Services Committee and product registrants.

Products are organized by pest. 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>.

For information on ginseng production, including pest biology, identification and cultural management, see OMAFRA Publication 848, *Guide to Ginseng Production*.

LEVELS OF CONTROL FOR FUNGICIDES AND INSECTICIDES

The value of all insecticides, miticides and fungicides is evaluated by the Pest Management Regulatory Agency (PMRA) prior to registration, which includes an assessment of efficacy. Wording on the product label such as control, suppression or partial suppression is used to describe the level of pest management provided by these products. The definitions of “control” and “suppression” for insecticides have a somewhat different meaning than the same terms applied to fungicides.

Fungicides

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

Suppression: A consistent level of disease management that is less than full control, as defined by commercial standards and expectations in the market, when compared to untreated control plots. In general, disease control ratings would be between 60% and 80%. 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 40%.

Insecticides

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), January 2014.

Note: The guidelines above 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.

1. Integrated Pest Management

Integrated pest management (IPM) is an approach to pest control that considers all available tools for maintaining acceptable levels of pests while minimizing economic, health and environmental risk. These tools include cultural, mechanical, biological and chemical pest control measures. Using IPM helps minimize adverse effects of pesticides and maintain economic returns.

IPM programs make extensive use of information collected before, during and after the field season, and require careful management by the grower. To implement an IPM program, you must understand:

- field characteristics, inputs and history.
- pest identification, biology and behaviour.
- beneficial organisms.
- monitoring and diagnostic techniques.
- use and timing of appropriate management tools.
- recordkeeping.
- sprayer calibration.

IPM can be more challenging for ginseng production because no specific pest thresholds and insect and disease monitoring programs have been developed for ginseng. However, there are many things growers can do to minimize the use of chemical controls. IPM in ginseng has five main components:

- site selection
- cover crops
- sanitation
- regular scouting
- timely application of pest control products

SITE SELECTION

Choose sites less favourable for pest development. Understand the conditions that influence the health of the crop and the development of pest populations. While site selection is important to IPM for all crops, it is particularly critical for ginseng. Poor site selection can dramatically increase the cost of pest control during the life of a ginseng garden and can even result in crop failure.

Replant Disease

Do not grow ginseng where it was previously grown, because of a disorder known as replant disease. Most gardens established on fields where ginseng was previously grown develop major root disease in the first or second year of production. *Cylindrocarpon* root rot is often severe in these fields and is likely one of the key causes of the disease. Replant disease can occur even several decades after the first crop is grown. A link between replant disease of ginseng and those of other perennial crops has not been shown, although some of the same pathogens may be involved. *Cylindrocarpon* is involved in other replant diseases, but it now appears these are not the same species that attack ginseng in most cases. It is possible that ginseng grown on land previously planted with other perennial crops may face a higher risk of disease. Evidence suggests that soil blown into a garden from land previously cropped to ginseng may also contribute to replant disease symptoms in the new garden. To learn more about *cylindrocarpon* root rot and replant disease, see OMAFRA Publication 848, *Guide to Ginseng Production*.

Soil Type and Drainage

Even on land that has never been planted with ginseng, the crop is prone to several aggressive root diseases that are often favoured in wet areas and heavier soils, particularly *phytophthora* root rot. Avoiding planting in these areas can reduce or delay the development of disease. Once disease begins in a garden, it can be easily spread by machinery or field workers to other areas of the garden, especially if surface water is present in the garden.

Choosing sites with good drainage and sandy soils (sand or loamy sand) that allow for rapid penetration of heavy rains can dramatically reduce the amount of disease in the crop. Ginseng production on heavier soils (e.g., loam or clay) has generally not been successful in Ontario.

A gentle slope will allow surface water to drain out of the garden. Align beds to allow water to drain down the trenches. To learn more about site

modification, see OMAFRA Publication 848, *Guide to Ginseng Production*.

Monitor new fields after heavy rains in the establishment year to identify areas with poor drainage. Either avoid these areas or improve the drainage through site modification such as the installation of drains, surface channels cut through the beds or gravel wells (French drains) that allow the water to pool below the surface and eventually drain away. Avoid planting new gardens where surface water can drain from an existing garden or from a recently harvested field into the new garden.

COVER CROPS

Cover crops are commonly used in land preparation for ginseng production. They are often planted in the year before seeding the ginseng crop or in the spring of the year of seeding to build soil organic matter and reduce plant parasitic nematodes in the soil.

Some cover crops, such as Canadian forage pearl millet, act as non-hosts for root lesion nematodes. Pearl millet is the most commonly used cover crop in ginseng production. If the cover crop remains weed-free over a summer, the nematodes have nothing to feed on and populations decline. Cover crops are often seeded in the beginning of June in the year before seeding the ginseng crop and are mowed once or twice during the summer to keep them from getting woody and forming seed heads. Most of the cover crops commonly used are naturally killed off with the frost in the fall and tilled under to provide time for the debris to break down before fumigation the following spring.

Brassica cover crops are occasionally used as a bio-fumigant in ginseng. Some cultivars of mustard (e.g., Cutlass), radish (e.g., Daikon) and rapeseed, when cultivated into the ground, will release chemicals that act as natural fumigants. They can be seeded in early spring of the year the ginseng is seeded and tilled under just as flowers begin to form, approximately 2 months later, depending on the crop. For brassica cover crops to work effectively, chop or mow them, incorporate them with a rototiller and seal them into the soil with a roller, in rapid succession. Optimal soil moisture and fertility will ensure a good stand.

SANITATION

Most ginseng diseases spread by wind, surface water run-off, movement of soil from one garden to another or spores clinging to machinery or field workers. Not much can be done to avoid air-borne spores from landing on the field. Select sites away from surface water to avoid disease spread from run-off. Good sanitation practices will minimize the other methods of dissemination.

Movement of spores in soil is the most common method of introducing a new soil pathogen into a garden. In the Sand Plains, wind-blown soil commonly spreads spores. Erect wind breaks and use cover crops to minimize this.

Soil can also be moved on farm machinery and on the boots of field workers. Older gardens will have more disease than seedling gardens because diseases tend to build up over time. Avoid travelling directly from an older garden into a newer garden without cleaning off machinery, boots and clothing. For any practices involving ginseng gardens of different ages, such as application of pest control products, always enter gardens from the youngest to the oldest. Provide disposable booties for workers to remove and change between gardens to minimize soil movement. Consider using a pressure washer on equipment to remove soil and debris between gardens, and applying disinfectants to kill off spores once the equipment is clean. This is especially important when leaving a garden with known root disease issues.

Some root pathogens, such as *Phytophthora cactorum*, have swimming spores that will often be present in surface water in low areas of the garden. Machinery or field workers can move this water down the row if it does not drain away rapidly. It is very common to see *Phytophthora* spores moved down the row and diseased plants lining both sides of the trenches. Furthermore, when water containing spores is splashed onto the leaves by rain, machinery or field workers, foliar infection can develop.

Foliar *Phytophthora* infections produce airborne spores that can spread many kilometres on the wind. Machinery and field workers should never travel through standing water in a garden. Growers often place extra straw, wood chips or gravel in low areas so standing water is below the surface, reducing splashing. Use subsoiling to cut through the plow pan and allow water to drain more easily.

Spores of foliar diseases, including alternaria, botrytis and phytophthora, can be easily picked up on the clothing of field workers, especially when the foliage is wet. There have been cases where foliar disease outbreaks occurred along the path a field scout used to walk the field. Minimize travel through gardens when the foliage is wet. The ginseng canopy gets much thicker in older gardens, and old gardens tend to dry out more slowly. After a rainfall or heavy dew, ginseng scouts (garden walkers) and field workers should enter seedling gardens first, since they are unlikely to brush against the much smaller tops in a seedling garden.

Inform all workers and visitors to a farm of the risks of pathogen spread before entering a garden. Train workers on proper sanitation practices annually to ensure procedures are being followed. Pay particular attention to the practices of consultants, suppliers and field scouts (garden walkers) that work on multiple farms, because they can be exposed to a wider range of pathogens.

SCOUTING

Ginseng scouts are often referred to as garden walkers. Their job is to identify new pest problems so pest control products can be used effectively and to ensure that pest management practices are working well. Systematic monitoring of pest populations, weather conditions, plant health and disease symptoms are critical components of an IPM program. The following tools are necessary in a scouting program:

- 16x–20x hand lens
- collection bags and vials
- trowel
- pocket knife
- disposable booties
- plastic gloves
- rainproof signs for bays and gardens
- plastic ribbon for marking posts (to identify the location of areas of concern)
- plastic flags for labelling hot spots
- waterproof markers for labelling ribbon and flags
- file folders
- scouting forms
- garden maps
- garden history forms

Monitoring Strategies

Before scouting, scouts should review pest control calendars to know when certain pests will be active. They should also learn to identify pest life stages and damage on different parts of the ginseng plant caused by diseases and insect pests. Understanding the biology and life cycle of pests and diseases will help identify and monitor pest populations over time. Scouts should be able to distinguish which insects are pests and which are harmless or beneficial in a garden. Over time, scouts will have to keep track of historical data to identify hot spots and previous problem areas. Scouts should carry field maps at all times to record the location of damage in a garden. Satellite photos and other scouting applications may facilitate this.

For each visit, scouts should consider the following:

- Record the stage of crop development, disease severity, population levels of insect pests and damage observed.
- Record the location of infestation and what part of the plant is affected. Estimate what portion of the entire garden is affected by the pest. For diseases, also record the symptoms seen, whether there are reproductive structures present and the garden conditions where symptoms are occurring.
- Flag areas of infestation well so spread can be measured over time.
- Keep a log of rainfall amounts, daily maximum/minimum temperatures and weather events.
- Keep a record of pesticides applied and other control measures used.

Monitoring Procedures for Scouting Ginseng Gardens

Scout gardens at least once a week and preferably twice a week during critical periods, looking for presence or signs of disease, insects and rodents. Critical periods include early in the season when leaves are more prone to disease, wet periods and times when insect pests are active. For more information on critical periods for specific pests, see OMAFRA Publication 848, *Guide to Ginseng Production*. Monitor at approximately the same time each day so insect activity can be tracked consistently over time. Consider the sanitation procedures described in *Sanitation* on page 2. In each visit, walk the length of randomly selected beds throughout the entire garden, looking for

obvious symptoms of disease or insect damage. Stop periodically to closely inspect plants, including fruit clusters and the underside of leaves and stems at several areas in a garden, looking for early signs of disease or insect populations.

Decide on a rough pattern in the field where plants will be closely examined, accounting for both edges and the centre of a garden and any areas with differing topography or other characteristics. However, when approaching an area of the garden selected for close inspection, choose the exact plants to examine at random and do not focus on disease “hot spots” for this assessment. This assessment will be used by the grower to track disease levels over time, and focusing only on hot spots will skew the results. Brush straw away from some plants to look for damage near the base of the stem. If plants are cut, check under the straw for the presence of rodent tunnels or other potential causes.

In addition to the random areas for close examination of plants, be on the lookout for hot spots where disease is present. Identify the disease in these areas and track it over time. Hot spots can occur where there has been standing water, the canopy is very dense or where there were diseased plants the previous year.

