Crop Profile for Cherry in Canada, 2016

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Agriculture and Agri-Food Canada

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Preface

National crop profiles are developed by the Pest Management Program of Agriculture and Agri-Food Canada (AAFC). The national crop profiles provide baseline information on crop production and pest management practices and document the pest management needs and issues faced by growers. This information is developed through extensive consultation with stakeholders.

Information on pest management practices and pesticides is provided for information purposes only. No endorsement of any pesticide or pest control technique discussed is implied. Product names may be included and are meant as an aid for the reader, to facilitate the identification of pesticides in general use. The use of product names does not imply endorsement of a particular product by the authors or any of the organizations represented in this publication.

For detailed information on growing sweet or sour cherries, the reader is referred to provincial crop production guides and provincial ministry websites listed in the Resources Section at the end of the profile.

Every effort has been made to ensure that the information in this publication is complete and accurate. Agriculture and Agri-Food Canada does not assume liability for errors, omissions, or representations, expressed or implied, contained in any written or oral communication associated with this publication. Errors brought to the attention of the authors will be corrected in subsequent updates.

Agriculture and Agri-Food Canada gratefully acknowledges the contributions of provincial crop specialists, industry specialists and growers in the gathering of information for this publication.

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Cherries (*Prunus* spp.) are stone fruits, members of the Amygdaloideae, a subfamily of the rose family, Rosaceae. The Amygdaloideae includes a number of commercially important fruit such as cherry, apple, pear, peach and plum as well as ornamental species.

Two types of cherry are important commercially world-wide: the sweet cherry *Prunus avium* and the sour or tart cherry *Prunus cerasus*. Both species are native to Europe and western Asia and are believed to have originated in the region between the Black and Caspian seas. The fruit has been cultivated since Roman times.

Cultivated cherries were introduced into North America in the 1800's by European settlers. Both sweet and sour cherries are produced in Canada.

Sweet cherries were first planted in the Okanagan Valley of British Columbia in the late 1800's. Production expanded significantly in the early 1900's with the development of the Kettle Valley Railway which provided a link to markets on the coast. The sweet cherry breeding program at Agriculture and Agri-Food Canada's Summerland Research and Development Centre, British Columbia has produced many new commercial varieties of sweet cherry with improved traits such as self-fertility, improved fruit size and later harvest, which have helped to make the industry more competitive.

Sour cherry is grown primarily in southern Ontario where the moderate climate is suitable to the production of this crop.

A dwarf sour cherry adapted to the colder climate of the Canadian Prairies has been developed by plant breeders at the University of Saskatchewan. The first cultivar, Carmine Jewel, was released in 1999, with cultivars Romeo, Juliette, Valentine, Crimson Passion and Cupid released in 2004. These winter-hardy, drought tolerant cherries grow as a shrub on their own rootstocks and reach heights of 3 meters.

Crop Production

Industry Overview

In 2016, sweet cherry ranked sixth and sour cherries 13th in marketed production among fruits grown in Canada (Statistics Canada, Table 32-10-0364, formerly CANSIM Table 001-0009). Canadian sweet cherry production totaled 16,688 metric tons on 2,193 hectares, with a farm gate value of $60.3 million. Sour cherry production totaled 6,125 metric tons on 1,052 hectares and had a farm gate value of $4.6 million (Table 1).

Sweet cherries are normally consumed fresh. Sour cherries are used for processing as pie fillings, juice, preserves and as dried fruit, as they retain their shape and remain firm during processing. Their tart flavour tends to become sweeter with processing. The use of dwarf sour cherries (whether eaten fresh or processed) varies with cultivar.

Cherries are high in Vitamin C, potassium, fibre and anti-oxidants, and are known for their anti-inflammatory, anti-viral and anti-cancer properties.

Table 1. General production information in Canada, 2016

	Sweet Cherry	Sour Cherry
Canadian production[1]	16,688 metric tonnes 2,193 hectares	6,125 metric tonnes 1,052 hectares
Farm gate value[1]	$60.3 Million	$4.6 Million
Fresh Consumption[2] **Processed Consumption[2]**	0.76 kg/ person/ year 0.39 kg/ person/ year	
Exports[3]	9,403 metric tonnes $77.6 Million	575 metric tonnes $5.3 Million
Imports[3]	N/A $142.3 Million	N/A $0.2 Million

[1] Statistics Canada. Table 32-10-0364-01 (formerly CANSIS 001-0009) - Area, production and farm gate value of fresh and processed fruits. (Database accessed: 2018-07-18).

[2] Statistics Canada. Table 32-10-0054-01 (formerly CANSIS 002-0011) - Food available in Canada (Database accessed: 2018-07-18).

[3] Statistics Canada. Table 32-10-0053-01 (formerly CANSIS 002-0010) - Supply and disposition of food in Canada (Database accessed:2018-07-18).

Production Regions

Due to their sensitivity to spring frosts and untimely rains, sweet cherries can be grown commercially in only a few areas in Canada. British Columbia is the largest producer of sweet cherries, accounting for 1,987 hectares or 91% of total Canadian production. The key production areas are the Okanagan, Similkameen and Kootenay Valleys. Ontario produces most of the remaining 8% or 176 hectares of sweet cherry, largely in the Niagara fruit growing area.

Sour cherries are grown primarily in Ontario, which accounts for 858 hectares or 82% of total Canadian production. Regions of Ontario important for growing sour cherry (and sweet cherry) include the Niagara Peninsula, Essex and Kent counties and the Lake Huron shoreline southwards from Goderich.

Sour cherry production in Saskatchewan has expanded to comprise 87 hectares or 8% of the total sour cherry production in Canada (Table 2).

Table 2. Distribution of cherry production in Canada, 2016

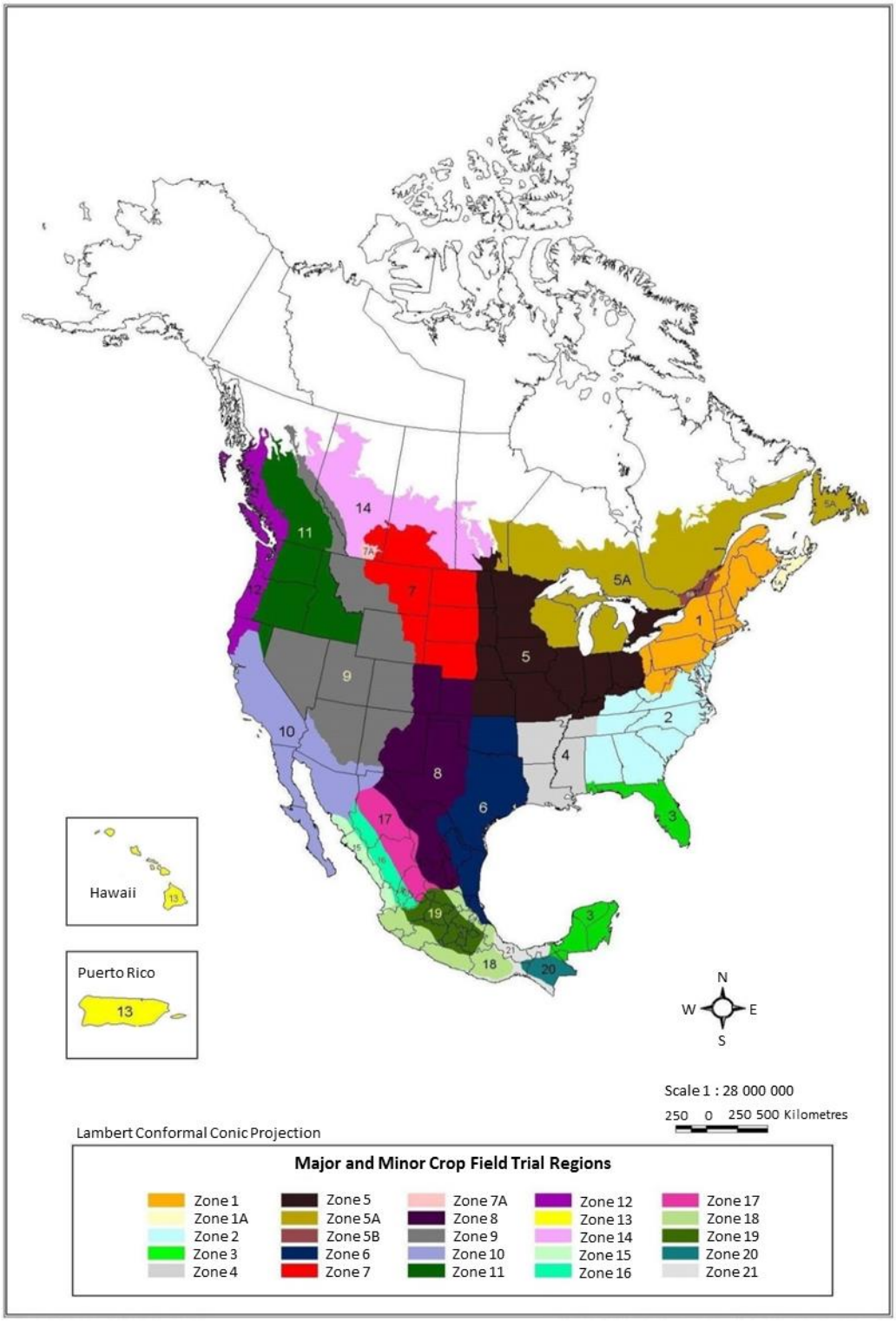
Production Regions	Cultivated Area[1] (hectares) Marketed production[1] (metric tonnes) and percentage ( ) Farm gate value[1] ($)	
	Sweet Cherry	**Sour Cherry**
British Columbia	1,987 ha 15,871 m. t. (95%) $56.6 M	42 ha 186 m. t. (3%) $0.2 M
Saskatchewan	1 ha 0 0	87 ha 59 m. t. (1%) $0.1 M
Ontario	176 ha 783 m. t. (5%) $3.6 M	858 ha 5,847 m. t. (96%) $3.9 M
Canada	2,193 ha 16,688 m. t. $60.3 M	1,052 ha 6,125 m. t. $4.6 M

[1] Statistics Canada. Table 32-10-0364-01 (formerly CANSIS 001-0009) - Area, production and farm gate value of fresh and processed fruits, by province (Database accessed: 2018-07-18).

Common zone map: North American major and minor field trial regions

The major and minor crop field trial regions were developed following stakeholder consultation and are used by the Pest Management Regulatory Agency (PMRA) in Canada and the United States (US) Environmental Protection Agency (EPA) to identify the regions where residue chemistry crop field trials are required to support the registration of new pesticide uses. The regions are based on a number of parameters, including soil type and climate but they do not correspond to plant hardiness zones. For additional information, please consult the PMRA Regulatory Directive 2010-05: *Revisions to the Residue Chemistry Crop Field Trial Requirements*.

Figure 1. Common zone map: North American major and minor field trial regions[1]



[1]Produced by: Spatial Analysis and Geomatics Applications, Agriculture Division, Statistics Canada, February 2001.

Cultural Practices

Cherries are best adapted to well-drained soils and do not grow well on soils with poor drainage or under prolonged wet conditions. The ideal site for an orchard is on a sloping hill, with a grade of 4 to 8% to allow for air drainage, surface water drainage and good light exposure. Location within 3 or 4 kilometers from a large body of water is also desirable as the water body can provide a moderating effect on temperatures in the spring and protect from spring frosts. The use of wind machines can also be beneficial to mitigate potential blossom damage from spring frosts in marginal growing areas. A soil pH of 6.0 to 6.5 is ideal for cherry orchards. Orchard productivity and fruit maturity dates are affected by cultivar, site characteristics, including soil type, degree and direction (aspect) of slope and climatic conditions such as mid-winter temperature extremes, rainfall, sunlight, wind and spring frost. These factors must be taken into account when planting an orchard. Canopy management in cherry orchards is very important to maximize annual yields.

In recent years there is a trend towards higher density plantings and later maturing varieties. The higher density plantings require careful management to maintain air circulation and prevent certain fungal diseases.

Table 3. Cherry production and pest management schedule in Canada

Time of Year	Activity	Action
December to early March (winter-dormancy)	Plant Care	Prune trees; review orchard renewal and long-term renovation plan.
	Soil Care	Prepare sites of new plantings; take soil samples in established sites for nutrient analysis.
	Disease Management	No action required.
	Insect Management	Apply delayed dormant controls for aphids, mites, scales, apple mealybug and other insects.
	Weed Management	Monitor for weeds and apply controls as required.
Late March to May (bud break and blossom)	Plant Care	Prune mature trees, remove brush and flail chop all pruning. Plant and prune new trees; irrigate as needed; place beehives in the orchard when first blossoms open and remove at petal fall, prior to insecticide applications. Activate wind machines for frost protection, as required. Initiate supplemental foliar nutrition and growth regulators, as required. Install deer fencing where required.
	Soil Care	Apply nitrogen to established orchards as needed; apply lime and other amendments as indicted by soil testing.
	Disease Management	Remove shoots which have bacterial, cytospora and coryneum blights; apply controls as required. Monitor conditions for brown rot/blossom blight, Botrytis and powdery mildew infection during and post bloom; apply controls as required.
	Insect Management	Set out and monitor yellow sticky traps for cherry fruit flies; monitor for leafrollers, fruitworms, budmoth, mites, aphids, apple mealybug, shothole borer, ambrosia beetles and beneficial organisms; apply controls as required.
	Weed Management	Monitor for weeds and apply controls as required; mow alleyways.
June to August (blossom, fruit development and harvest of summer varieties (August)	Plant Care	Monitor tree growth, apply supplemental nutrient sprays as needed; monitor soil moisture and irrigate as needed; thin cherries if required; manage canopy density for air circulation and light penetration. Apply rain split protectants as required. Have leaf analyses performed. Use bird control (noise deterrents).Hand harvest and deliver fruit to cold storage.
	Soil Care	Apply supplemental nutrients as needed.
	Disease Management	Maintain disease control of brown rot, Botrytis and powdery mildew; cut out wood with bacterial canker and powdery mildew; monitor mature fruit for little cherry disease.
	Insect Management	Monitor for spotted wing drosophila; monitor for peach tree borer; continue monitoring cherry fruit flies, leafrollers, budmoth, mites, aphid, apple mealybug, shothole borer, ambrosia beetles, wasps and beneficial organisms; begin monitoring for pear sawfly; apply controls as required;
	Weed Management	Seed cover crop in alleyways of new plantings; mow orchard alleyways. Monitor for weeds and apply controls as required.

