Crop Profile for Sweet Cherries in Canada

Prepared by:

Pesticide Risk Reduction Program

Pest Management Centre

Agriculture and Agri-Food Canada

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The sweet cherry, *Prunus avium* is a member of the Rosaceae (rose) family. Sweet cherries have been produced in Canada for many years. Production in British Columbia began over 75 years ago. Sweet cherries have been produced in Nova Scotia since before the 1950's when there was commercial production in the Bear River area of Annapolis County and where there is still an annual cherry festival. In British Columbia, production is centred in the Okanagan, Similkameen and Creston Valleys in the Southern Interior region of the province. In Ontario, 74% of the trees are located in the Niagara and Hamilton-Wentworth areas. Internationally, Canada is a relatively small producer of sweet cherries. The largest producers are the U.S. and Eastern Europe.

General Production Information

Canadian Production (2005)	6,883 metric tonnes
	1,285 hectares
Farm gate value (2005)	$23,685 million
Domestic consumption (2004)	0.32 kg/person
Export (2005)[1]	$13.7 million (fresh)
	$3.1 million (processed)
Imports (2005)[1]	$75.8 million (fresh)
	$18.8 million (processed)
Source(s): Statistics Canada (2005) [1]includes both sweet and sour cherries	

Production Regions

Due to sensitivity to spring frosts and untimely rains, *s*weet cherries can be grown commercially in only a few locations in Canada. British Columbia produces 76% (971 hectares) of the Canadian crop. Ontario produces about 24% (304 hectares) and there is a small acreage in Nova Scotia (8 hectares), Manitoba and Quebec. (Source: Statistics Canada (2005).

Cultural Practices

Cherries grow well on a variety of well-drained soils but are highly susceptible to poor drainage. Loam soils are ideal because they are easy to manage and generally have balanced nutrition and a good pH. 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 km from a 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. A pH of 6.0 to 6.5 is ideal for cherry orchards.

There is a trend towards higher density plantings. Older plantings average 120 trees per hectare, while the newer, high density plantings may have as many as 1,940 trees per ha (BC Horticultural Statistics). The higher density plantings require careful management to maintain air circulation and prevent certain fungal diseases.

The vast majority of cherries are used fresh. Cherries are also blended for sauces or drinks, frozen, canned and used for jams, pie fillings and yoghurt flavouring. A small portion of the industry is processed (brining). There are many new and expanding markets and emerging opportunities for growers producing high quality fruit. Cherries are a good source of Vitamin C, the B vitamins, and potassium.

Production Issues

Sweet cherry production in Canada is affected by many abiotic and biotic factors. Sweet cherries are affected by severe winter temperatures, spring frosts and heavy rain. Main biotic factors leading to yield and quality losses include diseases, weeds and insects. The major diseases of cherries are brown rot, botrytis fruit rot, bacterial canker, powdery mildew, cytospora canker, coryneum blight and alternaria fruit rot. Little cherry virus is of great concern as well, and requires further research. Cultural controls are essential for disease suppression in cherry orchards, since there are no registered chemical controls for several diseases that attack cherry trees. The western and eastern cherry fruit flies are the most important insect pests of cherries.

Table 1. Sweet Cherry Production and Pest Management Schedule

Time of Year	Activity	Action
Winter-dormancy (December to early March)	Plant Care	Prune trees
	Soil Care	Prepare sites of new plantings; take soil samples in established sites for nutrient analysis
	Disease Management	Remove shoots with bacterial, cytospora and coryneum blight.
	Insect Management	Apply delayed dormant controls for aphids, mites, scales, apple mealybug and other insects.
	Weed Management	Monitor for weeds and apply controls if needed.
Bud break and blossom (late March to May)	Plant Care	Plant and prune new trees; irrigate as needed; place beehives in the orchard when first blossoms open and remove prior to insecticide applications; brush removal.
	Soil Care	Apply nitrogen to established orchards as needed; apply lime as needed.
	Disease Management	Monitor for powdery mildew and brown rot during and post bloom; apply controls if needed.
	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 beneficials; apply controls if needed.
	Weed Management	Monitor for weeds and apply controls if needed.
June to August (Blossom, fruit development and harvest of summer varieties (August))	Plant Care	Seed cover crop; apply supplemental nutrient sprays as needed; irrigate as needed; thin cherries; have leaf analyses performed; hand harvest and market fruit; grading and packing.
	Soil Care	Apply boron as needed
	Disease Management	Treat for brown rot as needed; cut out wood with bacterial canker and powdery mildew; monitor mature fruit for little cherry disease.
	Insect	Set out and monitor pheromone traps for peach tree borer; continue monitoring