Pest pressure can vary greatly throughout a field, especially in hilly gardens. Find a vantage point for scanning a large area of the garden, and look for patterns, such as patches or areas of poor plant growth or where the colour is not normal. Examine these areas closely for pests. Pest issues will vary across a ginseng garden. Insect pests tend to be worse on the edges of the field where the insects first enter the garden, especially near forests or hedge rows. Make a rough sketch of contours and areas that are wet. Diseases tend to be worse in wet areas but are more likely than insects to occur throughout the garden.

Flag locations where pest symptoms have been identified and check them frequently to determine the extent of spread. If necessary, dig up the roots of diseased plants, particularly when there is no obvious cause for above-ground symptoms. For pests that can cause large areas of dead plants, for example, rhizoctonia, dig up roots of healthy plants on the perimeter of the affected area, as the pest will often not be readily identifiable in the dead

plants. Many ginseng diseases can be very difficult to accurately identify without close examination of pathogen spores and other microscopic structures. In these cases, submit samples to a lab for analysis.

Recordkeeping

Scouting forms can be simple or complex, depending on the grower's preference, but at a minimum, they should record:

- date
- garden name
- weather conditions (temperature, rainfall, wind)
- scout name
- problems encountered

Garden maps with directions and locations of problem areas can be very useful in conjunction with scouting forms, especially if the scout is not directly involved with spraying or other farm operations. The grid of posts in a ginseng garden provides a relatively easy mapping system for scouts. Develop a spreadsheet where each column is the width of a bay and each row is the distance between posts within a row. Gardens are erected with either a 7.3-x-7.3-m or an 11-x-11-m grid between posts or anchors. Mark problem areas using the bay number and the number of posts into the garden (e.g., 5th bay from the west, 5 posts from the south end).

Garden history forms can be very valuable when comparing good gardens with problem gardens. Keep these records confidential to maintain the privacy of the landowner. It is ideal to go back 5 years, or at least to the year before planting. Things to include:

- previous crops grown in that field and what herbicides were used on them
- whether ginseng was previously grown in the field
- type and timing of cover crops
- pre-plant fertility program and yearly fertility
- timing and rate of seeding
- seed source, how seed was stratified and what diseases were present in the garden where the seed was obtained
- timing and rate of fumigation, and emergence of weeds following fumigation
- quantity, type and timing of pest control products
- timing and rate of manure applications
- anything else that was applied to the garden, including soil amendments and biocontrols

Computer programs and mobile device applications that aid in scouting continue to be developed and even replace paper forms. See the OMAFRA website at ontario.ca/crops for more information on scouting programs.

Interpreting Results

Use scouting reports to time pest control product application effectively. If hot spots are identified in the scouting reports early enough, a localized application of a pest control product, rather than an application to the whole garden, can often control diseases or insects. This can save considerable time and product.

It is important to understand the biology of each insect and disease pest to determine if a localized spray will be effective. Diseases that spread by wind such as alternaria, botrytis and phytophthora are likely to spread throughout a garden and are unlikely to be controlled by a spot application of a pest control product. It is important to apply protectant fungicides for these diseases as soon as they are identified in a garden. When weather conditions are optimal for the spread of these diseases, preventive sprays are often necessary even before the disease is identified in a garden. In these cases, scouting reports will provide an indication of how effective the previously applied products were in controlling the disease.

Keep in mind that not all pests cause economic damage to the crop. The damage from many insect pests may be insufficient to warrant the application of a pest control product. For example, aphid populations in ginseng gardens rarely reach economically damaging levels. For ginseng, there are no established thresholds, so a grower must determine when a pest control product is warranted, based on experience. Use scouting to determine the level of damage caused by a particular pest and help make these decisions.

The amount of damage a pest will cause depends on a number of factors, including time of year and location of the damage on a plant. Leaf damage in May will have much more impact on root development than leaf damage in August or September. Ginseng has only one stem and cluster of leaves per year, and these cannot be repaired or replaced within a season. Damage in May results in lower photosynthesis all summer, whereas leaves

in August are already beginning to senesce and any damage at this stage will have much less impact on root development. Damage to ginseng stems is much more severe than damage to leaflets, since the entire top can be destroyed by one lesion on the stem, whereas one lesion on the leaflets will only stop photosynthesis in that one area. Damage to the roots is most severe, since it leads to plant death or unmarketable end product.

TIMELY APPLICATION OF PEST CONTROL PRODUCTS

Timing of pest control products is important to ensure maximum efficacy. Base an effective and efficient spray program on a scouting program, current weather conditions, spray history, choice of equipment, sprayer calibration and the recommended spray intervals specified on the label. Some products should be applied preventively when conditions are favourable for disease development, while others have curative action and should be applied when the pest is present in the garden. Many fungicides are preventive, while many insecticides have curative action and must come in contact with the pest to provide control.

The first step in a good spray program is ensuring proper pest identification. If the pest is misidentified, it is unlikely the spray program will be effective. A quick scan of the crop from a tractor is not sufficient for proper identification. There have been cases when growers mistook leafrollers for phytophthora leaf blight, since they both can cause leaves to droop down. On close inspection, it is very obvious which is affecting the ginseng. Application of a fungicide if leafrollers are the cause would be a waste of both time and money.

Some diseases of ginseng spread so rapidly through the garden that there is no tolerance for their presence, and preventive sprays should be applied before they appear in the garden. Two examples of this are alternaria leaf blight and phytophthora leaf blight, which occur in ginseng gardens almost every year. They normally begin to attack the crop very early in the season, when the leaves begin to unfold. For these diseases, begin the application of preventive fungicides when the leaves begin to unfold. The interval between sprays for these diseases can be adjusted based on weather conditions.

In contrast, botrytis blight is usually only a problem when there is physical damage to the crop from either frost, insect damage or damage from another disease. Furthermore, botrytis is only an issue in moist and warm conditions. Only apply fungicides for botrytis control when both of these conditions are met, or scouting has indicated its presence in the garden. Only apply controls for most root diseases when scouting indicates their presence in the garden, since they do not have the ability to spread quickly.

Some products provide control of multiple diseases or insects. Application of these products can reduce the number of sprays required over a season, since it avoids having to apply several different products in the same period for different diseases. See Table 3–12, *Activity of In-Season Fungicides on Ginseng Diseases*, page 33, to identify the efficacy of products on different ginseng diseases.

While the application timing of many products is important for control, only apply them when weather conditions are appropriate for ensuring product efficacy while preventing drift out of the garden. Products will not work if applied at the wrong time. For example, products that require rainfall or irrigation within 24 hr after application will not work for root diseases if rainfall does not occur. Some products are not effective unless applied when pests are active in the garden. For example, some products for cutworm provide best control when applied in the evening or at night when the cutworms are actively feeding. Never apply products under windy conditions or when it is dead calm and a temperature inversion is occurring. These conditions can lead to drift and potentially serious implications for the grower in loss of product efficacy, potential damage to neighbouring fields, environmental contamination and exposure of persons near the field.

It is important to choose the right equipment and methods to apply a pest control product effectively to the plant parts where coverage is needed. Things to consider for an optimal spray program include water volumes, tractor speeds, choice of nozzle, use of drop arms and sprayer calibration. An effective product will not control a pest if it does not reach the target in the crop. These considerations are also important for avoiding spray drift. For more information, see OMAFRA Publication 848, *Guide to Ginseng Production*.

RESISTANCE MANAGEMENT

Resistance is the ability of a pest to survive exposure to a pesticide at a rate or concentration that previously controlled it. Resistance to a pesticide develops after repeated exposure to a specific chemical or chemical family. A few naturally occurring resistant individuals survive after each application, while the susceptible portion of the population is killed. These resistant survivors multiply and gradually replace the susceptible ones. Eventually, the resistant population dominates, and the pesticide is no longer effective.

Resistance to pesticides can develop very quickly. Do not use the same chemical repeatedly unless it is used in rotation with a different chemical or used in combination with other chemicals having a different mode of action, or way of controlling the pest.

Long-term use of the fungicide Ridomil has resulted in resistant strains of *Phytophthora cactorum*, and the product may no longer work effectively in some cases. Newer products tend to have more specific modes of action, and these are much more prone to resistance than older products. In some cases, resistance can develop if the same product is applied as little as two or three times without rotating to a product with a different mode of action.

Many chemicals with the same active ingredients are marketed under different brand names. For example, the fungicide mancozeb is marketed under several brand names, including Dithane and Manzate. Consider these products to be the same product in terms of resistance management.

Different chemicals may also have the same mode of action. Pesticides are classified into different groups based on their modes of action. For example, Revus and Forum have different active ingredients, but the same mode of action, and are both in the same fungicide group, Group 40. Alternating between different active ingredients within one chemical group is the same as using the same active ingredient repeatedly, since resistance to both chemicals develops at the same time, even though only one may have been used repeatedly.

Certain pests are more prone to develop resistance to pesticides than others. Pests with a short life cycle and many generations per growing season, such as aphids, are more likely to develop resistance.

Pests are more likely to develop resistance to pesticides that have a single mode or site of action than to those with multiple modes of action (e.g., Group M fungicides).

To reduce the risk of pests developing resistance, use the following general strategies:

- **Know the active ingredient of a pesticide.** Many chemicals with the same active ingredient are marketed under different brand names. Do not alternate between chemicals with the same active ingredient.
- **Know the group.** Avoid repeated use of pesticides from the same chemical group or subgroup. For example, Actara and Closer are in the same chemical group. Rotate between products from different chemical groups. Pesticide labels and the tables in this publication indicate the chemical group or family for each product.
- **Only use chemical controls when necessary to help reduce the risk of a pest or disease developing resistance to a pesticide.** Major strategies for managing diseases should minimize the conditions that favour development of disease. These include sanitation, maintaining optimum levels of moisture and nutrients, improving drainage and proper site selection. For further details on insect pests and diseases, as well as IPM strategies for managing them, see OMAFRA Publication 848, *Guide to Ginseng Production*.

Do not exceed the total number of applications or total amount of product allowed per year for each product. Do not apply the product at rates lower or higher than the rate on the label. Monitor recently treated pest populations for signs of resistance. If you experience a control failure after using a registered product, do not reapply the same pesticide.

See the pesticide label for more information on resistance management. For more information on resistance management strategies or IPM options for a specific pest, contact an OMAFRA specialist or IPM consultant.

2. Using Pesticides in Ontario

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

Read the label before use.

Product labels may change.

Review the Grower Pesticide Safety Course Manual.
www.opep.ca/index.cfm/learning-resources/e-manuals/

Keep detailed spray records.

FEDERAL REGISTRATION OF PESTICIDES

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

The PMRA re-evaluates registered pesticides to determine whether today's health and environmental protection standards are still met when the pesticide is used according to the label. Outcomes of a re-evaluation can be:

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

The pesticide label is a legal document. Follow all label directions. Labels for all registered pesticides are under "Search Pesticide Labels" on the PMRA website at www.healthcanada.gc.ca/pmra. Ensure you have the most current label and are aware of any re-evaluation decisions.

REGULATION OF PESTICIDES IN ONTARIO

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

Classification of Pesticides

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

CERTIFICATION AND LICENSING

Certified Farmers and Their Assistants

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

assistants to growers, visit the Ontario Pesticide Education Program website at www.opep.ca or call 1-800-652-8573.