…continued

Table 3. Cherry production and pest management schedule in Canada (continued)

Time of Year	Activity	Action
September to November (harvest and post- harvest care)	Plant Care	Apply post harvest nutrient sprays. Irrigate as needed after harvest; remove dead, weak and diseased trees; begin dormant pruning.
	Soil Care	Take soil samples in established sites for nutrient analysis; begin preparation at sites of new plantings. Apply lime if required.
	Disease Management	Remove dead, weak and diseased trees; remove cankers; begin dormant pruning. Apply controls for bacterial canker.
	Insect Management	Apply postharvest controls for spotted wing drosophila, cherry fruit flies, mites and apple mealybugs, if needed.
	Weed Management	Mow alleyways; apply residual or systemic herbicides as required.

Abiotic Factors Limiting Production

Temperature extremes

Severe winter temperatures can cause cold injury to shoots, fruit spurs, trunks and even roots. Winter damage to cherry trees increases susceptibility to diseases and insects, particularly shothole borer and ambrosia beetle. Spring frost during bloom is also a threat in some regions, and can result in reduced fruit set.

Excessive Rain

Periods of heavy rain can cause rain split, which occurs when cherry fruit absorbs water and swells, eventually splitting. Over 50% loss can be experienced on sensitive cultivars. The wound caused by splitting serves as a point of entry for diseases, particularly brown rot and botrytis blight. Trees can be sprayed with calcium to reduce damage. Some growers use helicopters or air blast sprayers to avoid fruit split by drying the fruit.

Diseases

Key issues

- There is concern that the loss of older broad-spectrum fungicides (e.g. captan, chlorothalonil and certain ethylene bisdithiocarbamates [EBDC's]) as a result of regulatory re-evaluation will negatively impact resistance management programs for brown rot in stone fruit. Fungicide resistance in cherry leafspot and brown rot pathogen populations is a primary concern for sweet and sour cherry producers.

- New fungicides are required to provide adequate control of many cherry diseases including brown rot, botrytis blight, coryneum blight, powdery mildew, black knot, perennial canker and post-harvest diseases, and to enable resistance management strategies.

- There are currently no products available in Canada for the management of bacterial canker.

- Effective controls for nematodes in established plantings are required.

- Integrated disease management approaches including forecasting and monitoring to prevent early season infection and late season development of brown rot are required as there is no tolerance for this disease in domestic and export markets.

- The trend towards higher density plantings and later-maturing varieties has increased powdery mildew incidence and severity in cherries.

- There is currently a small acreage of sweet cherries grown under high tunnels in Ontario, and the effects of these growing conditions are not well understood. High humidity environments can be more prone to infections from brown rot, botrytis and powdery mildew pathogens. Best management strategies need to be evaluated for disease control strategies when growing under high tunnels.

Table 4. Occurrence of diseases in cherry production in Canada[1,2]

Disease	Sweet Cherry		Sour Cherry
	British Columbia	Ontario	Ontario
Brown rot			
Botrytis fruit rot and blossom blight			
Coryneum blight			
Cherry leaf spot (shot hole)			
Powdery mildew			
Black knot			
Canker diseases			
Bacterial canker			
Perennial canker			
Nematodes			
Post harvest diseases			
Slip skin			
Cherry replant disease			

Widespread yearly occurrence with high pest pressure.

Widespread yearly occurrence with moderate pest pressure OR localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure.

Widespread yearly occurrence with low pest pressure OR widespread sporadic occurrence with moderate pressure OR sporadic localized occurrence with high pest pressure.

Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low pressure OR localized sporadic occurrence with low to moderate pest pressure OR pest not of concern.

Pest not present.

Data not reported.

[1]Source: Cherry stakeholders in reporting provinces (British Columbia and Ontario). The data reflect the 2016, 2015 and 2014 production years.

[2]Refer to Appendix 1 for a detailed explanation of colour coding of occurrence data.

Table 5. Adoption of disease management practices in sweet cherry production in Canada[1]

Practice / Pest		Brown rot	Powdery mildew	Bacterial canker	Cherry leaf spot (shot hole)	Little cherry disease
Avoidance	Varietal selection / use of resistant varieties					
	Planting / harvest date adjustment					
	Rotation with non-host crops					
	Choice of planting site					
	Optimizing fertilization for balanced growth and to minimize stress					
	Minimizing wounding and insect damage to limit infection sites					
	Use of disease-free propagative materials (seed, cuttings or transplants)					
Prevention	Equipment sanitation					
	Canopy management (thinning, pruning, row or plant spacing, etc.)					
	Manipulating seeding / planting depth					
	Irrigation management (timing, duration, amount) to minimize disease infection periods and manage plant growth					
	Management of soil moisture (improvements in drainage, use of raised beds, hilling, mounds, etc.)					
	End of season or pre-planting crop residue removal / management					
	Pruning out / removal of infected material throughout the growing season					
	Removal of other hosts (weeds / volunteers / wild plants) in field and vicinity					
Monitoring	Scouting / spore trapping					
	Maintaining records to track diseases					
	Soil analysis for the presence of pathogens					
	Weather monitoring for disease forecasting					
	Use of precision agriculture technology (GPS, GIS) for data collection and mapping of diseases					

…continued

Table 5. Adoption of disease management practices in sweet cherry production in Canada[1] (continued)

Practice / Pest		Brown rot	Powdery mildew	Bacterial canker	Cherry leaf spot (shot hole)	Little cherry disease
Decision making tools	Economic threshold					
	Use of predictive model for management decisions					
	Crop specialist recommendation or advisory bulletin					
	Decision to treat based on observed disease symptoms					
	Use of portable electronic devices in the field to access pathogen / disease identification / management information					
Suppression	Use of diverse product modes of action for resistance management					
	Soil amendments and green manuring involving soil incorporation as biofumigants, to reduce pathogen populations					
	Biopesticides (microbial and non-conventional pesticides)					
	Controlled atmosphere storage					
	Targeted pesticide applications (banding, spot treatments, use of variable rate sprayers, etc.)					
	Selection of pesticides that are soft on beneficial insects, pollinators and other non-target organisms					
New practices (by province)	Monitoring and control of vector (British Columbia)					

This practice is used to manage this pest by at least some growers in the province.

This practice is not used by growers in the province to manage this pest.

This practice is not applicable for the management of this pest

Information regarding the practice for this pest is unknown.

[1]Source: Cherry stakeholders in reporting provinces (British Columbia and Ontario); the data reflect the 2016, 2015 and 2014 production years.

Table 6. Adoption of disease management practices in sour cherry production in Canada[1]

Practice / Pest		Brown rot	Powdery mildew	Bacterial canker	Cherry leaf spot (shot hole)	Little cherry disease
Avoidance	Varietal selection / use of resistant varieties					
	Planting / harvest date adjustment					
	Rotation with non-host crops					
	Choice of planting site					
	Optimizing fertilization for balanced growth and to minimize stress					
	Minimizing wounding and insect damage to limit infection sites					
	Use of disease-free propagative materials (seed, cuttings or transplants)					
Prevention	Equipment sanitation					
	Canopy management (thinning, pruning, row or plant spacing, etc.)					
	Manipulating seeding / planting depth					
	Irrigation management (timing, duration, amount) to minimize disease infection periods and manage plant growth					
	Management of soil moisture (improvements in drainage, use of raised beds, hilling, mounds, etc.)					
	End of season or pre-planting crop residue removal / management					
	Pruning out / removal of infected material throughout the growing season					
	Removal of other hosts (weeds / volunteers / wild plants) in field and vicinity					
Monitoring	Scouting / spore trapping					
	Maintaining records to track diseases					
	Soil analysis for the presence of pathogens					
	Weather monitoring for disease forecasting					
	Use of precision agriculture technology (GPS, GIS) for data collection and mapping of diseases					

…continued

Table 6. Adoption of disease management practices in sour cherry production in Canada[1] (continued)

Practice / Pest		Brown rot	Powdery mildew	Bacterial canker	Cherry leaf spot (shot hole)	Little cherry disease
Decision making tools	Economic threshold					
	Use of predictive model for management decisions					
	Crop specialist recommendation or advisory bulletin					
	Decision to treat based on observed disease symptoms					
	Use of portable electronic devices in the field to access pathogen / disease identification / management information					
Suppression	Use of diverse product modes of action for resistance management					
	Soil amendments and green manuring involving soil incorporation as biofumigants, to reduce pathogen populations					
	Biopesticides (microbial and non-conventional pesticides)					
	Controlled atmosphere storage					
	Targeted pesticide applications (banding, spot treatments, use of variable rate sprayers, etc.)					
	Selection of pesticides that are soft on beneficial insects, pollinators and other non-target organisms					

This practice is used to manage this pest by at least some growers in the province.

This practice is not used by growers in the province to manage this pest.

This practice is not applicable for the management of this pest

Information regarding the practice for this pest is unknown.

[1]Source: Cherry stakeholders in reporting provinces (Ontario); the data reflect the 2016, 2015 and 2014 production years.

Brown Rot (*Monilinia fructicola*)

Pest Information

Damage: Brown rot causes serious damage to cherries and other stone fruits during wet seasons. The disease causes blossom blight, fruit rot, twig blight and fruit loss. Blossoms and ripening fruits are most susceptible. Fruit may become completely rotted within 48 hours. Tan coloured tufts of spores develop in infected tissues. Early season infections may become latent, remaining invisible until the fruit begins to ripen or after harvest. Rotting fruit provide abundant inoculum that can infect additional healthy fruit. This type of infection causes the greatest losses in cherry. There is no tolerance of brown rot infected fruit in the market-place.

Life Cycle: The fungus over-winters in mummified fruit or in infected tissues on trees and on the orchard floor. Spores produced in the spring are wind-dispersed and in the presence of moisture, infect young twigs or leaves resulting in twig and leaf blight. During bloom, prolonged wet weather may result in extensive blossom infection. Infection proceeds slowly above 30^{o}C and below 5^{o}C, however frost-injured blossoms are more susceptible to brown rot infection than non-injured blossoms. Spores (conidia) produced on blighted blossoms cause secondary infections which spread to ripening fruit. Infected fruits eventually turn into shrivelled, black mummies that may drop or remain attached to the tree through the winter.

Pest Management

Cultural Controls: Prevention, mainly via sanitation is essential in the orchard if a brown rot epidemic is to be avoided. Removing all remaining fruit and mummified fruit from the tree after the final picking removes a source of infection for the following year. A weed-free herbicide strip in sod culture/ high density systems may also discourage the production of apothecia and spores from fruit mummies present on the orchard floor.

Resistant Cultivars: Some sweet cherry varieties such as “Vega” are extremely susceptible to brown rot. Early season varieties tend to be more susceptible to brown rot than the later season varieties.

Issues for Brown Rot

1. Access to new products is needed for control of brown rot and other pathogens post-harvest.
2. Efficient, cost effective monitoring and forecasting techniques need to be developed to improve decision making for brown rot fungicide sprays.
3. Resistance to fungicides remains a primary concern. Brown rot resistance to certain groups of fungicides (mainly group 2, 3 and 11 fungicides) has not been documented to date; however, there is an industry concern related to resistant isolates to one or more of these fungicide groups. No new fungicides have been registered for brown rot in stone fruit, however continued access to new cost-effective products remain important to maintain good resistance management programs.
4. There is concern about de-registration of older broad-spectrum fungicides (captan, chlorothalonil) that are under re-evaluation by PMRA. These older chemistries are critical for resistance management programs.

5. There is a need for the development of alternative, integrated pest management (IPM) practices to prevent both early season infections (infections occurring during the bloom period that remain latent until the fruit begins to mature), and late season development of brown rot.

Botrytis Fruit Rot & Blossom Blight (*Botrytis cinerea*)

Pest Information

Damage: Botrytis cinerea can cause fruit rot in cherry orchards and post-harvest. When wet weather persists, green fruit may rot and latent infections can cause rot as the fruit ripens. Infected fruits become soft and watery, then develop a firm and brown decay covered with light brown spores. This disease is often confused with brown rot in the field.

Life Cycle: The fungus overwinters in the soil and in plant debris. It becomes active under cool moist conditions. New infections are caused by spores produced in infected tissues. Fruit rot can spread in storage.

Life Cycle: The fungus overwinters in the soil and in plant debris. It becomes active under cool moist conditions. New infections are caused by spores produced in infected tissues. Fruit rot can spread in storage.

Pest Management

Cultural Controls: Pruning to remove excess branches can increase air flow. Ensuring adequate air circulation, good sanitation and avoiding overhead watering late in the day will help to prevent the development of botrytis. Other preventative measures include harvesting and storing only sound fruit, avoiding injuring or bruising fruit at harvest, burying of culls and rotted fruit promptly, and ensuring fruit is pre-cooled and kept cool until it reaches market.

Resistant Cultivars: None identified.

Issues for Botrytis Fruit Rot

1. There is concern about the de-registration of older broad-spectrum fungicides (captan, chlorothalonil) that are under re-evaluation by PMRA. Although registered for brown rot, these products are also effective against botrytis and provide much needed resistance management tools. There is a continued need for the registration of additional active ingredients for the control of botrytis on stone fruit.

Powdery Mildew (*Podosphaera clandestina*)

Pest Information

Damage: Cherry foliage, fruit and shoots are susceptible to powdery mildew. Infected tissues develop patches of powdery, white growth of fungal mycelium and spores. Severely affected foliage often becomes distorted and powdery mildew can cause early defoliation and prevent shoot growth of young, vigorous trees. Fruit infection appears as a white powdery covering on

the cherry as it ripens, resulting in unmarketable fruit. The trend towards higher density plantings and later-maturing varieties has led to increased powdery mildew pressure and damage.

Life Cycle: Powdery mildew overwinters as cleistothecia, (spore producing bodies) in bark crevices or in leaf litter. In the spring, the cleistothecia give rise to ascospores (sexual spores) that cause primary infection of leaves, shoots and fruit. Conidia (asexual spores) are produced within the infected tissues and cause secondary infections. There are multiple generations throughout the growing season. Immature fruit is much more susceptible than mature fruit. Outbreaks of powdery mildew are triggered by wet weather during fruit development.