	Management	cherry fruit flies, leafrollers, budmoth, mites, aphid, apple mealybug, shothole borer, ambrosia beetles and beneficials; begin monitoring for pear sawfly; apply controls if needed; use bird control (noise deterrents)
	Weed Management	Monitor for weeds and apply controls if needed.
September to November (harvest and post harvest care)	Plant Care	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
	Disease Management	Remove dead, weak and diseased trees; remove cankers; begin dormant pruning.
	Insect Management	Apply dormant oil: apply postharvest controls for cherry fruit flies, scales, mites and apple mealybugs, if needed.
	Weed Management	Mow for weeds.

Template adapted from BC Ministry of Agriculture, Food and Fisheries apple crop profile, July 2002.

Abiotic Factors Limiting Production

Key Issues

- Research is required on training systems, irrigation systems, growth regulators and scion-rootstock interactions to improve fruit quality, disease resistance, hardiness and production.
- Research is required on the effects of plant nutrition on winter hardiness and fruit quality and storage.
- Research is required on the regulation of fruit ripening for improved quality at harvest and extended storage and shelf life.
- Gibberellic acid is applied to most cherry variteties (BC) as a growth regulator to delay the harvest of the fruit. The currently available product is expensive as compared to generic products or other products available in the US.

Temperature extremes

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

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*. Trees can be sprayed with calcium to reduce damage. Some growers use helicopters or airblast sprayers to dry off the fruit.

Diseases

Key Issues

- There are no fungicides registered in Canada for control of post-harvest brown rot in cherries. Access to new products is needed for control of brown rot (and other postharvest pathogens).
- There are no chemical controls registered for control of bacterial canker which is of significant concern to cherry growers.
- Efficient, cost effective monitoring techniques need to be developed to determine the need for brown rot fungicide sprays.
- There is concern about the development of resistance to iprodione, a useful and versatile fungicide that gives superior protection of cherries (and peaches) against brown rot.
- The loss of the processing market for sweet cherries (in Ontario) due to the availability of lower cost alternatives from other sources, has removed the early pick option from growers. With this option, growers were able to pick cherries for processing in advance of expected weather conditions that would contribute to brown rot
- There is concern that so much public research resources have been directed to Plum Pox Virus and that there is little time and resources spent on research required on bacterial canker of sweet cherry. It is believed that more public resources should be directed to the issue of bacterial canker on sweet cherry.
- There are no fungicides registered for control of botrytis blossom blight.
- The trend towards higher density plantings and later-maturing varieties has increased powdery mildew incidence and severity.
- There are no fungicides registered for the control of Cytospora canker and Coreneum blight of sweet cherry.
- Recent research has revealed that there is more than a single virus causing little cherry disease in BC. An unrelated virus, called LChV-1 has been detected in numerous orchards in some areas of BC. Additional research is needed to understand the epidemiology of this disease, which causes symptoms similar to those caused by LChV-3.
- There are no post-harvest fungicides registered for botrytis fruit rot of sweet cherries. There is a need for additional products for post-harvest disease control.