Class 12 Requirements for Growers

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

Commercial Applicators (Exterminators) and Their Assisting Technicians

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

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

Exception Uses Under the Cosmetic Pesticide Ban

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

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

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

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

- Tree Care Specialists

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

- Inside front cover of this publication
- Pest Management Regulatory Agency (PMRA) website: www.healthcanada.gc.ca/pmra
- PMRA Pest Management Information Service: 1-800-267-6315 or TTY 1-800-465-7735 (from within Canada) or 1-613-736-3799 (from outside Canada)
- Ontario Ministry of the Environment and Climate Change (MOECC) website: ontario.ca/pesticides
- Regional MOECC Pesticides Specialist (See Appendix D. *Ontario Ministry of the Environment and Climate Change — Regional Contact Information*, on page 40.)
- Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website: ontario.ca/omafra
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) website: www.opep.ca
- Ontario Pesticide Training & Certification website: www.ontariopesticide.com
- Pesticide Industry Council's Pesticide Technician Program website at www.horttrades.com/pesticide-technician
- IPM Council of Canada website: www.ontarioipm.com or www.ipmcouncilcanada.org
- Pesticide Industry Regulatory Council (PIRC) at www.oipma.ca

PESTICIDE APPLICATION INFORMATION

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

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

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

For more information on pesticide application, see:

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

Restricted Entry Intervals

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

An REI can range from 1 hr to several days. A pesticide label may state different REIs that are specific to a crop and post-application task (e.g., scouting, harvesting). If the REI is not stated on a label for agricultural crops, use a 12-hr REI. For golf courses and residential turf applications, the spray solution must be dry before entry can occur.

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

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

See Figure 2–1 for an example of a 24-hr REI on a pesticide label.

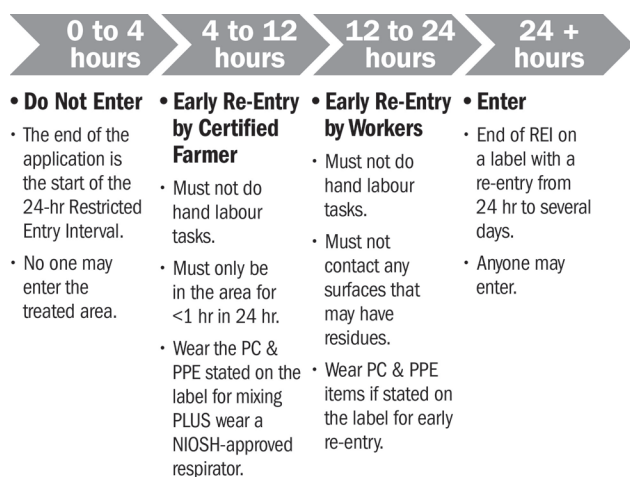


Figure 2-1. Example of a 24-hr REI on a pesticide label.

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

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

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

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

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

Buffer Zones

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

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

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

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

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

Setback Distances for Water Bodies

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

PROTECT THE ENVIRONMENT

Protect Water Sources

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

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

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

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

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

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

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

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

Bee Poisoning

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

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

information on reducing dust movement, see PMRA's *Pollinator Protection and Responsible Use of Treated Seed — Best Management Practices* at www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/pollinator-protection-pollinisateurs/treated_seed-semences_traitees-eng.php.

- Systemic insecticides may also pose a high risk to bees and other insect pollinators. Bees can be exposed to insecticide residues in or on flowers, leaves, pollen, nectar and/or surface water. Do not apply insecticide or allow it to drift onto blooming crops or off-site habitat if bees are foraging in or adjacent to the treatment area.
- Beekeepers should remove honeybee colonies as soon as pollination is complete in the crop and before any insecticides are applied post bloom. If the colonies cannot be removed in time, beekeepers can place burlap or cloth soaked in water at the entrance of the hive to disrupt the flight of the bees for up to 12 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.
- If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to bees. When there is a choice, choose a product formulation that is less hazardous to bees.
- Always read the most current label for guidance.
- Before applying a pesticide or planting with insecticide-treated seed, advise local beekeepers so they can move colonies out of the danger area, if this is an option.

Manage Drift

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

- Do not spray when wind speeds are high or gusty. These conditions increase the potential for

spray and vapour drift. Check pesticide labels for allowable wind speeds for spraying. However, not all labels provide this specific information.

- Constantly monitor wind conditions during spraying using a good-quality wind meter. Record the wind speed and direction. As wind conditions change, you may need to make adjustments to further reduce the drift potential, such as increasing water volume, minimizing nozzle-to-target distance, changing nozzle technology, stopping spraying until conditions improve or, if possible, moving to another field where wind conditions are acceptable for spraying.
- Do not spray during periods of dead calm. Periods of dead calm may occur in early morning or late evening, at which time the temperature is usually cooler and the relative humidity is typically higher, which can result in the spray droplets remaining aloft, like fog. When the wind picks up, these spray droplets can move away from the target area, possibly causing injury to adjacent non-target areas. Off-target drift in calm conditions can occur hours after the spray event was completed.

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

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

Field air temperatures are often very different from local or regional forecasts, so the most reliable method of detecting inversion conditions is to measure temperatures at, and several metres above, the ground. Spray applicators can recognize a temperature inversion when:

- there is a big difference between the daytime and nighttime temperatures
- early evening and nighttime wind speeds are considerably less than during the day
- sounds seem to carry farther
- odours seem more intense
- daytime cumulus clouds collapse toward evening

- overnight cloud cover is 25% or less
- mist, fog, dew or frost occur
- smoke or dust hangs in the air and/or moves laterally in a sheet

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

- Use the sprayer output specified on the pesticide label.
- Use a nozzle that will produce the droplet size specified on the pesticide label or delivers droplets appropriate for the job. Nozzles that produce fine droplets are rarely, if ever, required.
- Where practical, use air induction nozzles, which significantly reduce drift compared to conventional nozzles.
- Check the height of the boom to the target or distance from airblast boom to the target. Minimize the distance as much as possible while still maintaining spray uniformity.
- Establish buffer zones for the protection of adjacent sensitive areas. Some pesticide labels will state buffer zone setbacks; follow these carefully.
- Use spray plume protection where practical or available (hoods, shrouds, screens or air curtains).
- Use drift-reducing adjuvants in the spray tank as directed on the label. Mechanical or hydraulic agitations have been shown to reduce the effectiveness of certain drift-reducing adjuvants. Be aware that certain combinations of anti-drift adjuvants and air-induction nozzles have been shown to increase the incidence of fine droplets that will drift.
- When possible, use non-volatile pesticide formulations or products.

For more information about spray drift, see:

- Sprayers 101: www.sprayers101.com
- OMAFRA website: ontario.ca/spraydrift
- OMAFRA Factsheet *Pesticide Drift from Ground Applications*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos *How to Manage Spray Drift* and *Spray Drift Reduction Through Air Induction*, available at www.opep.ca/index.cfm/learning-resources/videos/chapter-18-drift-of-pesticides/

WASTE MANAGEMENT (CONTAINER DISPOSAL)

Empty Pesticide Containers Up to 23 L

Never re-use empty containers.

The Ontario Empty Pesticide Container Recycling Program, an industry-led program, is available free of charge to growers and commercial applicators. Through this program, you can return triple-rinsed or pressure-rinsed plastic pesticide and fertilizer containers up to 23 L to container collection depots located throughout the province. Remove the cap and booklet from the pesticide container before recycling. To locate the closest container collection depot, visit www.cleanfarms.ca, call your local dealer or contact CleanFARMS at 416-622-4460 (toll-free at 1-877-622-4460) or info@cleanfarms.ca.

Empty Pesticide Containers Greater Than 23 L

Growers and commercial applicators should return pesticide containers that are greater than 23 L in size to the point of sale or to the manufacturer for disposal. Contact your local dealer for details on disposal of these containers, or contact CleanFARMS at 416-622-4460 (toll-free at 1-877-622-4460) or info@cleanfarms.ca.

Empty Seed and Pesticide Bags

Growers can return their empty seed and pesticide bags to select retail locations. Contact your local dealer for details on disposal of these empty seed and pesticide bags, or contact CleanFARMS at 416-622-4460 (toll-free at 1-877-622-4460) or info@cleanfarms.ca.

Surplus Spray Mix

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

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

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

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

Surplus Pesticide Disposal

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

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

STORING PESTICIDES

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

Table 2–1. Requirements for farm pesticide storage facilities

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

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

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

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

For more information about storing pesticides, see:

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

PESTICIDE SPILLS

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

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

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

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

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

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

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

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

For information on preventing spills, see:

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

For pesticide poisonings and pesticide injuries, call:

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

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

3. Crop Protection

Detailed instructions on the use of each of the products listed in this publication are included in the label. Always read the label thoroughly before applying a pest control product and follow label instructions. See Chapter 2, *Using Pesticides in Ontario*, for a discussion of the safe use of pesticides.

To delay development of resistance to pesticides, follow resistance management guidelines outlined in Chapter 1, *Integrated Pest Management*. Always rotate between products in different chemical groups. The chemical group is indicated in the “Group” column of the appropriate tables. Products belonging to the same chemical group are grouped together in the tables.

Multi-site (M) fungicides are not prone to resistance development and do not have to be rotated.

Biological fungicides (Group 44) are also less prone to resistance development. Some products are not classified to mode of action (NC), and the mode of action has not been determined for others (U). Do not reduce rates below those specified on the label.

Table 3–1. Ginseng Seed Treatments

These products are no longer being marketed individually in Canada. They are still registered for use if growers have existing stock. Check for updates and new seed treatment registrations on the ONspecialtycrops blog at www.onspecialtycrops.wordpress.com.

Target Pest	Group	Active Chemical	Product	Rate	Notes
pythium	4	metalaxyl-M	Apron XL LS	20–40 mL/ 100 kg seed	Use in commercial seed-treatment plants only. Apply only once during the life of a garden as a seed treatment.
fusarium, rhizoctonia, cylindrocarpon	12	fludioxonil	Maxim 480 FS	5.2–10.4 mL/ 100 kg seed	Use in commercial seed-treatment plants only. One application as a seed treatment before planting (post-stratification). Maxim 480 FS seed treatment will not control <i>Pythium</i> spp. If this disease is expected to be a problem, mix with Apron XL LS seed treatment.

FUMIGATION

Fumigation is often necessary for control of soil-borne pathogens in Ontario ginseng production. It is normally used to reduce (but not eliminate) pathogen inoculum and delay the onset of disease in a garden. It is especially important for control of soil-borne nematodes and fungal diseases. It can also reduce insect and weed seed populations in the soil.

Research conducted by the Ontario Ginseng Growers Association and OMAFRA has consistently shown major benefits from fumigation in ginseng compared to unfumigated plots. The best product to use often depends on the soil pathogens present on the site and the cost of the application. Some products are more effective at controlling soil nematodes, while others are more effective at controlling diseases.

Regardless of the product being used, soil preparation and proper application procedures are essential for achieving optimal product efficacy. Improper fumigant application can lead to drift issues that can have major consequences for the grower and the industry. Applicators should pay close attention to weather conditions before, during and after fumigation to ensure proper site preparation, fumigant application and ideal conditions for optimizing efficacy.

The rules for fumigant application changed in 2014. Detailed instructions on the new requirements can be found on current fumigant labels, or by referring to the PMRA website. Applicators should follow label directions exactly to ensure the safety of the applicators, farm workers and the public surrounding treated fields.