Pest Management

Cultural Controls: Cultural controls include increasing air circulation by pruning, avoiding dense plantings, removing infected water sprouts and keeping grass short beneath cherries with low-hanging branches.

Resistant Cultivars: Cultivars vary in their susceptibility to this disease.

Issues for Powdery Mildew

1. Access to new products is needed for the control of powdery mildew to enable resistance management strategies. Products effective on both powdery mildew and cherry leaf spot would be beneficial, as sour cherry growers must manage both diseases during the growing season.

Cherry Leaf Spot (Shot-hole) (*Blumeriella jappii*)

Pest Information

Damage: Leaves develop small purple to brown spots with defined borders during early summer. In July, the centres of the spots frequently fall out, giving a shot-hole appearance. The leaves turn yellow and fall. Cherry leaf spot often defoliates the tree by midsummer resulting in poor fruit development. Repeated defoliation weakens the tree, making it more susceptible to winter injury and causing a reduction in flowering.

Life Cycle: The fungus overwinters on fallen leaves. In spring following wet weather, spores form and are dispersed by wind to new leaves where they cause infection. The initial leaf infections form spots and more spores are produced in these spots. Spores are rain splashed and infect other leaves. Secondary spread and infection by spores continues repeatedly, whenever wet and warm weather occurs, until leaves fall in autumn.

Pest Management

Cultural Controls: Cultural controls include good pruning to allow for improved air circulation and rapid drying of foliage. There are no practical methods to reduce primary inoculum.

Resistant Cultivars: None identified.

Issues for Cherry Leaf Spot

1. There is a need to closely monitor resistance to Group 11 fungicides (strobilurin). In the United States, some *B. jappii* isolates have been identified which are resistant to certain group 11 fungicides. There is a need to investigate the impact of premature leaf drop caused by cherry leaf spot on the winter hardiness of cherry, to enable more informed management decisions.
2. There is a concern that following the re-evaluation of captan and chlorothalonil (Bravo/ Echo) materials, there will be limited effective fungicide options for growers targeting cherry leaf spot. There is a need to register more effective fungicides with new chemistries to compensate for potential loss or resistance of certain fungicides.

Coryneum Blight (*Wilsonomyces carpophilus*)

Pest Information

Damage: Coryneum blight causes small reddish-brown to purple spots on many stone fruits, which may become "scabby" later in the season. Spots, which develop on leaves, drop out resulting in shot-hole symptoms. Lesions develop infrequently on twigs.

Life Cycle: The fungus overwinters in leaf and flower buds and twig cankers. Under suitable weather conditions, spores are produced in infected tissues in the spring and are blown to fruit and leaves where they cause new lesions. Disease development is favoured by frequent rainy periods at husk fall.

Pest Management

Cultural Controls: Disease monitoring and pruning out infected twigs during dormancy is the most common approach to cultural control.

Resistant Cultivars: None identified.

Issues for Coryneum Blight

1. There are no fungicides registered for coryneum blight in cherries.

Bacterial Canker (*Pseudomonas syringae pv. syringae*)

Pest Information

Damage: Bacterial canker attacks cherries, other stone fruits, pears, apple rootstocks and many species of ornamental trees. It is an increasing problem in young cherry orchards in the interior of British Columbia. Young cherry trees and trees under stress are more susceptible to infection. Elongated, gummy cankers which eventually girdle the main trunk and branches develop on susceptible trees. Buds may be killed. Circular lesions, which drop out to give a "shot-hole" effect, may develop on leaves. Outbreaks are often associated with prolonged periods of cold, wet weather with late spring frosts.

Life Cycle: The bacterium survives the winter in cankers, healthy buds and infected tissue and is disseminated to blossoms and young leaves in the spring by rain. The bacterium is able to survive the summer on the surface of healthy young leaves and other plants in the orchard. The pathogen infects leaf scars and wounds caused by pruning, insects, frost and winter freezing.

Pest Management

Cultural Controls: The use of clean nursery stock is crucial to minimizing infection. Avoiding planting cherries in frost prone areas helps minimize frost injury and subsequent bacterial canker infections. Measures that minimize stresses on trees such as providing adequate moisture and nutrients, planting in areas with good drainage and suitable soil pH will help to reduce the development of bacterial canker. Trees with minor gumming may recover. Small cankers can be cut out with a disinfected pruning knife. Affected branches may be pruned throughout the season. Using a pruning technique known as "stubbing", as well as late pruning will reduce the risk of bacterial canker. Heavily infected trees may not recover and may have to be removed to prevent disease spread to other trees.

Resistant Cultivars: Dwarf sweet cherry trees seem to be more susceptible to bacterial canker possibly because dwarf trees are more susceptible to stress, which predisposes them to the disease. Outbreaks in dwarf trees can serve as infection sources for standard size trees. MM2 and MM60 rootstocks appear to be less susceptible to bacterial canker than others, and the F12-1 Mazzard rootstock is reported to be resistant to bacterial canker.

Issues for Bacterial Canker

1. Additional reduced risk pesticide registrations are required for the control of bacterial canker. Only copper-based products are currently registered and these can result in high levels of copper in soils with repeated use over time.

Perennial Canker (*Leucostoma cincta, L. persoonii)*

Pest Information

Damage: Slightly sunken cankers are produced on scaffold limbs or trunks of infected trees. The primary symptom is the presence of dead twigs or branches after the tree has leafed-out in the spring. Perennial canker may often be misdiagnosed as bacterial canker, as gum is produced by the tree at infection sites.

Life Cycle: Small, black, fruiting bodies of the fungus often develop under the bark in the cankered areas. Later in the spring, masses of spores are extruded from these structures. Conidia (spores) are most abundant in the fall and spring. During rain or irrigation, spores are splashed and blown around the orchard. Infection occurs through injuries to the bark such as pruning wounds, leaf scars, winter injury and sunburn. Cankers increase in size during periods of tree dormancy. With renewed growth in the spring, trees are able to form callous tissue and wall off infection. Cankers develop a target-like appearance as a result of this annual pattern of growth.

Pest Management

Cultural Controls: Cultural controls include pruning as late in the spring as possible to take advantage of the more rapid rate of wound healing which occurs at higher temperatures. Training trees so that wide angles develop between the trunk and the branches and pruning out cankers on scaffold limbs, which can be sources of spores, will help reduce disease development. Measures that minimize winter injury, sunburn, rodent damage and insect damage will reduce infection sites.

Resistant Cultivars: None identified.

Issues for Perennial Canker

There is a need to develop and register effective chemical controls as well as educating growers on best management practices (e.g. timing of pruning & borer control) to reduce the amount of perennial canker infections in sweet cherry.

Black Knot (*Apiosporina morbosa*)

Pest Information

Damage: Black knot results in dark, corky swellings on twigs and small branches. As the knots mature, they can encircle twigs and small branches, restricting nutrient and moisture flow and resulting in reduced vigour, growth and fruit production on the distal portions of affected branches. Knots can be up to 15 cm long and may coalesce, forming larger areas with black knot.

Life Cycle: This disease affects many *Prunus* spp. including ornamental, fruit and wild species. The fungus produces fruiting bodies and spores in mature black knots in the spring. Spores are released during rainy periods and are spread by wind to twigs where new infections develop. The current year's growth is susceptible from bud-break to terminal bud set. Two years are required for the black knots to mature.

Pest Management

Cultural Controls: Strict sanitation is important in the management of black knot. Monitoring orchards and removal of black knots in late winter before growth resumes in the spring will reduce the risk of infection. Removal of wild hosts within 150 meters of the orchard and placement of new plantings away from orchards infected with black knot will also reduce the risk of infection.

Resistant Cultivars: None identified.

Issues for Black Knot

1. There is a need for the registration of additional fungicides for black knot that are compatible in spray mixes with oil-based materials.
2. There is a concern that following the re-evaluation of chlorothalonil-based products, there will be limited effective fungicide options for growers targeting black knot. There is a

need to register more effective fungicides with new chemistries to compensate for potential loss of key fungicides.

3. Additional research is needed on black knot removal methods and timing in order to properly manage current black knot infections while maintaining tree health.

Post-harvest diseases: Brown Rot (*Monilinia* spp.), Botrytis Rot (*Botrytis cinerea*), Alternaria Rot (*Alternaria* spp.), Rhizopus Rot (*Rhizopus spp.*) and Mucor Rot (*Mucor* spp.)

Pest Information

Damage: Post harvest diseases of cherry are caused by pathogens picked up in the orchard prior to harvest.

Life Cycle: Pathogens can remain in the orchard in infected tissues on the trees or on leaf litter. Fruit infections may be symptomless prior to harvest or may occur through wounding such as rain splits and insect feeding injury. Pathogens may sporulate in storage. Infections in storage can spread through spores or by vegetative growth of mycelium.

Pest Management

Cultural Controls: The management of diseases prior to harvest, ensuring adequate fertility, orchard sanitation, harvesting the fruit at proper maturity and maintaining proper storage conditions, will minimize disease development in storage.

Resistant Cultivars: None identified.

Issues for Post-harvest Diseases

1. There is a need for additional products for post-harvest control of pathogens, including monilinia, botrytis, alternaria, rhizopus and penicillium.
2. Additional research and disease forecasting is required to determine the risk level for post-harvest diseases to occur. Growers are questioning the need for post-harvest fungicide applications during low pressure seasons with little to no evidence of active infections pre-harvest.

Cherry Replant Disease

Pest Information

Damage: Overcoming replant disease is critical for the successful establishment of high-density orchards. It is associated with a progressive decline in fruit trees associated with the difficulty in establishing new orchards in nurseries or on old orchard sites. Specific replant diseases in stone fruits have been described to identify poor growth of many fruit and plantation crops when planted on land previously occupied by the same or closely related species.

Life Cycle: Replant disease is not a specific disease caused by a single agent. It is not well understood in cherry orchards but it is thought to arise from the interaction of several biotic and abiotic factors. Among these factors, pathogens, insects and soil contaminants may all play a role. Plant parasitic nematodes are frequently associated with replant failure, poor growth and yield in stone fruits, especially with apples, peach, and cherries.

Pest Management

Cultural Controls: Replant disease can be prevented by avoiding planting orchards on old orchard sites. While in the past, chemical fumigants were used to control replant problems in orchards many broad-spectrum fumigants are no longer available following phase out mandated under the Montreal Protocol. Some non-fumigant nematicides suitable for post-planting applications have been successful in cases where nematodes are closely associated with the replant disease.

Resistant Cultivars: None identified.

Issues for Cherry Replant Disease

1. There is a need to further study to understand and find solutions to cherry replant disease.

Slip Skin Maceration (SSM) Disorder

Pest Information

Damage: Sweet sherry slip-skin maceration (SSM) disorder is a problem affecting the quality of primarily late season sweet cherry (*Prunus avium* L.) in British Columbia. Affected tissue develop radially causing breakage of the skin and during shipping the affected areas may form sunken craters on the fruit's surface while the rest of the cherry remains firm. It has been described as a post-harvest disease/ disorder caused primarily by *Mucor piriformis,* and also by yeasts. *M. piriformis* is the only *Mucor* spp. found to have caused serious losses in cold storage of pears, apples and plums grown in California. Cherry-SSM disorder is not visible until immediately after harvest and symptoms continue to develop in storage and during shipping. This disorder continues to be a problem affecting the quality of sweet cherry in British Columbia.

Life Cycle: Preliminary investigations suggest both physiological and pathological factors, involving different yeast species within the genera *Hanseniaspora, Aureobasidium, Cryptococus, Candida* and *Rhodotorula* and fungi such as *M. piriformis* which develops rapidly at freezing temperatures of 0^{o}C. Sporangiospores of *M. piriformis* are mostly contained in the first 2 cm of the soil where it colonizes organic matter such as fallen fruit. The fungus survives best in cool, dry soil. Therefore, infected soil and debris are the major sources of inoculum carried by picking bins.

Pest Management

Cultural Controls: Sanitation measures such as removing fallen fruits from the ground can reduce inoculum sources and control rot in storage. As *M. piriformis* can survive on wooden fruit bins, they should be washed or steam-cleaned and covered with paper or plastic pads to protect fruits from bruising.

Resistant Cultivars: None identified.

Issues for Slip Skin Maceration Disorder

No issues were reported.

Nematodes: Dagger nematode (*Xiphinema americanum*), Northern root-knot nematode (*Meloidogyne hapla*) and Root lesion nematode (*Pratylenchus penetrans*)

Pest Information

Damage: Nematodes feed on cherry tree roots by piercing plant cells with their needle-like mouthparts and sucking-out cell contents. Feeding can reduce tree vigour, growth and yield. Root-knot nematodes induce the formation of galls at their feeding sites which reduce the uptake of water and nutrients by the tree. Dagger nematodes are vectors of virus diseases. Nematode damage usually appears in patches throughout the orchard, although entire blocks of orchard can be uniformly affected. Damage caused by nematodes in many crops can also provide an infection site for other disease-causing organisms, which further reduces yields.

Life Cycle: Most plant parasitic nematodes lay eggs in the soil or roots of host plants or are retained within the female body or cyst. Nematodes complete their life cycle within three to six weeks during the growing season depending upon available moisture and temperature. After the eggs hatch, the juvenile nematodes swim to other nearby plant roots and feed on them. Extreme moisture and temperatures will kill some species of nematodes. In general, most plant pathogenic nematodes develop from eggs, through four larval stages to become adults. Adult nematodes mate and lay eggs within the host or in soil in the vicinity of host roots. Some nematodes such as *Xiphinema* spp. feed and develop completely external to the plant. Others, including *Pratylenchus* spp. and *Meloidogyne* spp. spend a part of their life cycle within plant roots.

Pest Management

Cultural Controls: Soil testing may be carried out prior to planting a new orchard to determine whether plant parasitic nematodes are present.

Resistant Cultivars: Nematode resistant rootstocks are available.

Issues for |Nematodes

1. There are currently no nematicides registered for cherries.

Fungicides, bactericides and biofungicides registered for disease management in cherry production in Canada

Active ingredients registered for the management of **diseases** in cherry are listed below in Table 6 *Fungicides, bactericides and biofungicides registered for disease management in cherry production in Canada*. This table also provides registration numbers for products registered on cherry containing these active ingredients in addition to information about chemical family and regulatory status. For guidance about active ingredients registered for specific **diseases**, the reader is referred to individual product labels on the PMRA label database https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management.html and to provincial crop production guides.

Table 7. Fungicides and biofungicides registered for disease management in cherry production in Canada

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
Agrobacterium radiobacter, strain K84	21106	biological	N/A	unknown	unknown	R
Bacillus subtilis, strain QST 713	28549, 31666, 33035	microbial: *Bacillus* spp. and the fungicidal lipopeptides they produce	44	F6: lipid synthesis and membrane integrity	microbial disrupters of pathogen cell membranes	R
BLAD polypeptide	31782, 32139	polypeptide (lectin)	BM01	BM: biologicals with multiple modes of action	BM: multiple effects on cell wall, ion membrane transporters; chelating effects	R
boscalid	30141	pyridine-carboxamide	7	C2: respiration	complex II: succinate-dehydrogenase	R
boscalid + pyraclostrobin	27985	pyridine-carboxamide + methoxy-carbamate	7 + 11	C2: respiration + C3: respiration	complex II: succinate-dehydrogenase + complex III: cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene)	R + R
canola oil	32408, 32819	not classified	N/A	unknown	unknown	R
captan	4559, 9582, 9922, 14823, 23691, 24613, 26408, 31949, 32300	phthalimide (electrophile)	M04	multi-site contact activity	multi-site contact activity	R (RVD2018-12)
chloropicrin	25863, 28715	chloropicrin[4]	8B[4]	miscellaneous non-specific (multi-site) inhibitor[4]	miscellaneous non-specific (multi-site) inhibitor[4]	RE
chlorothalonil	15723, 28900, 29225, 29306, 29355, 29356	chloronitrile (phthalonitrile)	M	multi-site contact activity	multi-site contact activity	RE

… continued

Table 7. Fungicides and biofungicides registered for disease management in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
copper hydroxide	25901	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
copper octanoate	31825	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
copper (present as copper oxychloride)	13245, 19146	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
copper (present as copper sulphate)	9934	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
dodine	15608, 28351	guanidine	U12	unknown mode of action	cell membrane disruption (proposed)	R
fenbuconazole	27294	triazole	3	G1: sterol biosynthesis in membranes	C14-demethylase in sterol biosynthesis (erg11/cyp51)	R
fenhexamid	25900	hydroxyanilide	17	G3: sterol biosynthsis in membranes	3-keto reductase, C4-demethylation (erg27)	RE
ferbam	20136, 20536	dithiocarbamate and relatives (electrophile)	M03	multi-site contact activity	multi-site contact activity	RE
fluopyram (nematicide)	30509	pyridinyl-ethyl-benzamide	7	C2: respiration	complex II: succinate-dehydrogenase	R
fluopyram + trifloxystrobin	32107	pyridinyl-ethyl-benzamide + oximino-acetate	7 + 11	C2: respiration + C3: respiration	complex II: succinate-dehydrogenase + complex III: cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene)	R
fludioxonil	29528	phenylpyrrole	12	E2: signal transduction	MAP/histidine-kinase in osmotic signal transduction (os-2, HOG1)	R

…continued

Table 7. Fungicides and biofungicides registered for disease management in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
fluxapyroxad	30562, 30565, 31697	pyrazole-4-carboxamide	7	C2: respiration	complex II: succinate-dehydrogenase	R
hydrogen peroxide + peroxyacetic acid	32907	inorganic	N/A	unknown	unknown	R (RVD2018-09, RVD 2018-10)
iprodione	15213, 24709	dicarboximide	2	E3: signal transduction	MAP/ histidine-kinase in osmotic signal transduction (os-1, Daf1)	R (RVD2018-16)
isofetamid	31758	phenyl-oxo-ethyl thiophene amide	7	C2: respiration	complex II: succinate-dehydrogenase	R
kasugamycin	30591	hexopyranosil antibiotic	24	D3: amino acids and protein synthesis	protein synthesis (ribosome initiation step)	R
lime sulphur (calcium polysulphide)	16465	inorganic	M02	multi-site contact activity	multi-site contact activity	R
metconazole	30401, 30402, 33081	triazole	3	G1: sterol biosynthesis in membranes	C14-demethylase in sterol biosynthesis (erg11/cyp51)	R
methyl bromide	9564, 19498	alky halide[4]	8A[4]	miscellaneous non-specific (multi-site) inhibitor[4]	miscellaneous non-specific (multi-site) inhibitor[4]	PO[5]
metrafenone	29765	benzophenone	U8	unknown	actin disruption (proposed)	R
myclobutanil	22399	triazole	3	G1: sterol biosynthesis in membranes	C14-demethylase in sterol biosynthesis (erg11/cyp51)	R
oriental mustard seed meal	30263					
penthiopyrad	30331	pyrazole-4-carboxamide	7	C2: respiration	complex II: succinate-dehydrogenase	R

…continued

Table 7. Fungicides and biofungicides registered for disease management in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
propiconazole	numerous products	triazole	3	G1: sterol biosynthesis in membranes	C14- demethylase in sterol biosynthesis (erg11/cyp51)	R
Pseudomonas syringae, strain ESC-10	29673	biological	N/A	unknown	unknown	R
pyraclostrobin	27323, 27985	methoxy-carbamate	11	C3: respiration	complex III: cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene)	R
Reynoutria sachalinensis (extract)	30199	complex mixture, ethanol extract (anthraquinones resveratrol)	P05	P5: host plant defence induction	anthraquinone elicitors	R
sulphur	873, 14653, 16465, 18836, 29487, 31869, 32475	inorganic (electophiles)	M02	multi-site contact activity	multi-site contact activity	R
triforine	27686	piperazine	3	G1: sterol biosynthesis in membranes	C14-demethylase in sterol biosynthesis (erg11/cyp51)	RE
thiophanate-methyl	12279, 25343, 27297, 31784, 32096	thiophanate	1	B1: cytoskeleton and motor proteins	ß-tubuline assembly in mitosis	RE

…continued

Table 7. Fungicides and biofungicides registered for disease management in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
trifloxystrobin	27527, 27529, 30427, 30619	oximino-acetate	11	C3: respiration	complex III: cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene)	R

[1]Source: Pest Management Regulatory Agency label database (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php). **The list includes active ingredients registered as of October 10, 2018.** While every effort has been made to ensure all fungicides, bactericides and biofungicides registered in Canada on cherry have been included in this list, some active ingredients or products may have been inadvertently omitted. 'Numerous products' is entered where there are more than ten products registered for an active ingredient. Not all end-use products containing a particular active ingredient may be registered for use on this crop. The product label is the final authority on pesticide use and should be consulted for application information. The information in this table should not be relied upon for pesticide application decisions and use.

[2]Source: Fungicide Resistance Action Committee. *FRAC Code List 2018: Fungicides sorted by mode of action (including FRAC code numbering).* February 2018. (www.frac.info/) (accessed August 20, 2018).

[3]PMRA re-evaluation status as published in Re-evaluation Note REV2018-06, Pest Management Regulatory Agency Re-evaluation and Special Review Work Plan 2018-2023 and other re-evaluation documents: R - full registration, RE (yellow) - under re-evaluation, RES (yellow) - under special review and RES* (yellow) - under re-evaluation and special review. Other codes include: DI (red) - discontinued by registrant, PO (red) - being phased out as a result of re-evaluation by the PMRA.

[4] Source: Insecticide Resistance Action Committee. *IRAC MoA Classification Scheme (Version 8.4; May 2018)* (www.irac-online.org) (accessed August 23, 2018).

[5]As published by Government of Canada: *Notice to anyone engaged in the use of methyl bromide: June 2017 https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/notice-use-methyl-bromide-june-2017.html*

Insects and Mites

Key issues

- Spotted wing drosophila has become the most serious pest of cherries in Canada, and registrations of insecticides with a short pre-harvest interval and contact mode of action that kills or repels adults before eggs are laid are urgently needed.

- Cherry fruit fly continues to be a serious problem requiring alternative products which have short pre-harvest intervals and effectively control female flies before eggs are laid. Replacement products are required for diazinon and imidacloprid.

- The registration of reduced risk alternatives to endosulfan, phased out in 2016, is required for the management of peach tree borer and lesser peach tree borer. There is also a need for regional monitoring for lesser peach tree borer.

- There are currently no effective chemical controls for western flower thrips, which cause much of their damage during the blossom period.

- The potential increase in numbers of grape mealybug, a potential vector of little cherry disease virus, is of concern given the movement away from the use of organophosphate insecticides.

- The brown marmorated stinkbug is a new pest in Canadian cherry producing regions. Given its high potential for injury, it is important to continue monitoring the movement of this insect and to develop effective management strategies in advance of its possible spread into commercial orchards.

- Management strategies are needed for the control of cherry fruitworm, which the Canadian Food Inspection Agency (CFIA) has found in fruit for export, some of which has been rejected due to the presence of this pest.

Table 8. Occurrence of insect pests in cherry production in Canada[1,2]

Insect	Sweet Cherry		Sour Cherry
	British Columbia	Ontario	Ontario
Fruit flies			
Eastern cherry fruit fly			
Black cherry fruit fly			
Western cherry fruit fly			
Spotted wing drosophila			
Aphids			
Black cherry aphid			
Plum curculio			
Mites			
Two-spotted spider mite			
European red mite			
Grape mealybug			
Brown marmorated stinkbug			
Western flower thrips			
Oriental fruit moth			
Spring feeding caterpillar complex			
Eastern tent caterpillar			
European leafroller			
Eyespotted bud moth			
Fruit tree leafroller			
Red-banded leafroller			
Two generation leafrollers			
Obliquebanded leafroller			
Three lined leafroller			
Borers			
Peach tree borer			
Lesser peach tree borer			
Shothole borer			
Ambrosia beetle			
Widespread yearly occurrence with high pest pressure.			
Widespread yearly occurrence with moderate pest pressure OR localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure.			
Widespread yearly occurrence with low pest pressure OR widespread sporadic occurrence with moderate pressure OR sporadic localized occurrence with high pest pressure.			
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low pressure OR localized sporadic occurrence with low to moderate pest pressure OR pest not of concern.			
Pest is present and of concern, however little is known of its distribution, frequency and pressure.			
Pest not present.			
Data not reported.			

[1]Source: Cherry stakeholders in reporting provinces (British Columbia and Ontario). The data reflect the 2016, 2015 and 2014 production years.

[2]Refer to Appendix 1 for a detailed explanation of colour coding of occurrence data.

Table 9. Adoption of insect pest management practices in sweet cherry production in Canada[1]

	Practice / Pest	Fruit flies	Spotted wing drosophila	Aphids	Spring feeding caterpillar complex	Oblique-banded leafroller	Mites
Avoidance	Varietal selection / use of resistant or tolerant varieties						
	Planting / harvest date adjustment						
	Rotation with non-host crops						
	Choice of planting site						
	Optimizing fertilization for balanced growth						
	Minimizing wounding to reduce attractiveness to pests						
	Reducing pest populations at field perimeters						
	Use of physical barriers (eg. mulches, netting, floating row covers)						
	Use of pest-free propagative materials (seeds, cuttings and transplants)						
Prevention	Equipment sanitation						
	Canopy management (thinning, pruning, row or plant spacing, etc.)						
	Manipulating seeding / planting depth						
	Irrigation management (timing, duration, amount) to manage plant growth						
	Management of soil moisture (improvements in drainage, use of raised beds, hilling, mounds)						
	End of season or pre-planting crop residue removal / management						
	Pruning out / removal of infested material throughout the growing season						
	Tillage / cultivation to expose soil insect pests						
	Removal of other hosts (weeds / volunteers / wild plants) in field and vicinity						

…continued

Table 9. Adoption of insect pest management practices in sweet cherry production in Canada[1] (continued)

Practice / Pest		Fruit flies	Spotted wing drosophila	Aphids	Spring feeding caterpillar complex	Oblique-banded leafroller	Mites
Monitoring	Scouting / trapping						
	Maintaining records to track pests						
	Soil analysis for pests						
	Weather monitoring for degree day modelling						
	Use of precision agriculture technology (GPS, GIS) for data collection and mapping of pests						
Decision making tools	Economic threshold						
	Use of predictive model for management decisions						
	Crop specialist recommendation or advisory bulletin						
	Decision to treat based on observed presence of pest at susceptible stage of life cycle						
	Use of portable electronic devices in the field to access pest identification / management information						

…continued

Table 9. Adoption of insect pest management practices in sweet cherry production in Canada[1] (continued)

	Practice / Pest	Fruit flies	Spotted wing drosophila	Aphids	Spring feeding caterpillar complex	Oblique-banded leafroller	Mites
Suppression	Use of diverse pesticide modes of action for resistance management						
	Soil amendments and green manuring involving soil incorporation as biofumigants, to reduce pest populations						
	Biopesticides (microbial and non-conventional pesticides)						
	Release of arthropod biological control agents						
	Preservation or development of habitat to conserve or augment natural controls (eg. preserve natural areas and hedgerows, adjust crop swathing height, etc.)						
	Mating disruption through the use of pheromones						
	Mating disruption through the release of sterile insects						
	Trapping						
	Targeted pesticide applications (banding, variable rate sprayers, spot treatments, etc.)						
	Selection of pesticides that are soft on beneficial insects, pollinators and other non-target organisms						

This practice is used to manage this pest by at least some growers.

This practice is not used by growers to manage this pest.

This practice is not applicable for the management of this pest.

Information regarding the practice for this pest is unknown.

[1]Source: Cherry stakeholders in reporting provinces (British Columbia and Ontario); the data reflect the 2016, 2015 and 2014 production years.