Preparing for Fumigation

Soil preparation prior to fumigant application is critical for achieving maximum control of soil-borne pests. Fumigants cannot easily penetrate large clumps of soil and organic matter. Debris can prevent an adequate seal of the soil, allowing the fumigant to escape from the soil before it has a chance to kill soil organisms. Soil cultivation may be necessary well before fumigation to ensure breakdown of organic matter.

One week before application, cultivate the area thoroughly, breaking up clods and loosening soil deeply and thoroughly. If a soil crust has developed, lightly cultivate the soil immediately before fumigation.

Irrigate the soil before fumigation, if necessary, to ensure good soil moisture. Moist soil is necessary for ensuring optimal efficacy of some fumigants, which move through the soil in the soil water. For all fumigants, moist soil will slow the movement of the fumigant and can result in longer exposure of organisms to the product. This will result in higher efficacy.

On the other hand, saturated soil can prevent movement of the fumigant in the soil. This may reduce efficacy and/or cause the fumigant to remain trapped in the soil weeks after application. This may cause damage to the subsequently seeded crop and may result in exposure of field workers to escaping product.

Application Procedures

Apply fumigants under moderate temperatures and low wind speeds for maximum efficacy. Do not fumigate when air temperatures or soil temperatures in the top 7.5 cm of soil are below 4°C or above 30°C. Immediately after fumigation, seal the soil to prevent escape of the fumigant from the soil.

The best method for sealing the soil is through the use of tarps. This is required for the application of chloropicrin products to ginseng. For other products, if tarping is not possible, roll or cultipack immediately behind the fumigant applicator. See the notes section of Table 3–2 for sealing requirements for specific fumigants. For products not applied under a tarp, light watering after application will further prevent the escape of the fumigant from the soil. See the product labels for detailed application and re-entry instructions.

Post-Application Procedures

Soil should remain undisturbed for 7–14 days, depending on the product, after fumigation. This is to allow time for the product to be exposed to the target organisms, move through the soil profile and break down to more inert chemicals. Once the tarps are removed, the remaining fumigant in the soil must be allowed to escape before a crop is planted. Cultivation can aid in the escape, but growers must follow label directions for post-fumigation practices. Depending on the product, the soil type and soil moisture levels, it can take over 30 days after fumigation for the fumigant to have escaped and for it to be safe to plant the crop.

To ensure the fumigant has escaped, a sensitive plant such as a tomato or tobacco can be planted into the soil and then covered with a plastic pail. After a day, the pail can be removed. If there are signs of damage, it is not safe to plant. Consult the product label for more techniques for determining if it is safe to seed the crop.

New Requirements for Fumigants as of September 2014

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

- A Fumigation Management Plan (FMP) must be completed prior to the start of any fumigant application. This is an organized, written description of the steps involved to ensure a safe and effective fumigation. The specific requirements for the FMP will be listed on the product label.
- Mandatory Good Agricultural Practices will be required. This standardizes many practices already on existing labels and helps improve the safety and efficacy of soil fumigations. These practices will vary with the product and application method but will include identifying optimal weather conditions, proper soil preparation, requirements for soil moisture and temperature, methods for soil sealing and use of proper application depths.
- DO NOT apply these products when a temperature inversion is occurring or is predicted to occur within 48 hr after application is complete, as fumigant vapours may drift. For more information on how inversions affect drift of pest control products, see sprayers101.ca/spray-drift/surface-inversions/.
- DO NOT apply these products if light wind conditions (less than 3 km/h) are forecast to persist for more than 18 consecutive hours from the time the application starts until 48 hr after the application is complete.

- Any person involved in the use of fumigants is considered a fumigant handler. All fumigant handlers must hold an appropriate pesticide applicator certificate or licence recognized by the provincial pesticide regulatory agency where the pesticide application is to occur.
- The Application Block Period begins at the start of application and expires at least 5 days after the application is complete. The length of the period will depend on application criteria (e.g., tarped or non-tarped, etc.). The applicator must verbally warn workers of the application.
- Only fumigant handlers with an appropriate pesticide applicator certificate or licence may be in the application block during the Application Block Period, and in the buffer zone during the Buffer Zone Period. The Buffer Zone Period begins at the start of the application and lasts a minimum of 48 hr after the application is complete.
- Entry into fumigant application blocks by any person (other than fumigant handlers, emergency personnel and local, provincial or federal officials performing inspection, sampling or other official duties) is PROHIBITED during the Application Block Period.
- Fumigant Application signs must be posted on all entrances to the application block. Signs must be posted prior to the start of the application (but no earlier than 24 hr prior to application) and remain posted for the duration of the Application Block Period. Signs must be removed within 3 days of the end of the Application Block Period.

Buffer Zones

- A buffer zone must be established for all fumigant applications. A buffer zone is an area around the perimeter of the fumigated area that extends equally in all directions. The size of the buffer zone area will depend on the product and application criteria. Only fumigant handlers with appropriate certification may enter the buffer zone during the 48-hr period following application.
- The size of the buffer zone will vary with application method, rate and field size. Product labels will include tables to determine the required buffer zone distance.
- Buffer zones cannot include any residential area or building that may be occupied during the 48-hr period following application.
- An emergency preparedness plan will be required when residences or businesses are located in close proximity to the outer edge of the buffer zone.

Table 3–2. Preplant Fumigation for Ginseng in Ontario

Target Pests	Chemical Name	Product	Rate	Notes
nematodes, soil-borne diseases	chloropicrin	Chloropicrin 100	93 L/ha	Apply with chisels spaced no more than 30 cm apart and at a depth of 20 cm below the soil surface. Cover the soil with Raven Vaporsafe 1-mil film. Do not apply during an atmospheric inversion. Leave the soil undisturbed for 10–14 days after application and then cultivate to aerate the soil. Aerate for at least 5 days after opening the soil.
		Pic Plus	108 L/ha	
nematodes, soil-borne diseases, weeds	dazomet	Basamid	325–491 kg/ha	Apply as a granular with a spreader, then incorporate immediately. Basamid must be thoroughly and evenly incorporated into the soil to a depth of 15–23 cm immediately after application. This is best achieved using a rotary cultivator or rototiller equipped with L-shaped tines. Set the rotor speed to high and the forward speed to low. At warm soil temperatures (above 18°C at 10–15 cm), the soil may be opened 5–7 days after the BASAMID GRANULAR application.
	metam-potassium	Busan 1180	231–576 L/ha (soil injection)	Space injection shanks 12 cm apart and inject 10 cm deep into well-prepared soil. Ensure there is adequate soil moisture (60%–80% of field capacity) prior to treatment. On well-drained soils of light-to-medium texture that are not excessively wet or cold following application, planting may take place 21 days after treatment. Rate listed is for soil injection. Consult the label for recommended product rates if other methods of application are used.
	metam-sodium	Vapam HL	279–696 L/ha (soil injection)	Space injection shanks 13–15 cm apart and inject 10–15 cm deep into well-prepared soil. Ensure there is adequate soil moisture (60%–80% of field capacity) prior to treatment. On well-drained soils of light-to-medium texture that are not excessively wet or cold following application, planting may take place 21 days after treatment. Rate listed is for soil injection. Consult the label for recommended product rates if other methods of application are used.
		Busan 1020	375–935 L/ha (soil injection)	Space injection shanks 12 cm apart and inject 10 cm deep into well-prepared soil. Ensure there is adequate soil moisture (60%–80% of field capacity) prior to treatment. On well-drained soils of light-to-medium texture that are not excessively wet or cold following application, planting may take place 21 days after treatment. Rates listed are for soil injection. Consult the label for recommended product rates if other methods of application are used.
		Busan 1236	274–683 L/ha (soil injection)	

Table 3–3. Insect Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI.

PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.

Group	Chemical Name	Product	Rate	REI	PHI	Notes
CUTWORMS: ARMY, BLACK, PALE, WESTERN, RED-BACKED, WHITE, VARIEGATED						
3	permethrin	Pounce 384 EC	180–390 mL/ha	when dry	40 days	Apply when scouting indicates the presence of cutworms. Use higher rates for heavy infestations, dry conditions or larger worms. Apply under warm, moist conditions in the evening or at night. Maximum 2 applications/yr.
		Perm Up				
28	chlorantraniliprole	Coragen	250 mL/ha	12 hr	1 day	Apply when rain is not forecast for 24 hr. Thorough coverage of the stem near the straw is important for cutworm control. Maximum 4 applications/yr.
	cyantraniliprole	Exirel	500–750 mL/ha	12 hr	7 days	Begin applications when populations reach economically damaging levels. Thorough coverage is important to obtain optimum control. Maximum 4 applications/yr.
FOUR-LINED PLANT BUG						
3	permethrin	Ambush 500 EC	140–200 mL/ha	when dry	40 days	Apply when scouting indicates the presence of four-lined plant bug. Maximum 2 applications/yr.
		Perm Up	180–260 mL/ha			
		Pounce 384 EC				
LEAF ROLLERS						
5	spinosad	Success	145–182 mL/ha	when dry	3 days	Applications should be timed at egg hatch or when larvae are small. Use the upper rate under high insect pressure and/or for large larvae. Repeat applications based on monitoring of insect populations. Allow 7–10 days between applications. Do not apply immediately after a rainfall or when rainfall is forecast in the next 48 hr. Maximum 3 applications/yr.
		Entrust	290–364 mL/ha			
	spinetoram	Delegate	200 g/ha	12 hr	3 days	Use sufficient water volume for complete coverage of the plant foliage. Applications should be timed at egg hatch or small larvae. Repeat applications based on monitoring of insect populations. Repeat on a minimum 5-day interval. Maximum 3 applications/yr.
11	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> strain HD-1	Dipel 2X DF	565–1,125 g/ha in 760–1,250 L water	12 hr	1 day	For best control, apply when larvae are small. Re-apply if scouting indicates heavy infestation. Maximum 2 applications/yr.

Table 3–3. Insect Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI.

PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.

Group	Chemical Name	Product	Rate	REI	PHI	Notes
EUROPEAN CHAFER						
4	imidacloprid	Admire 240 Alias 240 SC	1.2 L/ha in 200 L water	24 hr	3 years	For reduction in numbers of European chafer, apply to newly seeded ginseng gardens before mulch is laid down. Avoid application to areas that are waterlogged or saturated. Sufficient irrigation (5–10 mm) is required within 24 hr of application to move the active ingredient to the root zone. More than 20 mm of irrigation/rainfall could wash chemical out of the root zone. Maximum 1 application/yr/crop.
APHIDS						
4	thiamethoxam	Actara 25WG	105 g/ha	12 hr	7 days	Do not apply or allow it to drift onto blooming crops or weeds if bees are foraging in/or adjacent to the treatment area. Apply before pests reach damaging levels. Maximum 2 applications/yr.
4C	sulfoxaflor	Closer	50–150 mL/ha in minimum 100 L water	12 hr	7 days	Do not apply this product during crop flowering or when flowering weeds are present in the treatment area. Rotate with insecticides with a different mode of action. Maximum 2 applications/yr.
4D	flupyradifurone	Sivanto Prime	500–750 mL/ha in minimum 100 L water	12 hr	7 days	Do not exceed 2,000 mL/ha in one season. Apply as a directed foliar spray ensuring thorough coverage. Allow a minimum of 10 days between applications.
9C	flonicamid	Beleaf 50SG	120–160 g/ha in minimum 94 L water	12 hr	3 days	Increase spray volumes when plant foliage is dense. Scout fields and apply only as populations warrant but before populations reach damaging levels. Allow a minimum of 7 days between applications. Maximum 3 applications/yr.