Table 10. Adoption of insect pest management practices in sour cherry production in Canada[1]

Practice / Pest		Fruit flies	Spotted wing drosophila	Aphids	Spring feeding caterpillar complex	Oblique-banded leafroller	Mites
Avoidance	Varietal selection / use of resistant or tolerant varieties						
	Planting / harvest date adjustment						
	Rotation with non-host crops						
	Choice of planting site						
	Optimizing fertilization for balanced growth						
	Minimizing wounding to reduce attractiveness to pests						
	Reducing pest populations at field perimeters						
	Use of physical barriers (e.g. mulches, netting, floating row covers)						
	Use of pest-free propagative materials (seeds, cuttings and transplants)						
Prevention	Equipment sanitation						
	Canopy management (thinning, pruning, row or plant spacing, etc.)						
	Manipulating seeding / planting depth						
	Irrigation management (timing, duration, amount) to manage plant growth						
	Management of soil moisture (improvements in drainage, use of raised beds, hilling, mounds)						
	End of season or pre-planting crop residue removal / management						
	Pruning out / removal of infested material throughout the growing season						
	Tillage / cultivation to expose soil insect pests						
	Removal of other hosts (weeds / volunteers / wild plants) in field and vicinity						

…continued

Table 10. Adoption of insect pest management practices in sour cherry production in Canada[1] (continued)

Practice / Pest		Fruit flies	Spotted wing drosophila	Aphids	Spring feeding caterpillar complex	Oblique-banded leafroller	Mites
Monitoring	Scouting / trapping						
	Maintaining records to track pests						
	Soil analysis for pests						
	Weather monitoring for degree day modelling						
	Use of precision agriculture technology (GPS, GIS) for data collection and mapping of pests						
Decision making tools	Economic threshold						
	Use of predictive model for management decisions						
	Crop specialist recommendation or advisory bulletin						
	Decision to treat based on observed presence of pest at susceptible stage of life cycle						
	Use of portable electronic devices in the field to access pest identification / management information						

…continued

Table 10. Adoption of insect pest management practices in sour cherry production in Canada[1] (continued)

Practice / Pest		Fruit flies	Spotted wing drosophila	Aphids	Spring feeding caterpillar complex	Oblique-banded leafroller	Mites
Suppression	Use of diverse pesticide modes of action for resistance management						
	Soil amendments and green manuring involving soil incorporation as biofumigants, to reduce pest populations						
	Biopesticides (microbial and non-conventional pesticides)						
	Release of arthropod biological control agents						
	Preservation or development of habitat to conserve or augment natural controls (e.g. preserve natural areas and hedgerows, adjust crop swathing height, etc.)						
	Mating disruption through the use of pheromones						
	Mating disruption through the release of sterile insects						
	Trapping						
	Targeted pesticide applications (banding, variable rate sprayers, spot treatments, etc.)						
	Selection of pesticides that are soft on beneficial insects, pollinators and other non-target organisms						

This practice is used to manage this pest by at least some growers.

This practice is not used by growers to manage this pest.

This practice is not applicable for the management of this pest.

Information regarding the practice for this pest is unknown.

[1]Source: Cherry stakeholders in reporting provinces (Ontario); the data reflect the 2016, 2015 and 2014 production years.

Fruit Flies: Eastern Cherry Fruit Fly (*Rhagoletis cingulata*), Black Cherry Fruit Fly (*R. fausta*) and Western Cherry Fruit Fly (*R. indifferens*)

Pest Information

Damage: Cherry fruit fly species attack sweet and sour/ tart cherry crops and wild cherries. Primary damage results from the feeding of the larvae (maggots) in the fruit. Maggots and their frass within the fruit render it unmarketable. Larvae are undetectable from the exterior of the cherry, but they are easily visible when the cherry is opened. There is a zero tolerance for cherry fruit flies in marketed fruit.

Life Cycle: All species of fruit flies have similar life cycles. Adults emerge from June through August, depending on temperature and moisture conditions. Populations generally peak close to harvest. Female flies can lay up to 250 eggs, but deposit usually only one egg per cherry. Larvae feed within the fruit for one to two weeks. At maturity larvae cut exit holes and drop to the soil where they overwinter as pupae. Only one generation of cherry fruit fly develops each year, though some of the pupae may remain in the soil for two years.

Pest Management

Cultural Controls: The removal of unmanaged, wild hosts near the orchard will eliminate sources of infestation. The use of landscape fabrics or other materials to impede upward movement of flies in early summer and downward movement of larvae in later summer has been used successfully as part of an integrated pest management (IPM) program. Baited, yellow sticky boards can be used to monitor the presence of adult fruit flies.

Resistant Cultivars: None identified.

Issues for Cherry Fruit Flies

1. Additional products are required for the control of cherry fruit flies. It is important that new products have short pre-harvest intervals and effectively control female flies in the pre-oviposition period.

Spotted Wing Drosophila (*Drosophila suzukii*)

Pest Information

Damage: Spotted wing drosophila (SWD) is a serious pest of soft fruit and berries. This fruit fly is known to infest raspberry, blackberry, blueberry, strawberry, cherry, peach, nectarine, apricot and plum as well as numerous wild hosts. Unlike other fruit flies, spotted wing drosophila will attack and oviposit within sound fruit. Larvae feed within fruit causing softening and breakdown of flesh which makes the fruit unmarketable. Wounds caused by egg-laying serve as entry points for disease.

Life Cycle: The insect overwinters as an adult fly. In the spring, flies mate and lay eggs under the skin of ripening fruits. Larvae feed and develop within the fruit. The entire life cycle from eggs, through larval and pupal stages to adult, varies between 7 days at 28˚C to 50 days at 12˚C.

Due to the short generation time and extended period of egg laying by adults, there can be several, overlapping generations each year. This insect is spread short distances by wind and can be carried to new areas through the movement of infested fruit.

Pest Management

Cultural Controls: Strict sanitation measures are important in the field and in processing areas. The frequent harvest of all ripe fruit and removal of unmarketable fruit culls from the orchard will help to reduce the risk of infestation and reduce sources of continued infestations. Flies can be monitored using apple-cider vinegar traps.

Resistant Cultivars: None identified.

Issues for Spotted Wing Drosophila

1. Spotted wing drosophila has become a very serious pest of cherries. Full registrations of insecticides to control this pest are needed. Materials already registered for control of cherry fruit fly should be investigated for label expansions to include this pest.
2. Materials with a short pre-harvest interval and with contact modes of action that kill or repel adults before eggs are laid or the development of bait sprays, should be explored. There is a need for the development of beneficial management practices which includes proper management of fruit culls in and around orchards. There is evidence that SWD populations can dramatically increase where abundant ripe and rotting fruit are present.
3. The use of commercial lures for mass trapping of overwintered populations in the spring should be explored.

Spring Feeding Caterpillar Complex: Eastern Tent Caterpillar (*Malacosoma americanum*), European Leafroller (*Archips rosanus*), Eyespotted Bud Moth (*Spilonota ocellana*), Fruit-tree Leafroller (*Archips argyrospila*), and Redbanded Leafroller (*Argyrotaenia velutiana*)

Pest Information

Damage: A number of caterpillars may feed on blossoms, foliage and developing fruit in early spring. Feeding damage is apparent as holes in leaves, defoliation, rolled leaves and small holes and corky scars on fruit. These insects feed on many other deciduous trees and shrubs and tend to be more prevalent towards the edges of orchards.

Life Cycle: Spring feeding caterpillars overwinter as eggs or larvae in hibernacula (shelters/ refuges) on trees. Young larvae become active in the spring, feeding on leaves and buds. When fully grown larvae pupate, with adult moths emerging later to lay eggs on the trees. European leafrollers overwinter as eggs on fruit trees, as there is only one generation per year. Eggs hatch in the spring and the newly hatched larvae disperse on silken threads. Larvae enter buds and feed on flower parts, eventually moving to the leaves and nearby fruit. Mature larvae pupate within leaf rolls. Adults emerge from June to August, mate, and lay overwintering eggs.

Pest Management

Cultural Controls: The presence of these insects can be monitored visually. Egg masses for some insects may be removed by pruning. Pheromones are available for use against these pests.
Resistant Cultivars: None available.

Issues for Spring Feeding Caterpillars

1. Need to investigate spring feeding caterpillar damage thresholds on young trees to determine the need for control.

Oriental Fruit Moth (*Grapholitha molesta*)

Pest Information

Damage: The Oriental fruit moth attacks primarily *Prunus* species, but is also known to attack apple and pear. Depending on the host crop, the larvae feed on shoots and fruits.
Life Cycle: Mature larvae of the Oriental fruit moth overwinter on or near the host. The larvae pupate in the spring and the first generation of adults emerges in early May. Eggs are laid on foliage and the larvae feed within the shoots. Larval broods appear in June, late July, early September and October (the overwintering brood). Up to four generations per year may be expected.

Pest Management

Cultural Controls: A pheromone is available to monitor male moths. Typically new growth is inspected in spring for larvae or feeding damage, and growing tips and fruits are monitored for larvae as the season progresses.
Resistant Cultivars: None identified.

Issues for Oriental Fruit Moth

None identified.

Two-Generation Leafrollers: Obliquebanded Leafroller (*Choristoneura rosaceana),* Three-lined Leafroller (*Pandemis limitata*)

Pest Information

Damage: These insects attack a range of fruits and woody ornamental plants in addition to cherries. First generation insects feed on leaves, buds and flowers. Feeding injury on fruit is evident as irregular holes and russet scars appear on mature fruit. Feeding by the second summer generation results in small holes on fruits which may develop rot.
Life Cycle: The obliquebanded leafroller and three-lined leafroller have two generations per year. They overwinter as larvae in cocoons formed in bark crevices. The larvae emerge in the spring and feed on flower parts, leaves and young fruit. Pupation occurs within leaf rolls and moths

emerge to lay eggs in June and July. Second generation moths are present from August to October. These moths lay eggs that hatch into larvae which overwinter.

Pest Management

Cultural Controls: Pruning trees will open up the canopy and help to remove egg-masses and allow sufficient penetration of treatment sprays, especially into the upper canopy where leafrollers are most active. Elimination or spraying of unmanaged tree-hosts in close proximity to commercial orchards helps to reduce leafroller pressure. Monitoring is an important practice used to determine if pest levels warrant treatment. A pheromone product which reduces pest pressure through mating disruption is registered in Canada.

Resistant Cultivars: None identified.

Issues for Two Generation Leafrollers

1. There is a need to better understand the biology of obliquebanded leafroller (OBLR) in sour cherry. There are concerns about small leafroller larvae present in harvested bins and questions regarding the rate of development of OBLR when feeding on sour cherry.

Plum Curculio (*Conotrachelus nenuphar*)

Pest Information

Damage: Hosts include plum, apricot, cherry, apple, pear, gooseberry and chokecherry. Adult curculios feed on young fruit. Females lay eggs in young fruit and leave a characteristic crescent-shaped scar near the egg-laying site. Infested fruit may become deformed, drop prematurely or may remain infested until harvest, when they are unmarketable.

Life Cycle: Adults overwinter in debris close to orchards and emerge in the spring to feed on buds, fruit spurs and developing fruit. Adult curculio beetles lay eggs in fruit and after hatching larvae feed within the fruit. At maturity, the larvae drop to the soil to pupate. The subsequent generation of adults appears from late July to early September when they feed on fruit before seeking overwintering sites near the tree-host.

Pest Management

Cultural Controls: The regular collection and disposal of fallen fruit will help reduce the population of plum curculio.

Resistant Cultivars: None identified

Issues for Plum Curculio

1. Studies are required to incorporate new trap monitoring methods into effective integrated pest management (IPM) systems.
2. Research is needed to develop better attractant lures so that trapping methods can be more efficiently used to aid in early warning and timing of sprays.

3. New chemistries are required for control of plum curculio. There is currently a heavy reliance on neonicotinoids (group 4) for control of this pest.

Black Cherry Aphid (*Myzus cerasi*)

Pest Information

Damage: Feeding on terminal shoots by the black cherry aphid results in inward curling of leaves and shoot deformities which can slow down the growth of young trees. Aphids cause little direct fruit damage but can leave undesirable deposits of sticky honeydew on fruit that can promote sooty mould growth. The level of tolerance for the black cherry aphid on young trees is very low.

Life Cycle: Aphids overwinter as eggs on the host plant. Eggs hatch at bud break. Young aphids infest blooms and later, growing tips. In July and August adults migrate to summer hosts but return to cherry to lay overwintering eggs. Several generations are produced per year.

Pest Management

Cultural Controls: Monitoring is used to determine when controls are required. The removal of infested terminals reduces populations. A number of beneficial species will help to reduce aphids to non-damaging levels, including lady beetles, lacewings, syrphid flies and parasitic wasps.

Resistant Cultivars: None identified.

Issues for Black Cherry Aphid

1. With the phasing out of endosulfan products, diazinon, and some uses of neonicotinoids, there will be a need to register insecticides from alternate chemical groups to control aphids in cherries.

Brown Marmorated Stinkbug (*Halymorpha halys*)

Pest Information

Damage: Although the brown marmorated stinkbug (BMSB) has not yet been identified as a pest in crops in Canada, it has caused significant crop injury in other jurisdictions where it is established in agricultural crops. This insect has a broad host range including tree fruit, berries, grapes, ornamentals, grain crops, tomatoes, peppers and sweet corn. Injury is caused by feeding of adults and nymphs. The insect injects saliva with digestive enzymes into the plant and ingests the liquefied plant material, with each feeding puncture resulting in fruit injury in cherry crops.

Life Cycle: The insect spreads through natural means and also as a "hitchhiker" in cargo and vehicles. It has been intercepted in many provinces over the years and in 2012, an established population was identified in the Hamilton, Ontario area. It readily moves among host crops throughout the growing season. BMSB overwinter as adults. In the spring, adults mate and lay eggs on host plants. Both nymphs and adults feed on host plants. Adults are long-lived and females may lay several hundred eggs over an extended period of time. In the fall, adults move

back to protected overwintering sites. They have frequently entered structures in the fall where they are a nuisance pest.

Pest Management

Cultural Controls: Monitoring for the insect may be done through aggregation pheromones and by scouting. Although thresholds have not been established, small numbers of nymphs and adults can cause considerable damage in a growing season.

Resistant cultivars: None available.

Issues for Brown Marmorated Stinkbug

1. BMSB is a pest of concern in cherry producing regions. Although there has been no measurable crop loss in Canada as of yet, given the high potential for crop injury close to harvest it is important to continue monitoring for presence and potential movement of this insect into commercial orchards. Effective management strategies must be developed in advance of the establishment of this insect in orchards.

Mites: Two-spotted Spider Mite (*Tetranychus urticae*), European red mite (*Panonychus ulmi*), and Plum Rust Mite (*Aculus fockeui*)

Pest Information

Damage: A light infestation of two-spotted spider mites can cause leaf specks but a heavy infestation can cause leaf bronzing and loss of foliage. Prolonged feeding by two-spotted spider mite or European red mite populations can stress cherry tree, reduce shoot growth and fruit bud setting the following year.

Life Cycle: Two-spotted spider mites and European red mite (ERM) progress through several immature stages including a six-legged larva and eight-legged nymph. Mature female of two-spotted spider mite is orange in colour but its ERM counterpart is more reddish-brown. They may overwinter at the base of buds and in leaf scars or in bark crevices. In Ontario, there may be three to five generations of two-spotted spider mite per growing season and they are able to disperse by wind over wide areas, possibly from apple orchard to cherry orchard. Two-spotted spider mite populations continue to thrive until cool, late summer weather reduces their activity. In the spring, nymphs move down from the trees to begin feeding on weeds. This mite infestation is often accompanied by more silk webbing on the leaf surface compared to European red mite. In the case of rust mite, the pest moves to the flower parts at bud opening and several generations can be produced during the growing season.

Pest Management

Cultural Controls: In Ontario, two-spotted spider mites are found in cherry orchards and appear generally later in the season than European red mites. Natural enemies of mites include some predatory mites and thrips. Care in choosing products and application rates that are least toxic to the predatory mites may favour control by these beneficial species. Natural egg hatching of overwintering ERM and two-spotted spider mites can be reduced by extreme winter weather.

Healthy, well-maintained trees will tolerate higher mite populations than weak or stressed trees. Herbicide sprays can also negatively affect the number of predator mites within a cherry orchard. Clean, weed-free areas under the trees in the fall and an early spring can eliminate optimal habitat for predaceous mites and without predator mite presence early in the season, two-spotted spider mite populations can grow unchecked.

Resistant Cultivars: None identified.

Issues for Mites

None identified.

Grape Mealybug (*Pseudococcus maritimus*)

Pest Information

Damage: Grape mealybugs may transmit little cherry virus, a serious threat for cherry growers. Crawlers are the most mobile and capable of transmitting the virus. In heavy infestations, mealybug may move to fruit clusters. As they feed, they excrete a sugary honeydew which supports the growth of sooty moulds, which may cause fruit marking and rejection.

Life Cycle: Grape mealybugs have two generations per year. They overwinter as eggs under the loose bark of trunks. Increasing summer populations move to new tissue growth to feed. Eggs can be laid on all plant parts during the season that hatch from mid-June to July. Adult females will appear in late summer and early fall. Some females will oviposit in the fruit clusters but the majority of the females move to old wood to lay their overwintering eggs. Ants are often found in association with mealybugs as they feed on the honeydew and tend to the mealybugs, protecting them from predators and pathogens.

Pest Management

Cultural Controls: Older standard trees are most susceptible to mealybug infestations because they provide more hiding places for all stages and less exposure to insecticide sprays if they are not properly pruned to open up the canopies. Mealybugs prefer to feed on tender new growth, so sucker removal will aid in reducing the risk of damaging population levels. Integrated management practices used for grape mealybug in Ontario vineyards will likely also be helpful in cherry orchards. Once established, parasites and predators of grape mealybugs can help keep populations down, but an infestation may slowly spread unless controlled with insecticides. When it is necessary to spray, leaving an untreated refuge for natural enemies and using an insecticide that is not toxic to beneficial species will also help to conserve important mealybug predators.

Resistant Cultivars: None identified.

Issues for Grape Mealybug

1. With the movement away from the use of organophosphate insecticides, there is concern for grape mealybug as a potential vector of little cherry disease virus.

Peach Tree Borer (*Synanthedon exitiosa*) and Lesser Peach Tree Borer (*S. pictipes*)

Pest Information

Damage: Damage caused by the peach tree borer results from larval tunnelling under the bark at or below the ground level. Masses of gum mixed with sawdust and excreta near the soil line of the tree trunk are evidence of attack. Young trees can be girdled and killed while older trees are weakened and become susceptible to attack by other insect pests. Larvae of the lesser peach tree borer feed in cankers and wounds throughout the tree.

Life Cycle: Adult peach tree borers are a clear winged moth and are active from late June until September. Female moths lay their eggs on tree trunks near the soil line. After hatching, the larvae bore into the tree and feed on the sapwood. They may take up to 2 years to mature. The larvae overwinter in their feeding tunnels or in the soil and become active in the spring. The life cycle of the lesser peach tree borer is similar to that of the peach tree borer. Adults of the lesser peach tree borer are active from May through September. Larvae overwinter in feeding tunnels. Pupation occurs in the spring with adult moths emerging to lay eggs in cankers and cracks in bark.

Pest Management

Cultural Controls: A mating disruption pheromone is available in Canada for peach tree borer and appears to be an effective control method. Physical barriers may be placed around the base of trees to deter egg laying by the peach tree borer. Monitoring for borers is a helpful practice and pupal skins found in cankered areas are evidence of lesser peach tree borer. Cultural practices that reduce problems due to canker diseases and maintain tree health will minimize problems caused by lesser peach tree borer.

Resistant Cultivars: None identified.

Issues for Peach Tree Borer and Lesser Peach Tree Borer

1. There is a need for the registration of reduced risk alternatives to endosulfan products (no longer available since December 2016) for the management of peach tree borer.
2. There is a need for additional resources to better track peach tree borer populations, to aid in determining optimal timings for trunk sprays, especially in young orchards where mating disruption is not being used.

Shothole Borer (*Scolytus rugulosus*)

Pest Information

Damage: The shothole borer is attracted to healthy as well as diseased or stressed trees. Small holes at the base of buds, sometimes exhibiting a clear gum or resin exudate is characteristic of damage caused by this insect. Larval feeding on the cambium results in a network of tunnels under the bark. Feeding reduces leaf and bud expansion and can result in yellowing and wilting of foliage.

Life Cycle: There are two generations of the insect per year. Adults emerge in May and tunnel under bark to lay eggs. Larvae are present from April to July. A second adult generation appears from August to September, lays eggs and produces an overwintering larval generation. Hosts include native and cultivated trees, with cherry trees being the preferred host. Migration into orchards occurs from forested and urban areas.

Pest Management

Cultural Controls: Removing dead and weakened wood from the orchard and following practices that encourage tree vigour will help reduce problems due to shothole borer. Placing trap logs around the orchard and destroying the trap logs before adult emergence will help to reduce crop damage due to this insect.

Resistant Cultivars: None identified.

Issues for Shotholer Borer

1. There is a need for the registration of chemical controls for shothole borer.

Ambrosia Beetle (*Xyloborus dispar*)

Pest Information

Damage: Larvae tunnelling in the sapwood of small branches causes wilting and dieback of leaves and delayed emergence in the spring. Young trees may be girdled. Severely infested branches and small stems are weakened by tunnelling and are susceptible to breakage.

Life Cycle: Ambrosia beetles overwinter as adults in tunnels bored into trees. Adults appear in April and after mating, tunnel into host to lay eggs. Larvae are present from May to July (in British Columbia) and tunnel in sapwood and into heartwood. Larvae feed on the ambrosia fungus that develops in the tunnels. New adults overwinter in the host. One generation occurs per year.

Pest Management

Cultural Controls: Since ambrosia beetles are attracted to weakened trees, minimizing stress and maintaining trees in good vigour will help reduce damage caused by this pest. Ethanol-baited traps can be used to monitor adults.

Resistant Cultivars: None identified.

Issues for Ambrosia Beetle

None identified.

Western Flower Thrips (*Frankiniella occidentalis*)

Pest Information

Damage: Damage often shows up in patches or where fruit touch each other, resulting in faint rings of scarring. They can also damage flowers. In British Columbia, Western flower thrips lay their eggs in the ovary of cherry flowers, causing a dimple-like injury to form on mature fruit. As the fruit begins to colour, the dimple appears as a bright red spot against the yellow-green background, reducing the quality of the crop.

Life Cycle: Western flower thrips have a very wide host range; including many crop and weed species. Females insert eggs into the leaf tissue. Development from egg to adult requires from 10 to 30 days, depending on temperature. Once mature, females begin to lay eggs. The females reproduce asexually (without mating). Consequently, increases in the thrips population can occur very rapidly, especially during periods of hot, dry weather. There are several overlapping generations per year. In Ontario, both adults and nymphs overwinter on winter grains, clover and alfalfa. They migrate into vegetable fields as the weedy roadsides dry down and the winter wheat and alfalfa are harvested.

Pest Management

Cultural Controls: Delaying mowing ground cover until after petal-fall stage will reduce thrips movement towards cherry trees and may reduce their damage. Heavy rainfall is also effective in knocking thrips off the plant for a short time.

Resistant Cultivars: None identified.

Issues for Western Flower Thrips

1. There is a need to find effective controls which are not toxic to bees that will prevent damage from thrips during bloom.

Wasps, European Paper and others (*Polistes dominula*)

Pest Information

Damage: European paper wasp is a recent introduction in Western Canada. Wasps prey on other insects as host tree fruits (cherries, apples and grapes) ripen, and wasp workers attack and damage the fruit, creating channels across surface of the fruit, which render it unmarketable. Damage also provides a point of entry for infection from bacteria, yeast and fungi. Wasps may also be a nuisance to pickers and orchard workers.

Life Cycle: Fertilized queens overwinter in sheltered locations such as buildings, hollow trees or rock piles. They emerge in the spring to construct their nests and lay their eggs. Worker female larvae develop in 40 days under favorable conditions. In the fall, several queens are produced in each colony and leave to seek suitable overwintering sites.

Pest Management

Cultural Controls: Reducing the availability of nest-building sites will minimize the development of colonies. Trapping out queens using suitable traps or attractants in the spring can help to disrupt wasp colonies.

Resistant Cultivars: None identified.

Issues for Wasps, European Paper and Others

1. There is a need to find effective controls that will prevent fruit injury due to wasps from occurring close to harvest.

Insecticides, miticides and bioinsecticides registered for the management of insect and mite pests in cherry production in Canada

Active ingredients registered for the management of **insects and mites** in cherry are listed below in Table 9 *Insecticides, miticides and bioinsecticides registered for the management of insect and mite pests in cherry production in Canada*. This table also provides registration numbers for products registered on cherry containing these actives in addition to information about chemical family and regulatory status. For guidance about active ingredients registered for specific **insects and mites**, the reader is referred to individual product labels on the PMRA label database https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management.html and to provincial crop production guides.

Table 11. Pesticides and biopesticides registered for the management of insect pests in cherry production in Canada

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
(E,E)-8,10-dodecadien-1-ol + 1-dodecanol + 1-tetradecanol	31589	not classified	N/A	pheromone - behavioral mating disruption for codling moth	R
(E,E)-8,10-dodecadien-1-ol + 1-dodecanol + 1-tetradecanol + Z-8-dodecen-1-yl acetate + E-8-dodecen-1-yl acetate + Z-8-dodecen-1-ol	29352	not classified	N/A	pheromone - behavioral mating disruption for codling moth, oriental fruit moth and lesser appleworm	R
(E, E)-8, 10-dodecadien-1-ol + 1-dodecanol + 1-tetradecanol + Z-11-tetradecen-1-yl acetate + Z-9-tetradecen-1-yl acetate + Z-11-tetradecen-1-ol + Z-11-tetradecenal	28814	not classified	N/A	pheromone - behavioral mating disruption for codling moth and leafroller moths	R
(Z,Z)-3,13-octadecadien-1-yl acetate + (E,Z)-2,13-octadecadien-1-yl acetate + (Z,Z)-3,13-octadecadien-1-ol + (E,Z)-2,13-octadecadien-1-ol	30589	not classified	N/A	pheromone - behavioral mating disruption for dogwood borer (*Synanthedon scitula*)	R

…continued

Table 11. Pesticides and biopesticides registered for the management of insect pests in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
(Z,Z)-3,13 octadecadien-1-yl acetate + (E,Z)-3,13 octadecadien-1-yl acetate	27141, 30042	not classified	N/A	pheromone - behavioral mating disruption for peach borer and apple clearwing moth	R
Z-8-dodecen-1-yl acetate + E-8-dodecen-1-yl acetate + Z-8-dodecen-1-ol	31419	not classified	N/A	pheromone - behavioral mating disruption for oriental fruit moth	R
Bacillus thuringiensis subsp. a*izawai*, strain ABTS-1857	31557	*Bacillus thuringiensis* and the insecticidal proteins they produce	11A	microbial disruptor of insect midgut membranes	R
Bacillus thuringiensis subsp. *kurstaki*, strain ABTS-351	11252, 26508	*Bacillus thuringiensis* and the insecticidal proteins they produce	11A	microbial disruptor of insect midgut membranes	R
Bacillus thuringiensis subsp. *kurstaki*, strain EVB113-19	26854, 27750, 32425	*Bacillus thuringiensis* and the insecticidal proteins they produce	11A	microbial disruptor of insect midgut membranes	R
acetamiprid	27128	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	R
bifenazate	27925	bifenazate	20D	mitochondrial complex III electron transport inhibitor	R

…continued

Table 11. Pesticides and biopesticides registered for the management of insect pests in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
canola oil	32408, 32819	not classified	N/A	unknown	R
carbaryl	22339	carbamate	1A	acetylcholinesterase (AChE) inhibitor	R
chlorantraniliprole	28981	diamide	28	ryanodine receptor modulator	R
clothianidin	29382, 29384	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	RES*
cyantraniliprole	30895	diamide	28	ryanodine receptor modulator	R
cyclaniliprole	32862, 32889	diamide	28	ryanodine receptor modulator	R
dimethoate	8277, 9382, 9807, 25651	organophosphate	1B	acetylcholinesterase (AChE) inhibitor	R
ferric sodium (EDTA)	28774	not classified	N/A	unknown	R
flonicamid	29796	flonicamid	29	chlordotonal organ modulator - undefined target site	R
flupyradifurone	31452	butenolide	4D	nicotinic acetylcholine receptor (nAChR) competitive modulator	R
imidacloprid	24094, 28475, 28726, 29048	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	RES*
iron (present as ferric phosphate)	27085, 27096, 30025	not classified	N/A	unknown	R