WEED CONTROL IN GINSENG

Good weed control depends on the timing of herbicide applications. Check the label to find out which weeds are susceptible and at what growth stage treatment is most effective.

Table 3–4. Weed Control for Ginseng in Ontario

Target Weeds	Chemical Name	Product	Rate	Notes
Spring prior to emergence of ginseng plants				
annual weeds, perennial weeds	glyphosate (present as diammonium, isopropylamine, potassium or dimethylamine salts)	Many trade names	Depends on the product used. Consult the product label.	New gardens: Glyphosate is not registered for application to new gardens in Ontario. Established gardens (seedling year and later): Apply in the spring before the crop has emerged above the soil. Apply when weeds are at the growth stage described on the label. DO NOT USE A FALL APPLICATION IN ESTABLISHED GARDENS. DO NOT EXCEED THE RATE OR SPRAY VOLUMES, OR CROP INJURY MAY RESULT. Glyphosate products are non-selective herbicides and may cause crop damage if in contact with actively growing ginseng foliage.
Post-emergence				
grasses (see label)	fluazifop-P-butyl and S-isomer	Venture L	1–2 L/ha depending on grass species. Apply at 100 L/ha of spray solution.	A maximum of 3 applications per year are permitted. Apply in early May, late June, mid-August. Use ground application only. Do not apply in the year of harvest. Do not exceed 2 L/ha at a single application. Consult the label for rates to control specific grass species.
various annual and perennial broadleaf weeds	carfentrazone-ethyl	Aim EC	37–117 mL/ha in at least 100 L/ha of spray solution	Banded application only. Apply to row middles using hooded sprayer, ensuring there is no spray deposition on the crop. Apply to actively growing weeds up to 10 cm tall, no more than once per growing season. Use with adjuvants (Agral 90, Ag-Surf or Merge) as per label rates. Do not apply within 1 day of harvest. Consult the label for optimal rates to control specific weeds.

Table 3–5. Slug Control for Ginseng in Ontario

Target Pest	Active Chemical	Product	Rate	Notes
slugs and snails including, but not limited to: field slugs, smooth slug, dusky slug, grey garden slug, black field slug, large red slug, large black slug, spotted garden slug, slender slug, banana slug and <i>Helix</i> , <i>Helicella</i> and <i>Cepaea</i> spp.	iron phosphate	Sluggo Professional Slug and Snail Bait	12–50 kg/ha	Bait may be broadcast with conventional broadcast applicators. Apply at the higher rate if infestation is severe, if the area is heavily watered or after heavy rains. Re-apply as the bait is consumed or every 2 weeks. Do not place in piles. Sluggo Professional Slug and Snail Bait is best when applied to moist soil.

Table 3–6. Pythium Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI.

PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.

Group	Chemical Name	Product	Rate	REI	PHI	Notes
4	metalaxyl-M and S-isomer	Ridomil Gold 480SL	650 mL/ha in minimum 2,500 L water	12 hr	N/A ¹	Damping-off only. DO NOT USE DURING THE GROWING SEASON. Apply as a soil broadcast application in the seedling year just prior to emergence of seedlings. Do not make more than 3 applications per year of products containing metalaxyl or metalaxyl-M and S-isomer. See Table 3–8. <i>Phytophthora Control for Ginseng in Ontario</i> , page 28. Maximum 1 application/yr.
M	captan	Maestro 80 DF	2.5 kg/ha in 935–1,871 L water	25 days/ 5 days/ 48 hr ²	20 days	Begin applications prior to disease onset, when conditions are conducive to disease development with a minimum interval of 7 days. Apply in sufficient water volume to cover all plant surfaces. Maximum 8 applications/yr.
		Captan WDG				

¹ The PHI for Ridomil products is 9 days, but Ridomil Gold 480SL should not be applied during the growing season.

² 25 days for setting up hand-set irrigation, 5 days for scouting, 48 hr for all other activities.

Table 3–7. Rhizoctonia Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI.

PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.

Group	Chemical Name	Product	Rate	REI	PHI	Notes
9 and 12	cyprodinil + fludioxonil	Switch 62.5 WG	775–975 g/ha	12 hr	7 days	Apply by broadcast ground application in sufficient water volume to obtain thorough coverage and penetration to the soil and root zone. While treating for other ginseng diseases listed on the label, Switch 62.5 WG will also provide control of rhizoctonia and suppression of cylindrocarpon if present. If only treating for rhizoctonia and/or cylindrocarpon use Scholar 50 WP or other fungicides registered for the targeted diseases. Maximum 2 applications/yr.
11	azoxystrobin	Quadris Flowable	1.12 L/ha in 4,000 L water	12 hr	2 years	Apply to newly seeded gardens in the fall before application of the straw mulch. Apply over the straw mulch in the seedling year before emergence. Maximum of 2 applications in the life of a ginseng garden. CAUTION: Quadris is extremely toxic to apples and crabapples. Control drift to prevent damage to susceptible plants.
12	fludioxonil	Scholar 50 WP Scholar 230 SC	280–560 g/ha 0.6–1.2 L/ha	12 hr	14 days	Apply by broadcast ground application in sufficient water volume to obtain thorough coverage and penetration to root zone, on a 14–21-day interval. To manage resistance, rotate with fungicides from a different group. Use Quadris for newly seeded gardens and in the spring of the seedling year. After that time, use alternative products if scouting indicates the presence of the disease. Maximum 3 applications/yr.
29	fluazinam	Allegro 500 F	1.2 L/ha in 100–500 L water	24 hr	30 days	Apply in the fall and spring as a soil drench over the straw mulch. Use high water volume to move the product to the root zone for enhanced control. Use Quadris for newly seeded gardens and in the spring of the seedling year. After that time, use alternative products if scouting indicates the presence of the disease. Maximum 4 applications/yr.
M	captan	Maestro 80 DF Captan WDG	2.5 kg/ha in 935–1,871 L water	25 days/ 5 days/ 48 hr ¹	20 days	Begin applications prior to disease onset, when conditions are conducive to disease development with a minimum interval of 7 days. Apply in sufficient water volume to cover all plant surfaces. Maximum 8 applications/yr.

¹ 25 days for setting up hand-set irrigation, 5 days for scouting, 48 hr for all other activities.

Table 3–8. Phytophthora Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI. PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.						
Group	Chemical Name	Product	Rate	REI	PHI	Notes
4	metalaxyl-M and S-isomer	Ridomil Gold 1G	31.25 kg/ha	12 hr	9 days	Root rot only. Make one application in the spring just prior to the time the plants begin growing, and repeat at 6-week intervals. Do not apply other products containing metalaxyl-M to ginseng once the tops have emerged. Maximum 3 applications/yr of all products containing metalaxyl-M or metalaxyl-M and S-isomer.
		Ridomil Gold 480SL	650 mL/ha in minimum 2,500 L water	12 hr	N/A ¹	Root rot only. DO NOT USE AFTER TOPS HAVE EMERGED. Apply as a soil broadcast application in the spring prior to ginseng emergence to 2-yr and older gardens. Maximum 1 application/yr. Follow application of Ridomil 480SL with a maximum of 2 applications of Ridomil Gold 1G, 6 weeks apart. Do not make more than 3 applications/yr of products containing metalaxyl or metalaxyl-M and S-isomer. Maximum 1 application/yr.
U15	oxathiapiprolin	Orondis Gold A	1.04 L/ha	12 hr	14 days	Root rot only. ALWAYS APPLY ORONDIS GOLD A & B AT THE SAME TIME. Orondis Gold A should be added to the tank before Orondis Gold B. Time application immediately prior to a rainfall or irrigation to move it into the root zone. Optimum time is preventively, prior to crop emergence. Do not make more than 3 applications in total per year of products containing either metalaxyl or metalaxyl-M and S-isomer. ORONDIS B will also provide control of pythium root rot. Maximum 1 application/yr.
4	metalaxyl-M and S-isomer	Orondis Gold B	650 mL/ha in minimum 2,500 L water			
11	fenamidone	Reason 500 SC	600 mL/ha in 460–1,400 L water	12 hr	14 days	Begin applications as soon as crop and/or environmental conditions become favourable for disease development. Repeat applications should be at 8–14-day intervals. Maximum 3 applications/yr.
33	mono- and dibasic, sodium, potassium and ammonium phosphites	Phostrol	5.6 L/ha in 1,000 L water	12 hr	0 days	Suppression only. For preventive suppression of phytophthora root rot, begin foliar applications when environmental conditions first become conducive to disease development and continue on a 7-day interval if disease conditions persist. Maximum 9 applications/yr.

¹ The PHI for Ridomil products is 9 days, but Ridomil Gold 480SL should not be applied during the growing season.² 25 days for setting up hand-set irrigation, 5 days for scouting, 48 hr for all other activities.

Table 3–8. Phytophthora Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI.

PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.

Group	Chemical Name	Product	Rate	REI	PHI	Notes
40	dimethomorph	Forum	450 g/ha in 2,000 L water	12 hr	30 days	Leaf blight only. Suppression only. MUST be tank-mixed with Dithane DG Rainshield NT, Manzate Pro-Stick or Penncozeb 75 DF Raincoat. See label for details. Apply preventively every 5–7 days under high disease pressure or every 7–10 days under low disease pressure. Do not apply more than one application of Forum fungicide or any other Group 40 fungicide (e.g., Revus) before alternating with at least one application of a fungicide that is not in Group 40. Maximum 3 applications/yr.
	mandipropamid	Revus	583 mL/ha in 470–1,400 L water	12 hr	3 days	Foliar or drench application by ground equipment only, prior to disease development, and continue throughout the season on a 7-day interval. A non-ionic adjuvant (0.25% v/v) should be used. Do not apply more than one application of REVUS fungicide or any other Group 40 fungicide (e.g., Forum) before alternating with at least one application of a fungicide that is not in Group 40. Maximum 4 applications/yr.
M	captan	Maestro 80 DF	2.5 kg/ha in 935–1,871 L water	25 days/ 5 days/ 48 hr ²	20 days	Begin applications prior to disease onset, when conditions are conducive to disease development with a minimum interval of 7 days. Apply in sufficient water volume to cover all plant surfaces. Maximum 8 applications/yr.
		Captan WDG				
U	fosetyl-Al	Aliette WDG	5.5 kg/ha in minimum 200 L water	when dry	31 days	Make first application at full emergence. Repeat once between full emergence and seed set if environmental conditions require it. Apply again at seed set and once again between seed set and pre-senescence (if required). The final application should be at pre-senescence. Do not use with a spreader/sticker. Maximum 5 applications/yr.

¹ The PHI for Ridomil products is 9 days, but Ridomil Gold 480SL should not be applied during the growing season.

² 25 days for setting up hand-set irrigation, 5 days for scouting, 48 hr for all other activities.

Table 3–9. Alternaria and Botrytis Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI. PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.						
Group	Chemical Name	Product	Rate	REI	PHI	Notes
2	iprodione	Rovral	1.1 kg/ha in minimum 2,000 L water	12 hr	30 days	Alternaria only. Apply when disease first appears and repeat at monthly intervals, rotating with other alternaria fungicides. Maximum 3 applications/yr.
7	fluxapyroxad	Sercadis	250–333 mL/ha	12 hr	7 days	Alternaria only. For optimal disease control, begin applications prior to disease development and continue on a 7–14-day interval if conditions are conducive for disease development. Ensure good coverage of all above-ground plant surfaces. For resistance management, tank-mix with a compatible non-Group 7 fungicide effective against <i>Alternaria</i> when use is permitted. Avoid applying two sequential applications of Sercadis or other Group 7 fungicides. Maximum 3 applications/yr.
	penthiopyrad	Fontelis	1.0–1.75 L/ha	12 hr	0 days	Botrytis only. Begin applications prior to disease development and continue on a 7–14-day interval. Do not make more than 2 sequential applications before switching to a fungicide from a different group. Do not apply more than 4.5 L/ha of Fontelis per season.
9	pyrimethanil	Scala SC	2.0 L/ha	12 hr	30 days	Begin applications when conditions are favourable for disease development. Repeat on a minimum 7-day interval. To delay resistance, rotate with 2 non-group 9 fungicides between each Scala SC application. Maximum 3 applications/yr.
9 and 12	cyprodinil + fludioxonil	Switch 62.5 WG	975 g/ha in minimum 200 L water	12 hr	7 days	Begin applications prior to or at the onset of disease and repeat applications on a 7–10-day interval if conditions remain favourable for disease development. Maximum 2 applications/yr.
11	trifloxystrobin	Flint	140–210 g/ha	12 hr	7 days	Alternaria only. Begin applications preventively and continue as needed on a 14-day interval. To manage resistance development, rotate to a non-strobilurin fungicide after each application of Flint or other Group 11 fungicide. Maximum 4 applications/yr.
12	fludioxonil	Scholar 50 WP	280–560 g/ha	12 hr	14 days	Apply by broadcast ground application in sufficient water volume to obtain thorough coverage of leaves and stems, on a 14–21-day interval. To manage resistance, rotate with fungicides from a different group. Maximum 3 applications/yr.
		Scholar 230 SC	0.6–1.2 L/ha			

¹ 25 days for setting up hand-set irrigation, 5 days for scouting, 48 hr for all other activities.

Table 3–9. Alternaria and Botrytis Control for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI.

PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.

Group	Chemical Name	Product	Rate	REI	PHI	Notes
17	fenhexamid	Elevate 50 WDG	1.7 kg/ha	4 hr	0 days	Botrytis only. Apply prior to disease establishment, when conditions favour disease development. Repeat applications as needed on a 10–14-day interval. Maximum 4 applications/yr.
29	fluazinam	Allegro 500F	1.2 L/ha in 100–500 L water	24 hr	30 days	Begin applications when the disease first appears or when conditions are favourable for disease development. Repeat applications as needed on a 7–14-day interval. Maximum 4 applications/yr.
M	captan	Maestro 80 DF	2.5 kg/ha in 935–1,871 L water	25 days/ 5 days/ 48 hr ¹	20 days	Botrytis only. Begin applications prior to disease onset, when conditions are conducive to disease development with a minimum interval of 7 days. Apply in sufficient water volume to cover all plant surfaces. Maximum 8 applications/yr.
	chlorothalonil	Bravo Zn	2.4–4.8 L/ha	48 hr	14 days	Start applications when disease threatens and repeat at 7–10-day intervals. Maximum 6 applications/yr.
		Echo 720	1.7–3.3 L/ha			
		Echo 90 DF	1.4–2.6 kg/ha			
M/M3	mancozeb	Dithane Rainshield	4.4 kg/ha in 2,000 L water	12 hr	30 days	Alternaria only. Apply when disease first appears and repeat at 14-day intervals as part of a regular spray program. Maximum 6 applications/yr.
		Manzate Prostick				
		Kingpin 75 WDG				
		Penncozeb 75 DF Raincoat	4.4 kg/ha in 2,000 L water	24 hr		

¹ 25 days for setting up hand-set irrigation, 5 days for scouting, 48 hr for all other activities.

Table 3–10. Cylindrocarpon Suppression for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI. PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.						
Group	Chemical Name	Product	Rate	REI	PHI	Notes
9 and 12	cyprodinil + fludioxonil	Switch 62.5 WG	775–975 g/ha	12 hr	7 days	Suppression only. Apply by broadcast ground application in sufficient water volume to obtain thorough coverage and penetration to the soil and root zone. While treating for other ginseng diseases listed on the label, Switch 62.5 WG will also provide control of rhizoctonia and suppression of cylindrocarpon if present. If only treating for rhizoctonia and/or cylindrocarpon, use Scholar 50 WP or other fungicides registered for the targeted diseases. Maximum 2 applications/yr.
12	fludioxonil	Scholar 50 WP	280–560 g/ha	12 hr	14 days	Suppression only. Apply by broadcast ground application in sufficient water volume to obtain thorough coverage and penetration to root zone, on a 14–21-day interval. Maximum 3 applications/yr.
		Scholar 230 SC	0.6–1.2 L/ha			
M	captan	Maestro 80 DF	2.5 kg/ha	25 days/	2 days	Suppression only. Begin applications prior to disease onset, when conditions are conducive to disease development with a minimum interval of 7 days. Apply in sufficient water volume to cover all plant surfaces. Maximum 8 applications/yr.
		Captan WDG	in 935–1,871 L water	5 days/ 48 hr ¹		

¹ 25 days for setting up hand-set irrigation, 5 days for scouting, 48 hr for all other activities.

Table 3–11. Biofungicides for Disease Suppression for Ginseng in Ontario

LEGEND: REI = Restricted-Entry Interval. Do not enter treated fields unprotected until after the REI has passed. If no REI is specified, assume a 12-hr REI. PHI = Pre-Harvest Interval. The required time period between the last spray and the first harvest.						
Group	Chemical Name	Product	Rate	REI	PHI	Notes
SCLEROTINIA WHITE MOULD						
44	<i>Bacillus subtilis</i> strain QST 713	Serenade OPTI	2.0 L/ha	12 hr	0 days	Suppression only. White mould is not a common disease in ginseng. Apply only when there is a history of disease. Begin applications soon after emergence if conditions are conducive to disease development. Repeat as necessary every 7–10 days.
PYTHIUM, RHIZOCTONIA AND FUSARIUM						
44	<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	RootShield WP	3–4 kg/ha in 1,000 L water	12 hr	0 days	Suppression only. Apply to the soil surface immediately around the ginseng plants. Use higher rates when conditions favour disease development or high disease pressure is anticipated. Sufficient irrigation or rainfall of at least 5 mm should occur within 24 hr after application to move the active ingredient into the root zone. Agitate to maintain suspension.
	<i>Bacillus subtilis</i> strain QST 713	Serenade SOIL	2.7–14 L/ha	12 hr	0 days	Suppression only. Ensure incorporation into the seed zone within 24 hr of application with rain or overhead irrigation.

Table 3–12. Activity of In-Season Fungicides on Ginseng Diseases

Ratings in cells marked with an * (shaded cells) indicate the disease is listed on the product label for control or suppression. Please see the product label for registered uses, product rates and application procedures. Use fungicides only for the crop and disease combinations listed on the label. The numbers in the cells indicate the level of control or suppression based on research on ginseng and experience with these products in other crops. This information is provided to assist in your overall disease management decisions. Biofungicides are not included in this table because their efficacy on ginseng diseases is unknown.

LEGEND: 0 = not effective, based on research on ginseng
 1 = slightly effective
 2 = moderately effective
 3 = effective with limitations
 4 = very effective
 — = unknown for ginseng
 * = disease is listed on the product label for control or suppression

Product	Alternaria	Botrytis	Phytophthora Leaf Blight	Phytophthora Root Rot ^a	Rhizoctonia ^a	Cylindrocarpus ^a	Pythium ^a
Aliette WDG	—	—	1 *	1 ^b *	—	—	—
Allegro 500 F	2 *	3 *	1	0	2 *	—	—
Bravo 500	3 ^c *	3 *	1	—	—	—	—
Captan 80 WDG	—	3 *	3	3 *	1 *	1 *	2 *
Dithane Rainshield	3 ^c *	1	1	2	—	—	—
Echo DF	3 ^c *	3 *	1	—	—	—	—
Echo 720	3 ^c *	3 *	1	—	—	—	—
Elevate 50 WDG	2	3 *	—	—	—	—	—
Flint	4 ^d *	1	—	—	—	—	—
Fontelis	2	3 ^d *	—	—	—	2	—
Forum	—	—	3 ^d *	2	—	—	—
Kingpin 75 WDG	3 ^c *	1	1	2	—	—	—
Maestro DF	—	3 *	3	3 *	1 *	1 *	2 *
Manzate Prostick DF	3 ^c *	1	1	2	—	—	—
Orondis Gold	—	—	3	3 *	—	—	2 *
Penncozeb 75 DF Raincoat	3 ^c *	1	1	2	—	—	—
Phostrol	—	—	— *	— *	—	—	—
Reason 500 SC	—	0	3 *	3 *	—	—	2
Revus	—	—	3 *	2 *	—	—	0
Ridomil Gold 1G	—	—	0	1 ^e *	—	—	2
Rovral	3 *	3	—	—	—	—	—
Scala SC	3 *	4 *	—	—	—	—	—
Scholar 50 WP	4 ^d *	3 *	—	—	3 *	1 *	—
Scholar 230 SC	4 ^d *	3 *	—	—	3 *	1 *	—
Sercadis	— *	—	—	—	—	—	—
Switch 62.5 WG	4 *	4 *	—	—	3 *	1 *	—

^a Based on a soil drench/high water volume application unless specified otherwise.

^b Systemic fungicide — foliar application is sufficient to provide the root protection specified.

^c Control inconsistent across multiple studies.

^d Based on one research trial.

^e Based on research with resistant strains. Efficacy unknown for strains found in Ontario.

ONTARIO EMERGENCY USE REGISTRATIONS

Products that are registered as Emergency Use are not listed because they are only registered for limited periods of time. For an up-to-date list of Emergency Use Registrations for ginseng, consult the OMAFRA website at ontario.ca.