…continued

Table 11. Pesticides and biopesticides registered for the management of insect pests in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
kaolin	27469	not classified	N/A	unknown	R
lambda-cyhalothrin	24984, 26837, 29052, 32427	pyrethroid, pyrethrin	3A	sodium channel modulator	RE
lime sulphur or calcium polysulphide	16465	not classified	N/A	unknown	R
malathion	8372	organophosphate	1B	acetylcholinesterase (AChE) inhibitor	R
methoxyfenozide	27786	diacylhydrazine	18	ecdysone receptor agonist	R
mineral oil	9542, 14981, 18709, 21655, 23370, 27666, 29768, 33099	not classified	N/A	unknown	R
novaluron	28515, 28881	benzoylurea	15	inhibitor of chitin biosynthesis, type 0	R
phosmet	sour cherry only: 23006, 29064	organophosphate	1B	acetylcholinesterase (AChE) inhibitor	RE
potassium salts of fatty acids	27886, 28146, 31433	not classified	N/A	unknown	R
pyridaben	25135	METI acaricide and insecticide	21A	mitochondrial complex I electron transport inhibitor	RE

…continued

Table 11. Pesticides and biopesticides registered for the management of insect pests in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
spinetoram	28777, 28778	spinosyn	5	nicotinic acetylcholine receptor (nAChR) allosteric modulator	R
spinosad	26835, 27825, 28336, 30382	spinosyn	5	nicotinic acetylcholine receptor (nAChR) allosteric modulator	RE
spirodiclofen	28051	tetronic and tetramic acid derivative	23	inhibitor of acetyl CoA carboxylase	R
spirotetramat	28953, 28954	tetronic and tetramic acid derivative	23	inhibitor of acetyl CoA carboxylase	R
sulfoxaflor	30826	sulfoximine	4C	nicotinic acetylcholine receptor (nAChR) competitive modulator	R
sulfoxaflor + spinetoram	31442	sulfoximine + spinosyn	4C + 5	nicotinic acetylcholine receptor (nAChR) competitive modulator + nicotinic acetylcholine receptor (nAChR) allosteric modulator	R
sulphur	14653, 18836, 29487, 31869, 32475	sulphur	N/A	unknown	R
thiamethoxam	28408	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	RES*
thiram (repellent)	13258	dithiocarbamate and relatives (electrophile)	M03	multi-site contact activity	RE

…continued

Table 11. Pesticides and biopesticides registered for the management of insect pests in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
Storage Treatment					
methyl bromide	9564, 19498	alkyl halide	8A	miscellaneous non-specific (multi-site) inhibitor	PO[5]

[1]Source: Pest Management Regulatory Agency label database (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php). **The list includes all active ingredients registered as of October 10, 2018.** While every effort has been made to ensure all insecticides, miticides and biopesticides registered in Canada on cherry have been included in this list, some active ingredients or products may have been inadvertently omitted. 'Numerous products' is entered where there are more than ten products registered for an active ingredient. Not all end-use products containing a particular active ingredient may be registered for use on this crop. The product label is the final authority on pesticide use and should be consulted for application information. The information in this table should not be relied upon for pesticide application decisions and use. '

[2] Source: Insecticide Resistance Action Committee. *IRAC MoA Classification Scheme (Version 8.4; May 2018)* (excluding pheromones) (www.irac-online.org) (accessed Aug. 23, 2018).

[3]PMRA re-evaluation status as published in Re-evaluation Note REV2018-06, Pest Management Regulatory Agency Re-evaluation and Special Review Work Plan 2018-2023 and other re-evaluation documents: R - full registration, RE (yellow) - under re-evaluation, RES (yellow) - under special review and RES* (yellow) - under re-evaluation and special review. Other codes include: DI (red) - discontinued by registrant, PO (red) - being phased out as a result of re-evaluation by the PMRA.

[4]Source: Fungicide Resistance Action Committee. *FRAC Code List 2017: Fungicides sorted by mode of action (including FRAC code numbering)* (www.frac.info/) (accessed September 13, 2017).

[5]As published by Government of Canada: *Notice to anyone engaged in the use of methyl bromide: June 2017 https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/notice-use-methyl-bromide-june-2017.html*

Weeds

Key Issues

- Weed species that are tolerant to glyphosate are becoming more prevalent. There is a need to register additional contact herbicides that are effective against a wide range of broadleaf weeds and grasses as alternatives to glyphosate.

- There is a need to register additional pre-emergent, residual herbicides that are safe for use in young plantings in all tree fruit.

- There is a need for weed surveys to identify and determine the distribution of problem weeds.

Table 12. Occurrence of weeds in cherry production in Canada[1,2]

Weed	Sweet Cherry		Sour Cherry
	British Columbia	**Ontario**	**Ontario**
Annual broadleaf weeds			
Annual grass weeds			
Perennial broadleaf weeds			
Perennial grass weeds			
Widespread yearly occurrence with high pest pressure.			
Widespread yearly occurrence with moderate pest pressure OR localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure.			
Widespread yearly occurrence with low pest pressure OR widespread sporadic occurrence with moderate pressure OR sporadic localized occurrence with high pest pressure.			
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low pressure OR localized sporadic occurrence with low to moderate pest pressure OR pest not of concern.			
Pest is present and of concern, however little is known of its distribution, frequency and pressure.			
Pest not present.			
Data not reported.			

[1]Source: Cherry stakeholders in reporting provinces (British Columbia and Ontario). The data reflect the 2016, 2015 and 2014 production years.

[2]Refer to Appendix 1 for a detailed explanation of colour coding of occurrence data.

Table 13. Adoption of weed management practices in sweet cherry production in Canada[1]

Practice / Pest		Annual broadleaf weeds	Annual grass weeds	Perennial broadleaf weeds	Perennial grass weeds
Avoidance	Varietal selection / use of competitive varieties				
	Planting / harvest date adjustment				
	Crop rotation				
	Choice of planting site				
	Optimizing fertilization for balanced crop growth				
	Use of weed-free propagative materials (seed, cuttings or transplants)				
	No till or low disturbance seeding to minimize weed seed germination				
	Use of physical barriers (e.g. mulches)				
Prevention	Equipment sanitation				
	Canopy management (thinning, pruning, row or plant spacing, etc.)				
	Manipulating seeding / planting depth				
	Irrigation management (timing, duration, amount) to maximize crop growth				
	Management of soil moisture (improvements in drainage, use of raised beds, hilling, mounds)				
	Weed management in non-crop lands				
Monitoring	Scouting / field inspection				
	Maintaining records of weed incidence including records of herbicide resistant weeds				
	Use of precision agriculture technology (GPS, GIS) for data collection and mapping of weeds				

…continued

Table 13. Adoption of weed management practices in sweet cherry production in Canada[1] (continued)

Practice / Pest		Annual broadleaf weeds	Annual grass weeds	Perennial broadleaf weeds	Perennial grass weeds
Decision making tools	Economic threshold				
	Crop specialist recommendation or advisory bulletin				
	Decision to treat based on observed presence of weed at susceptible stage of development				
	Decision to treat based on observed crop damage				
	Use of portable electronic devices in the field to access weed identification / management information				
Suppression	Use of diverse herbicide modes of action for resistance management				
	Soil amendments and green manuring involving soil incorporation as biofumigants to reduce weed populations				
	Biopesticides (microbial and non-conventional pesticides)				
	Release of arthropod biological control agents				
	Mechanical weed control (cultivation / tillage)				
	Manual weed control (hand pulling, hoeing, flaming)				
	Use of stale seedbed technique				
	Targeted pesticide applications (banding, spot treatments, variable rate sprayers, etc.)				
	Selection of herbicides that are soft on beneficial insects, pollinators and other non-target organisms				
New practices (by province)	Use of long residual pre-emergent herbicide (Ontario)				

This practice is used to manage this pest by at least some growers.

This practice is not used by growers to manage this pest.

This practice is not applicable for the management of this pest.

Information regarding the practice for this pest is unknown.

[1]Source: Cherry stakeholders in reporting provinces (British Columbia and Ontario); the data reflect the 2016, 2015 and 2014 production years.

Table 14. Adoption of weed management practices in sour cherry production in Canada[1]

Practice / Pest		Annual broadleaf weeds	Annual grass weeds	Perennial broadleaf weeds	Perennial grass weeds
Avoidance	Varietal selection / use of competitive varieties				
	Planting / harvest date adjustment				
	Crop rotation				
	Choice of planting site				
	Optimizing fertilization for balanced crop growth				
	Use of weed-free propagative materials (seed, cuttings or transplants)				
	No till or low disturbance seeding to minimize weed seed germination				
	Use of physical barriers (eg. mulches)				
Prevention	Equipment sanitation				
	Canopy management (thinning, pruning, row or plant spacing, etc.)				
	Manipulating seeding / planting depth				
	Irrigation management (timing, duration, amount) to maximize crop growth				
	Management of soil moisture (improvements in drainage, use of raised beds, hilling, mounds)				
	Weed management in non-crop lands				
Monitoring	Scouting / field inspection				
	Maintaining records of weed incidence including records of herbicide resistant weeds				
	Use of precision agriculture technology (GPS, GIS) for data collection and mapping of weeds				

…continued

Table 14. Adoption of weed management practices in sour cherry production in Canada[1] (continued)

Practice / Pest		Annual broadleaf weeds	Annual grass weeds	Perennial broadleaf weeds	Perennial grass weeds
Decision making tools	Economic threshold				
	Crop specialist recommendation or advisory bulletin				
	Decision to treat based on observed presence of weed at susceptible stage of development				
	Decision to treat based on observed crop damage				
	Use of portable electronic devices in the field to access weed identification / management information				
Suppression	Use of diverse herbicide modes of action for resistance management				
	Soil amendments and green manuring involving soil incorporation as biofumigants to reduce weed populations				
	Biopesticides (microbial and non-conventional pesticides)				
	Release of arthropod biological control agents				
	Mechanical weed control (cultivation / tillage)				
	Manual weed control (hand pulling, hoeing, flaming)				
	Use of stale seedbed technique				
	Targeted pesticide applications (banding, spot treatments, variable rate sprayers, etc.)				
	Selection of herbicides that are soft on beneficial insects, pollinators and other non-target organisms				
New practices	Use of long residual pre-emergent herbicide (Ontario)				

This practice is used to manage this pest by at least some growers.

This practice is not used by growers to manage this pest.

This practice is not applicable for the management of this pest.

Information regarding the practice for this pest is unknown.

[1]Source: Cherry stakeholders in reporting provinces (Ontario); the data reflect the 2016, 2015 and 2014 production years.

Annual and Perennial Weeds

Pest Information

Damage: Weeds compete with orchard trees for moisture and nutrients. A range of annual and perennial broadleaf weeds may be present in cherry orchards. Annual grass weeds that occur in sweet cherries include annual bluegrass, wild oats and barnyard grass.

Life Cycle: Summer annual weeds germinate in the spring, flower and fruit in the summer or fall and die before the onset of winter. Winter annuals germinate in the fall, overwinter in a vegetative state, flower in the spring, form seeds and then die. Perennial weeds live for many years. They spread through flowering and seed production as well as through expansion of their root system. Perennials can also be spread vegetatively through the movement of tubers, rhizomes and root systems.

Pest Management

Cultural Controls: Mechanical weeding, hand weeding, cover cropping and mulching may be used to control weeds. Cover crops are grown between orchard trees to provide weed control, as well as protection from leaching and erosion. Early season weed control will minimize the impact of competition and reduce weed seed development. Tillage and cultivation are used only in the year prior to orchard establishment.

Issues for Annual and Perennial Weeds

1. Weed species that are tolerant to glyphosate are becoming more prevalent. There is a need to register additional contact herbicides that are effective against a wide range of broadleaf weeds and grasses as alternatives to glyphosate.
2. There is a need to register additional pre-emergent residual herbicides that are safe for use in young plantings in all tree fruits.
3. There is a need for weed surveys to identify problem weeds and determine the distribution of problem weeds.
4. The use and environmental impact of innovative methods of weed control (for example flaming, mulch application, use of cultivators) need further study. Methods for low- cost production of mulches are also required.

Herbicides and bioherbicides registered for weed management in cherry production in Canada

Active ingredients registered for the management of **weeds** in cherry are listed in *Table 15 Herbicides and bioherbicides registered for weed management in* cherry *production in Canada*. This table also provides registration numbers for products registered on cherry containing these actives in addition to information about chemical family and regulatory status. For guidance about active ingredients registered for specific **weeds**, the reader is referred to individual product labels on the PMRA label database https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management.html and to provincial crop production guides.