Table 3–13. Pest Control Products and Companies for Ginseng in Ontario

USE CODES: f = fungicide h = herbicide i = insecticide n = nematocide s = seed treatment							
Examples of Brand Name/ Trade Name ¹	Active Ingredient/ Common Name	Registration Number/ PCP # ²	Use	Active Amount	Ontario Class ³	Primary Agent in Canada	Website and Contact Number
ACTARA 25WG	thiamethoxam	28408	i	25%	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
ADMIRE 240	imidacloprid	24094	i	240 g/L	4	Bayer CropScience Inc.	www.cropsscience.bayer.ca 1-888-283-6847
AIM EC	carfentrazone-ethyl	28573	h	240 g/L	3	FMC Corporation	www.fmccrop.ca 1-888-593-6224
ALIAS 240 SC	imidacloprid	28475	i	240 g/L	4	UAP Canada Inc.	www.uap.ca 1-800-265-4624
ALIETTE WDG	fosetyl-AI	24458	f	80%	3	Bayer CropScience Inc.	www.cropsscience.bayer.ca 1-888-283-6847
ALLEGRO 500F	fluazinam	27517	f	500 g/L	3	ISK BioSciences Corp.	www.iskbc.com 1-877-706-4640
AMBUSH 500 EC	permethrin	14882	i	500 g/L	4	AMVAC Chemical Corporation	www.amvac-chemical.com 1-888-462-6822
APRON XL LS	metalaxyl-M and S	25585	s	33.3%	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
BASAMID	dazomet	15032	h, f, n	97%	3	Engage Agro Corp.	www.engageagro.com 519-826-7878
BELEAF 50SG	flonicamid	29796	i	50%	4	UAP Canada Inc.	www.uap.ca 1-800-265-4624
BRAVO 500	chlorothalonil	15723	f	500 g/L	4	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
BUSAN 1020	metam sodium	19421	h, f, n	33%	4	Buckman Laboratories of Canada Ltd.	www.buckman.com 1-450-424-4404
BUSAN 1180	metam potassium	25124	h, f, n	54%	3	Buckman Laboratories of Canada Ltd.	www.buckman.com 1-450-424-4404
BUSAN 1236	metam sodium	25103	h, f, n	42%	4	Buckman Laboratories of Canada Ltd.	www.buckman.com 1-450-424-4404
CAPTAN 80 WDG	captan	23691	f	80%	3	Adama Agricultural Solutions Canada Ltd.	www.adama.com/canada 1-855-264-6262
CHLOROPICRIN 100	chloropicrin	25863	f, n	99%	2	TriEst Ag Group	www.triestag.com 1-844-878-5178
CLOSER	sulfoxaflor	30826	i	240 g/L	3	Dow Agrosciences Canada Inc.	www.dowagro.ca 1-800-667-3852
CORAGEN	chlorantraniliprole	28982	i	200 g/L	2	E.I. du Pont Canada Co.	www.dupont.ca 1-800-667-3925
DELEGATE	spinetoram	28778	i	25%	3	Dow Agrosciences Canada Inc.	www.dowagro.ca 1-800-667-3852
DIPEL 2X DF	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	26508	i	57%	4	Valent BioSciences Corporation	www.valent.ca 1-800-323-9597

¹ Mention of a brand or trade name in this table does not constitute a guarantee or warranty of the product by the Ontario Ministry of Agriculture, Food and Rural Affairs, nor that these products are approved to the exclusion of comparable products. All trade names are capitalized.

² See the pesticide label to confirm the current product registration number (PCP#).

³ The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the Ministry of the Environment and Climate Change the classification of pesticide products before they can be sold or used in Ontario. Most pesticides used in ginseng are either a Class 2, 3 or 4. Users of Class 2 and 3 products must be certified through the Grower Pesticide Safety Course.

Class 2: Restricted or commercial use only; very hazardous and/or persistent

Class 3: Restricted or commercial use only; moderately hazardous and/or moderately persistent

Class 4: Restricted or commercial use only; less or least hazardous and/or low persistence

Table 3–13. Pest Control Products and Companies for Ginseng in Ontario

USE CODES: f = fungicide h = herbicide i = insecticide n = nematocide s = seed treatment							
Examples of Brand Name/ Trade Name ¹	Active Ingredient/ Common Name	Registration Number/ PCP # ²	Use	Active Amount	Ontario Class ³	Primary Agent in Canada	Website and Contact Number
DITHANE RAINSHIELD	mancozeb	20553	f	75%	4	Dow Agrosciences Canada Inc.	www.dowagro.ca 1-800-667-3852
ECHO 720	chlorothalonil	29355	f	720 g/L	4	UAP Canada Inc.	www.uap.ca 1-800-265-4624
ECHO 90DF	chlorothalonil	29356	f	90%	4	UAP Canada Inc.	www.uap.ca 1-800-265-4624
ENTRUST	spinosad	30382	i	240 g/L	4	Dow Agrosciences Canada Inc.	www.dowagro.ca 1-800-667-3852
ELEVATE 50 WDG	fenhexamid	25900	f	50%	3	Arysta LifeScience North America	www.arystalifescience.ca 1-866-761-9397
EXIREL	cyantraniliprole	30895	i	100 g/L	3	E.I. du Pont Canada Co.	www.dupont.ca 1-800-667-3925
FLINT	trifloxystrobin	30619	f	50%	4	Bayer CropScience Inc.	www.cropsscience.bayer.ca 1-888-283-6847
FONTELIS	penthiopyrad	30331	f	200 g/L	4	E.I. du Pont Canada Co.	www.dupont.ca 1-800-667-3925
FORUM	dimethomorph	32026	f	500 g/L	3	BASF Canada Inc.	www.agsolutions.ca 1-877-371-2273
glyphosate: many trade names	glyphosate	see labels	h	see labels	4	see labels	
KINGPIN 75 WDG	mancozeb	31281	f	75%	4	FMC Corporation	www.fmccrop.ca 1-888-593-6224
MAESTRO 80DF	captan	26408	f	80%	3	Arysta LifeScience North America	www.arystalifescience.ca 1-866-761-9397
MANZATE PRO-STICK	mancozeb	28217	f	75%	3	United Phosphorus Inc.	www.uplonline.com 1-800-438-6071
MAXIM 480FS	fludioxonil	27001	s	40%	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
ORONDIS GOLD A	oxathiapiprolin	32134	f	100 g/L	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
ORONDIS GOLD B	metalaxyl-M and S-isomer	32133	f	480 g/L	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
PENNCOZEB 75DF RAINCOAT	mancozeb	30241	f	75%	3	United Phosphorus Inc.	www.uplonline.com 1-800-438-6071
PERM-UP	permethrin	28877	i	384 g/L	3	United Phosphorus Inc.	www.uplonline.com 1-800-438-6071
PHOSTROL	mono- and dibasic sodium, potassium and ammonium phosphites	30449	f	53.6%	4	Engage Agro Corp.	www.engageagro.com 1-800-900-5487

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Class 3: Restricted or commercial use only; moderately hazardous and/or moderately persistent

Class 4: Restricted or commercial use only; less or least hazardous and/or low persistence

Table 3–13. Pest Control Products and Companies for Ginseng in Ontario

USE CODES: f = fungicide h = herbicide i = insecticide n = nematocide s = seed treatment							
Examples of Brand Name/ Trade Name ¹	Active Ingredient/ Common Name	Registration Number/ PCP # ²	Use	Active Amount	Ontario Class ³	Primary Agent in Canada	Website and Contact Number
PIC PLUS	chloropicrin	28715	f, n	85.1%	2	TriEst Ag Group	www.triestag.com 1-844-878-5178
POUNCE 384EC	permethrin	16688	i	384 g/L	4	UAP Canada Inc.	www.uap.ca 1-800-265-4624
QUADRISS FLOWABLE	azoxystrobin	26153	f	250 g/L	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
REASON 500SC	fenamidone	27462	f	500 g/L	3	Bayer CropScience Inc.	www.cropsscience.bayer.ca 1-888-283-6847
REVUS	mandipropamid	29074	f	23.3%	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
RIDOMIL GOLD 1G	metalaxyl-M and S-isomer	26612	f	1%	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
RIDOMIL GOLD 480SL	metalaxyl-M and S-isomer	28474	f	480 g/L	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
ROOTSHIELD WP	<i>Trichoderma harzianum</i>	29890	f	1.0 x 10 ⁷ CFU/g	3	BioWorks Inc.	www.bioworksinc.com 1-800-877-9443
ROVRAL	iprodione	15213	f, s	500 g/kg	3	FMC Corporation	www.fmccrop.ca 1-888-593-6224
SCALA SC	pyrimethanil	28011	f	400 g/L	3	Bayer CropScience Inc.	www.cropsscience.bayer.ca 1-888-283-6847
SCHOLAR 50WP	fludioxonil	28568	f	50%	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
SCHOLAR 230SC	fludioxonil	29528	f	230 g/L	4	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
SERENADE OPTI	<i>Bacillus subtilis</i>	31666	f	1.31 x 10 ¹⁰ CFU/g	3	BayerCrop Science Inc.	www.cropsscience.bayer.ca 1-888-283-6847
SERENADE SOIL	<i>Bacillus subtilis</i>	30647	f	1 x 10 ⁹ CFU/g	3	Bayer CropScience Inc.	www.cropsscience.bayer.ca 1-888-283-6847
SERCADIS	fluxapyroxad	31697	f	300 g/L	2	BASF Canada Inc.	www.agsolutions.ca 1-877-371-2273
SIVANTO PRIME	flupyradifurone	31452	i	200 g/L	3	Bayer CropScience Inc.	www.cropsscience.bayer.ca 1-888-283-6847
SLUGGO PROFESSIONAL	ferric phosphate	30025	i	0.76%	4	Engage Agro Corp.	www.engageagro.com 519-826-7878
SUCCESS	spinosad	26835	i	480 g/L	4	Dow Agrosiences Canada Inc.	www.dowagro.ca 1-800-667-3852
SWITCH 62.5 WG	cyprodinil/ fludioxonil	28189	f	37.5%/ 25%	3	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682
VAPAM HL	metam sodium	29128	h, f, n	42%	4	UAP Canada Inc.	www.uap.ca 1-800-265-4624
VENTURE L	fluazifop-p-butyl	21209	h	125 g/L	2	Syngenta Canada Inc.	www.syngenta.ca 1-877-964-3682

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² See the pesticide label to confirm the current product registration number (PCP#).

³ The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the Ministry of the Environment and Climate Change the classification of pesticide products before they can be sold or used in Ontario. Most pesticides used in ginseng are either a Class 2, 3 or 4. Users of Class 2 and 3 products must be certified through the Grower Pesticide Safety Course.

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Class 4: Restricted or commercial use only; less or least hazardous and/or low persistence

4. Appendices

Appendix A. Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) Specialty Crop Advisory Staff

Sean Westerveld

Ginseng and Herbs Specialist

P.O. Box 587

Blueline Rd. & Hwy #3

Simcoe, ON N3Y 4N5

Tel: 519-426-4323

Fax: 519-428-1142

E-mail: sean.westerveld@ontario.ca

Melanie Filotas

Horticulture IPM Specialist (Simcoe)

P.O. Box 587

Blueline Rd. & Hwy #3

Simcoe, ON N3Y 4N5

Tel: 519-426-4434

Fax: 519-428-1142

E-mail: melanie.filotas@ontario.ca

A complete list of Ontario Ministry of Agriculture, Food and Rural Affairs advisory staff is available on the OMAFRA website at ontario.ca/crops.

Agricultural Information Contact Centre

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

1 Stone Rd. W.

Guelph, ON N1G 4Y2

Tel 519-826-4047

Toll-free 1-877-424-1300

TTY 1-855-696-2811

Fax 519-826-7610

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

Appendix B. Diagnostic Services

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

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

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

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

How to Sample for Nematodes

Soil

When to Sample

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

How to Sample Soil

Use a soil sampling tube, trowel or narrow-bladed shovel to take samples. Sample soil to a depth of 20–25 cm. If the soil is bare, remove the top 2 cm prior to sampling. A sample should consist of 10 or more subsamples combined. Mix well. Then take a sample of 0.5–1 L from this. No one sample should represent more than 2.5 ha. Mix subsamples in a clean pail or plastic bag.

Sampling Pattern

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

Number of Subsamples

Based on the total area sampled:

500 m ²	10 subsamples
500 m ² –0.5 ha	25 subsamples
0.5 ha–2.5 ha	50 subsamples

Roots

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

Problem Areas

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

Sample Handling

Soil Samples

Place in plastic bags as soon as possible after collecting.

Root Samples

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

Storage

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

Submitting Plant for Disease Diagnosis or Identification

Sample Submission Forms

Forms can be obtained from your local Ontario Ministry of Agriculture, Food and Rural Affairs office. Carefully fill in all the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past 3 years and this year's pesticide use records.