Table 15. Herbicides and bioherbicides registered for weed management in cherry production in Canada

Active Ingredient[1]	**Product Registration Numbers**[1]	**Chemical Family**[2]	**Resistance Group**[2]	Site **of Action**[2]	**Re-evaluation Status (Re-evaluation Decision Document)**[3]
2,4-D (present as dimethylamine salt)	5931, 17511, 26163, 29248, 31332	phenoxy-carboxylic-acid	4	synthetic auxin	RES
ammonium soap of fatty acids	30012, 30515	not classified	N/A	unknown	R
bentazon (present as sodium salt)	12221, 32661, 32827, 33011	benzothiadiazinone	6	inhibition of photosynthesis at photosystem II site B	R
carfentrazone-ethyl	28573, 33127	triazolinone	14	inhibition of protoporphyrinogen oxidase (Protox, PPO)	R
clethodim	22625, 27598, 29277	cyclohexanedione 'DIMs'	1	inhibition of acetyl CoA carboxylase (ACCase)	R
dichlobenil	12533	nitrile	20	inhibition of cell wall synthesis site A	R
etephon	11580	growth regulator	N/A	unknown	R
fluazifop-p-butyl	21209	aryloxyphenoxy-propionate 'FOP'	1	inhibition of acetyl CoA carboxylase (ACCase)	R
flumioxazin	29231, 29235	N-phenylphthalimide	14	inhibition of protoporphyrinogen oxidase (Protox, PPO)	R

....continued

Table 15. Herbicides and bioherbicides registered for weed management in cherry production in Canada (continued)

Active Ingredient[1]	**Product Registration Numbers**[1]	**Chemical Family**[2]	**Resistance Group**[2]	Site **of Action**[2]	**Re-evaluation Status (Re-evaluation Decision Document)**[3]
flumioxazin	29231, 29235	N-phenylphthalimide	14	inhibition of protoporphyrinogen oxidase (Protox, PPO)	R
gibberellic acid	11904, 27653, 29884	growth regulator	N/A	unknown	R
gibberellin A3	29359	growth regulator	N/A	unknown	R
gibberellins A4, A7 + 6-benzyladenine	16636	growth regulator	N/A	unknown	R
glufosinate ammonium	23180, 28532, 32860	phosphinic acid	10	inhibition of glutamine synthetase	R
glyphosate (present as dimethylamine salts)	28840, 28977, 29774, 29775, 30319, 30516, 31090	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R
glyphosate (present as isopropylamine salts)	31913, 32181,	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R
glyphosate (present as potassium salt)	numerous products	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R

…continued

Table 15. Herbicides and bioherbicides registered for weed management in cherry production in Canada (continued)

Active Ingredient[1]	**Product Registration Numbers**[1]	**Chemical Family**[2]	**Resistance Group**[2]	Site **of Action**[2]	**Re-evaluation Status (Re-evaluation Decision Document)**[3]
glyphosate (present as isopropylamine and potassium salts)	32228, 32532, 33029, 33030	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R
indaziflam	30220, 30221, 30451, 32803, 32804	unknown	29	inhibition of cell wall synthesis site C	R
linuron	15544, 16279, 16363, 20193, 21353	urea	7	inhibition of photosynthesis at photosystem II site A (different behavior from group 5)	RES*
methyl bromide (fumigant, pre-plant soil application)	19498	alky halide[4]	8A[4]	miscellaneous non-specific (multi-site) inhibitor[4]	PO[5]
metribuzin	numerous products	triazinone	5	inhibition of photosynthesis at photosystem II site A	R
s-metolachlor and R-enantiomer	25728, 25729, 29347, 32847	chloroacetamide	15	inhibition of mitosis	RE
pendimethalin	29542	dinitroaniline	3	microtubule assembly inhibition	R
paraquat	8661, 33125	bipyridylium	22	photosystem-I-electron diversion	R
prohexadione calcium	28042, 33010	growth regulator	N/A	unknown	R
rimsulfuron	30057	sulfonylurea	2	inhibition of acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS)	R

…continued

Table 15. Herbicides and bioherbicides registered for weed management in cherry production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Family[2]	Resistance Group[2]	Site of Action[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
sethoxydim	24835	cyclohexanedione 'DIM'	1	inhibition of acetyl CoA carboxylase (ACCase)	R
simazine and related triazines	16370	triazine	5	inhibition of photosynthesis at photosystem II site A	R
terbacil	10628, 30082	uracil	5	inhibition of photosynthesis at photosystem II site A	R
trifluralin	23933, 28289	dinitroaniline	3	microtubule assembly inhibition	R

[1]Source: Pest Management Regulatory Agency label database (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php). **The list includes all active ingredients registered as of October 10, 2018.** While every effort has been made to ensure all herbicides, bioherbicides and plant growth regulators registered in Canada on cherry have been included in this list, some active ingredients or products may have been inadvertently omitted. 'Numerous products' is entered where there are more than ten products registered for an active ingredient. Not all end-use products containing a particular active ingredient may be registered for use on this crop. The product label is the final authority on pesticide use and should be consulted for application information. The information in this table should not be relied upon for pesticide application decisions and use. '

[2]Source: Weed Science Society of America (WSSA). Herbicide Site of Action Classification list (last modified August 16, 2017) http://wssa.net (accessed August 23, 2018)

[3]PMRA re-evaluation status as published in Re-evaluation Note REV2018-06, Pest Management Regulatory Agency Re-evaluation and Special Review Work Plan 2018-2023 **and other re-evaluation documents**: R - full registration, RE (yellow) - under re-evaluation, RES (yellow) - under special review and RES* (yellow) - under re-evaluation and special review. Other codes include: DI (red) - discontinued by registrant, PO (red) - being phased out as a result of re-evaluation by the PMRA.

[4] Source: Insecticide Resistance Action Committee. *IRAC MoA Classification Scheme (Version 8.4; May 2018)* (www.irac-online.org) (accessed August 23, 2018).

[5]As published by Government of Canada: *Notice to anyone engaged in the use of methyl bromide: June 2017 https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/notice-use-methyl-bromide-june-2017.html*

Vertebrate Pests

Deer, bears, field mice, and birds are the primary vertebrate pests of cherry orchards. Ungulates such as deer (and elk in British Columbia) chew buds, spurs, shoots and leaves, and trees that are damaged when they are young may not become commercially productive. Cherry orchards are generally fenced at planting to protect fruit trees from these animals. Woven wire fences at least 2.4 meters in height provide the best protection but are expensive to install. In some areas, bears invade orchards in the fall in years when native berry crops are poor. Losses from bears include destroyed fruit as well as broken tree limbs.

Field Mice: Meadow Mice, Meadow Voles (*Microtus* spp.)

Pest Information

Damage: Field mice cause damage by gnawing the stems and roots of trees. Injury to the trees can begin in late summer or when food becomes scarce in the fall, but usually occurs in winter under a protective snow cover. Below ground injury may be extensive but not visible from the surface until the plants fail to leaf out normally. Severe damage, such as complete girdling of the trunk or roots can kill trees.

Life Cycle: Field mice are found in areas of dense vegetation where they feed on seeds, tubers, rhizomes and other plant material. They create a network of runways on the ground surface through which they travel. They nest in cavities in the ground. Litters are produced monthly throughout the growing season.

Pest Management

Cultural Controls: Vegetation in and around the orchard can be managed to discourage rodents. Maintaining a weed-free strip within orchard tree rows can reduce mouse habitat. Mouse guards around trees can also be effective to prevent voles from damaging the bark, as can painting the bark with repellent products. A number of wild predators can also help to keep the mouse population in check including hawks, coyotes, foxes and weasels. Reducing or eliminating long grass through mowing and herbicide treatment, and avoiding the use of a sickle-bar mower that produces a thatch layer can lower rodent populations by removing cover for voles. The same can be avoided by removing mulch or decaying vegetation around the base of trees. Toxic baits placed in bait stations give a reliable control in orchards where voles are abundant but broadcasting poison baits on the orchard floor can be poisonous to farm pets and non-target wildlife.

Issues for Rodents

None identified.

Birds

Pest Information

Damage: Birds feed on ripening fruit and can destroy an entire crop. Damage becomes less noticeable in older orchards due to the larger crop size. Common birds causing damage in cherries are red-wing blackbirds, starlings, robins, goldfinches, orioles, blue jays, crows, cedar waxwings and gulls. Starlings, which cause the most severe damage, are capable of causing serious crop loss.

Pest Management

There are three types of bird repellent methods currently available to growers.
Acoustical repellents: Use of sound to scare birds away
Visual repellents: Birds generally have very good eyesight and react to both movement and objects that resemble their enemies (for example, osprey kites). Visual deterrents are usually used together with acoustical systems.
Physical exclusion: Nets may be draped directly on top of the trees or fastened to an overhead structure which totally encloses the orchard. Once birds establish, they are difficult to deter from feeding on the crop.
An integrated approach, using a variety of these repellent methods is the most effective, and when started early can prevent birds from establishing in the orchard.

Issues for Birds

1. Birds continue to be a pest of concern in sweet cherry orchards. Acoustic deterrents are problematic when used close to residential areas. There is a need for continued research on laser bird repellents and other bird control strategies in cherry orchards.
2. There is a need for further investigation of the use of methyl anthranilate (a compound found naturally in labrusca grapes), dimethyl anthranilate and cane sugar as a safe way to deter problematic bird species. Proper concentrations and pre-harvest intervals need to be looked at so fruit quality is not affected.
3. There is concern over the lack of research on pest birds.

Resources

Integrated Pest Management/ Integrated Crop Management Resources for Production of Sweet and Sour Cherries in Canada

British Columbia Ministry of Agriculture. *Tree Fruits Information on identification and management of insect and mite pests and plant diseases of tree fruit crops in British Columbia*: *Insects and Mites*.
https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/insects-and-plant-diseases/tree-fruits

British Columbia Ministry of Agriculture and British Columbia Fruit Growers' Association. 2010. *Integrated Fruit Production Guide for Commercial Tree Fruit Growers, Interior of British Columbia*. British Columbia Central Branch Library. Branch Call Number: 634.05 T78.
https://vpl.bibliocommons.com/item/show/1127085038_integrated_fruit_production_guide_for_commercial_tree_fruit_growers

British Columbia Ministry of Agriculture. BC Tree Fruit Production Guide: *Cherry Management Schedule*.

https://www.bctfpg.ca/horticulture/crop-management/

British Columbia Ministry of Agriculture. BC Tree Fruit Production Guide: *Cherry Spray Schedule*.

https://www.bctfpg.ca/pesticides/spray-schedules/cherries/

Health Canada. Pest Management Regulatory Agency. *Publications Section*.
https://www.canada.ca/en/health-canada/corporate/contact-us/pest-management-regulatory-agency-publications.html

Ontario Ministry of Agriculture, Food and Rural Affairs. *Ontario Crop IPM*.

http://www.omafra.gov.on.ca/IPM/english/index.html

Ontario Ministry of Agriculture, Food and Rural Affairs. Publication 360. *Guide to Fruit Production 2016-17*. 310 pp.

http://www.omafra.gov.on.ca/english/crops/pub360/p360toc.htm

Provincial Crop Specialists and Provincial Minor Use Coordinators

Province	Ministry	Crop Specialist	Minor Use Coordinator
British-Columbia	British Columbia Ministry of Agriculture and Lands www.gov.bc.ca/al	Maria Jeffries Plant Health Coordinator Maria.Jeffries@gov.bc.ca	Caroline Bédard caroline.bédard@gov.bc.ca
Saskatchewan	Saskatchewan Agriculture www.agriculture.gov.sk.ca	Forrest Scharf forrest.scharf@gov.sk.ca	Carter Peru carter.peru@gov.sk.ca
Ontario	Ontario Ministry of Agriculture, Food and Rural Affairs www.omafra.gov.on.ca/english/index.html	Wendy McFadden-Smith, Tender Fruit and Grape IPM Specialist wendy.mcfadden-smith@ontario.ca Amanda Green Tree Fruit Specialist amanda.green@ontario.ca	Jim Chaput jim.chaput@ontario.ca

National and Provincial Cherry and Fruit Grower Organizations

Provincial:

BC Cherry Association (http://www.bccherry.com)

British Columbia Fruit Growers Association (www.bcfga.com)

BC Tree Fruits (http://www.bctree.com)

Ontario Fruit and Vegetable Growers Association (www.ofvga.org)

Saskatchewan Fruit Growers Association (www.saskfruit.com)

National:

Canadian Cherry Producers Inc. (www.cherryproducers.ca)

Canadian Horticultural Council (www.hortcouncil.ca)

Appendix 1

Definition of terms and colour coding for pest occurrence table of the crop profiles.

Information on the occurrence of disease, insect and mite and weed pests in each province is provided in Tables 4, 8 and 12 of the crop profile, respectively. The colour coding of the cells in these tables is based on three pieces of information, namely pest distribution, frequency and pressure in each province as presented in the following chart.

<table>
<tr><th>Presence</th><th colspan="4">Occurrence information</th><th>Colour Code</th></tr>
<tr><td rowspan="12">Present</td><td rowspan="10">Data available</td><td>Frequency</td><td>Distribution</td><td>Pressure</td><td></td></tr>
<tr><td rowspan="5">**Yearly** - Pest is present 2 or more years out of 3 in a given region of the province.</td><td rowspan="3">**Widespread** - The pest population is generally distributed throughout crop growing regions of the province. In a given year, outbreaks may occur in any region.</td><td>**High** - If present, potential for spread and crop loss is high and controls must be implemented even for small populations.</td><td>Red</td></tr>
<tr><td>**Moderate** - If present, potential for spread and crop loss is moderate: pest situation must be monitored and controls may be implemented.</td><td>Orange</td></tr>
<tr><td>**Low** - If present, the pest causes low or negligible crop damage and controls need not be implemented.</td><td>Yellow</td></tr>
<tr><td rowspan="3">**Localized** - The pest is established as localized populations and is found only in scattered or limited areas of the province.</td><td>**High** - see above</td><td>Orange</td></tr>
<tr><td>**Moderate** - see above</td><td>White</td></tr>
<tr><td>**Low** - see above</td><td>White</td></tr>
<tr><td rowspan="5">**Sporadic** - Pest is present 1 year out of 3 in a given region of the province.</td><td rowspan="3">**Widespread** - as above</td><td>**High** - see above</td><td>Orange</td></tr>
<tr><td>**Moderate** - see above</td><td>Yellow</td></tr>
<tr><td>**Low** - see above</td><td>White</td></tr>
<tr><td rowspan="3">**Localized** - as above</td><td>**High** - see above</td><td>Yellow</td></tr>
<tr><td>**Moderate** -see above</td><td>White</td></tr>
<tr><td>**Low** - see above</td><td>White</td></tr>
<tr><td rowspan="2">Data **not** available</td><td colspan="3">**Not of concern:** The pest is present in commercial crop growing areas of the province but is causing no significant damage. Little is known about its population distribution and frequency in this province; however, it is not of concern.</td><td>White</td></tr>
<tr><td colspan="3">**Is of concern:** The pest is present in commercial crop growing areas of the province. Little is known about its population distribution and frequency of outbreaks in this province and due to its potential to cause economic damage, is of concern.</td><td>Blue</td></tr>
<tr><td>Not present</td><td colspan="4">The pest is not present in commercial crop growing areas of the province, to the best of your knowledge.</td><td>Black</td></tr>
<tr><td>Data not reported</td><td colspan="4">Information on the pest in this province is unknown. No data is being reported for this pest.</td><td>Grey</td></tr>
</table>

References

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