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

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

Delivery

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

Submitting Insect Specimens for Identification

Collecting Samples

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

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

Appendix C. Other Contacts

AGRICULTURE & AGRI-FOOD CANADA RESEARCH CENTRES

www.agr.gc.ca/index_e.php

Eastern Cereals and Oilseeds Research Centre

960 Carling Ave.
Ottawa, K1A 0C6
Tel 613-759-1858

Greenhouse and Processing Crops Centre

2585 County Road 20
Harrow, NOR 1G0
Tel 519-738-2251

Southern Crop Protection and Food Research Centre

1391 Sandford St.
London, N5V 4T3
Tel 519-457-1470

Vineland Research Farm

4902 Victoria Ave. N.
Vineland, LOR 2E0
Tel 905-562-4113

Guelph Food Research Centre

93 Stone Rd. W.
Guelph, N1G 5C9
Tel 519-829-2400

CANADIAN FOOD INSPECTION AGENCY REGIONAL OFFICES (PLANT PROTECTION)

www.inspection.gc.ca

Belleville

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

Brantford

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

Hamilton

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

London

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

St. Catharines

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

Ottawa District

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

Toronto

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

Guelph

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

UNIVERSITY OF GUELPH

Main Campus

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

Ridgetown Campus

Ridgetown, NOP 2C0
Tel 519-674-1500
www.ridgetownc.uoguelph.ca

Department of Plant Agriculture

www.plant.uoguelph.ca

Department of Plant Agriculture, Guelph

50 Stone Rd. W.
Guelph, N1G 2W1
Tel 519-824-4120, ext. 56083
Fax 519-763-8933

Department of Plant Agriculture, Simcoe

1283 Blueline Rd., Box 587
Simcoe, N3Y 4N5
Tel 519-426-7127
Fax 519-426-1225

Department of Plant Agriculture, Vineland

Box 7000, 4890 Victoria Ave. N.
Vineland Station, LOR 2E0
Tel 905-562-4141
Fax 905-562-3413

Lab Services Division

P.O. Box 3650, 95 Stone Rd. W.
Guelph, N1H 8J7
Tel 519-767-6299
www.guelphlabservices.com

Trace Organics and Pesticides

Tel 519-767-6485

Pest Diagnostic Clinic

Tel 519-767-6256

VINELAND RESEARCH AND INNOVATION CENTRE

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

Appendix D. Ontario Ministry of the Environment and Climate Change — Regional Contact Information

REGION/County	Address	Telephone/Fax	
Central Region Toronto, Halton, Peel York, Durham, Muskoka, Simcoe	5775 Yonge St., 8th Floor Toronto, ON M2M 4J1	Tel	416-326-6700
		Toll-free	1-800-810-8048
		Fax	416-325-6345
West-Central Region Halldimand, Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Ontario Government Building 119 King St. W., 9th Floor Hamilton, ON L8P 4Y7	Tel	905-521-7640
		Toll-free	1-800-668-4557
		Fax	905-521-7820
Eastern Region Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry, Haliburton, Peterborough, City of Kawartha Lakes, Northumberland, Renfrew, Ottawa, Lanark (Township of South Algonquin)	1259 Gardiners Rd., Unit 3 P.O. Box 22032 Kingston, ON K7M 8S5	Tel	613-549-4000
		Toll-free	1-800-267-0974
		Fax	613-548-6908
Southwestern Region Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth	733 Exeter Rd., 2nd Floor London, ON N6E 1L3	Tel	519-873-5000
		Toll-free	1-800-265-7672
		Fax	519-873-5020
Northern Region (EAST) Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma (East), Timiskaming, Sault Ste. Marie	199 Larch St., Suite 1201 Sudbury, ON P3E 5P9	Tel	705-564-3237
		Toll-free	1-800-890-8516
		Fax	705-564-4180
Northern Region (West) Algoma (West), Cochrane, Kenora, Rainy River, Timmins, Thunder Bay	435 James St. S., Suite 331, 3rd Floor Thunder Bay, ON P7E 6S7	Tel	807-475-1205
		Toll-free	1-800-875-7772
		Fax	705-475-1754
Standards Development Branch	Pesticides Section 40 St. Clair Ave. W., 7th Floor Toronto, ON M4V 1M2	Tel	416-327-5519
		Fax	416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Ave. W., 12A Floor Toronto, ON M4V 1L5	Tel	416-314-8001
		Toll-free	1-800-461-6290
		Fax	416-314-8452

Appendix E. The Metric System and Abbreviations

Metric units

Linear measures (length)

10 millimetres (mm) = 1 centimetre (cm)

100 centimetres (cm) = 1 metre (m)

1,000 metres = 1 kilometre (km)

Square measures (area)

100 m × 100 m = 10,000 m² = 1 hectare (ha)

100 ha = 1 square kilometre (km²)

Cubic measures (volume)

Dry measure

1,000 cubic millimetres (mm³) = 1 cubic centimetre (cm³)

1,000,000 cm³ = 1 cubic metre (m³)

Liquid measure

1,000 millilitres (mL) = 1 litre (L)

100 L = 1 hectolitre (hL)

Weight-volume equivalents (for water)

(1.00 kg) 1,000 grams = 1 litre (1.00 L)

(0.50 kg) 500 g = 500 mL (0.50 L)

(0.10 kg) 100 g = 100 mL (0.10 L)

(0.01 kg) 10 g = 10 mL (0.01 L)

(0.001 kg) 1 g = 1 mL (0.001 L)

Weight measures

1,000 milligrams (mg) = 1 gram (g)

1,000 g = 1 kilogram (kg)

1,000 kg = 1 tonne (t)

1 mg/kg = 1 part per million (ppm)

Dry-liquid equivalents

1 cm³ = 1 mL

1 m³ = 1,000 L

Metric conversions (approximate)

5 mL = 1 tsp

15 mL = 1 tbsp

28.5 mL = 1 fl. oz.

Handy metric conversion factor (approximate)

litres per hectare × 0.4 = litres per acre

kilograms per hectare × 0.4 = kilograms per acre

Application rate conversions

Metric to Imperial or U.S. (approximate)

litres per hectare × 0.09 = Imp. gallons per acre

litres per hectare × 0.11 = U.S. gallons per acre

litres per hectare × 0.36 = Imp. quarts per acre

litres per hectare × 0.43 = U.S. quarts per acre

litres per hectare × 0.71 = Imp. pints per acre

litres per hectare × 0.86 = U.S. pints per acre

millilitres per hectare × 0.014 = U.S. fluid ounces per acre

grams per hectare × 0.015 = ounces per acre

kilograms per hectare × 0.89 = pounds per acre

tonnes per hectare × 0.45 = tons per acre

Imperial or U.S. to metric (approximate)

Imp. gallons per acre × 11.23 = litres per hectare (L/ha)

U.S. gallons per acre × 9.35 = litres per hectare (L/ha)

Imp. quarts per acre × 2.8 = litres per hectare (L/ha)

U.S. quarts per acre × 2.34 = litres per hectare (L/ha)

Imp. pints per acre × 1.4 = litres per hectare (L/ha)

U.S. pints per acre × 1.17 = litres per hectare (L/ha)

Imp. fluid ounces per acre × 70 = millilitres per hectare (mL/ha)

U.S. fluid ounces per acre × 73 = millilitres per hectare (mL/ha)

tons per acre × 2.24 = tonnes per hectare (t/ha)

pounds per acre × 1.12 = kilograms per hectare (kg/ha)

pounds per acre × 0.45 = kilograms per acre (kg/acre)

ounces per acre × 70 = grams per hectare (g/ha)

Dry weight conversions (approximate)

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

Conversion tables – metric to imperial (approximate)

Length

1 millimetre (mm) = 0.04 inches

1 centimetre (cm) = 0.40 inches

1 metre (m) = 39.40 inches

1 metre (m) = 3.28 feet

1 metre (m) = 1.09 yards

1 kilometre (km) = 0.62 miles

Area

1 square centimetre (cm²) = 0.16 square inches1 square metre (m²) = 10.77 square feet1 square metre (m²) = 1.20 square yards1 square kilometre (km²) = 0.39 square miles

1 hectare (ha) = 107,636 square feet

1 hectare (ha) = 2.5 acres

Volume (dry)

1 cubic centimetre (cm³) = 0.061 cubic inches1 cubic metre (m³) = 1.31 cubic yards1 cubic metre (m³) = 35.31 cubic feet1,000 cubic metres (m³) = 0.81 acre-feet

1 hectolitre (hL) = 2.8 bushels

Volume (liquid)

1 millilitre (mL) = 0.035 fluid ounces (Imp.)

1 litre (L) = 1.76 pints (Imp.)

1 litre (L) = 0.88 quarts (Imp.)

1 litre (L) = 0.22 gallons (Imp.)

1 litre (L) = 0.26 gallons (U.S.)

Weight

1 gram (g) = 0.035 ounces

1 kilogram (kg) = 2.21 pounds

1 tonne (t) = 1.10 short tons

1 tonne (t) = 2,205 pounds

Pressure

1 kilopascal (kPa) = 0.15 pounds/in.²

Speed

1 metre per second = 3.28 feet per second

1 metre per second = 2.24 miles per hour

1 kilometre per hour = 0.62 miles per hour

Temperature

°F = (°C × 9/5) + 32

Conversion tables – imperial to metric (approximate)

Length

1 inch = 2.54 cm

1 foot = 0.30 m

1 yard = 0.91 m

1 mile = 1.61 km

Area

1 square foot = 0.09 m²1 square yard = 0.84 m²

1 acre = 0.40 ha

Volume (dry)

1 cubic yard = 0.76 m³

1 bushel = 36.37 L

Volume (liquid)

1 fluid ounce (Imp.) = 28.41 mL

1 pint (Imp.) = 0.57 L

1 gallon (Imp.) = 4.55 L

1 gallon (U.S.) = 3.79 L

Weight

1 ounce = 28.35 g

1 pound = 453.6 g

1 ton = 0.91 tonne

Pressure

1 pound per square inch = 6.90 kPa

Temperature

°C = (°F – 32) × 5/9

Abbreviations

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

Emergency and First-Aid Procedures for Pesticide Poisoning

For pesticide poisonings and pesticide injuries, call the Poison Information 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 Material Safety Data Sheets (MSDS) for the pesticides you use.** Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

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

IF AN ACCIDENT OR POISONING HAPPENS

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

FIRST AID

If a pesticide comes in contact with skin:

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

If pesticide comes in contact with eyes:

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

If pesticide was inhaled:

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

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

If a pesticide was swallowed:

- call the Poison Information Centre **IMMEDIATELY**. Emergency numbers are listed at the front of each Bell telephone directory.

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

Call the Ministry of the Environment and Climate Change **Spills Action Centre** at

1-800-268-6060 (24 hr a day, 7 days a week).

Notify your municipality.

To obtain copies of other OMAFRA publications, please order:

- online at ontario.ca/publications
- by phone through the ServiceOntario Contact Centre, Monday to Friday, 8:30 AM to 5:00 PM ET
 - 416-326-5300
 - 1-800-668-9938, toll-free across Canada
 - 1-800-268-7095 (TTY), toll-free across Ontario

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Agricultural Information Contact Centre
1-877-424-1300
1-855-696-2811 (TTY)
E-mail: ag.info.omafra@ontario.ca
ontario.ca/omafra

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