Table 2. Degree of occurrence of disease pests in Canadian Sweet Cherries production

	Degree of occurrence	
Major Diseases	**BC**	**ON**
Brown rot	E	E
Bacterial canker	E	E
Botrytis fruit rot and blossom blight	E	DNR
Powdery mildew	E	DNR
Root lesion nematode	DNR	DNR
Cytospora canker	E	DNR
Little cherry disease (LChV)	E	DNR
Minor diseases	BC	ON
Alternaria fruit rot	E	DNR
Cherry leaf spot	DNR	DNR
Coryneum blight	E	DNR
Rhizopus rot	E	DNR
Phytophthora crown rot	E	DNR

Widespread yearly occurrence with high pest pressure

Localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure

Widespread yearly occurrence with low to moderate pest pressure

Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low to moderate pest pressure

Pest not present

DNR - Data not reported

E – established

D – invasion expected or dispersing

Source(s): Crop profile focus groups 2005 (British Columbia and Ontario)

Major Diseases

Brown Rot *(Monilinia fructicola)*

Pest Information

Damage: Brown rot causes serious damage to cherries and other stone fruits during wet seasons. The disease causes a blossom blight, fruit rot and twig blight. Blossoms and ripening fruit 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 it is harvested. This type of infection causes the greatest losses in sweet cherry. Brown rot may be confused with Botrytis in the field. There is no tolerance of brown rot infected fruit in the market.

Life Cycle: The fungus overwinters 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. The hours of wetting

necessary for blossom infection decrease from 18 hours at 10°C to 5 hours at 25°C. Infection proceeds slowly above 30°C and below 5°C. Frost-injured blossoms are more susceptible to brown rot infection than non-injured blossoms. Spores (conidia) produced on blighted blossoms cause secondary infections. These infections spread to ripening fruit. Rotting fruit provide abundant inoculum that can infect additional healthy fruit. Fruit becomes increasingly susceptible as it ripens. Infected fruits eventually turn into shrivelled, black mummies that may drop or remain attached to the tree through the winter.

Pest Management

Chemical Controls: Boscalid, captan, chlorothalonil, fenbuconazole, fenhexamid, ferbam, iprodione, myclobutanil, propiconazole, sulphur, thiophanate-methyl and triforine are registered in Canada. Sweet cherry fruit appears to be susceptible throughout the entire period of development and continuous protection of the sweet cherry crop from bloom to harvest is required.

Cultural Controls: Prevention is critical. 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. Where growers wait to prune until shuck fall to promote rapid wound closure and decrease chances of cytospora canker infection, fall removal of unpicked fruit is essential. A weed-free herbicide strip in sod culture/high density systems may also discourage the production of apothecia and production of spores from fruit mummies on the orchard floor.

Alternative Controls: None identified.

Cultivar Susceptibility: 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. There are no fungicides registered in Canada for control of post-harvest brown rot in cherries. There is a need for a post-harvest fungicide dip in high-risk years. Access to new products is needed for control of brown rot (and other postharvest pathogens).
2. Efficient, cost effective monitoring techniques need to be developed to determine the need for brown rot fungicide sprays.
3. There is concern about the development of resistance to iprodione, a useful and versatile fungicide that gives superior protection of cherries (and peaches) against brown rot. It is essential to limit iprodione to only 2-3 applications per season, so as to delay the possible development of brown rot resistance to iprodione and cross-resistance to dichloran.
4. Chlorothalonil, sulphur and captan are protective fungicides to which the brown rot fungus has not developed resistance. Sulphur is not widely recommended because it causes skin irritation to fruit pickers and kills beneficial mites thus resulting in undesirable outbreaks of red mite. Captan is particularly valuable in programs designed to delay the development of fungicide resistance and should be alternated with other fungicides so as to reduce the frequency of use of resistance-prone fungicides. A disadvantage of captan is its phytotoxicity to a few sweet cherry cultivars (e.g., Schmidt).
5. The loss of the processing market for sweet cherries (in Ontario) due to the availability of lower cost alternatives from other sources, has removed the early pick option from

growers. With this option, growers were able to pick cherries for processing in advance of expected weather conditions that would contribute to brown rot.

Bacterial Canker *(Pseudomonas syringae)*

Pest Information

Damage: Pseudomonas syringae infects cherries, other stone fruits, pears, apple rootstocks and many species of ornamental trees. Bacterial canker has been an increasing problem particularly on young cherry trees. On young cherry trees the disease causes elongated, gummy cankers. These cankers may expand rapidly in the spring, causing girdling of the main trunk or branches. Bacterial canker can also kill buds and sometimes causes brown, circular lesions on leaves that fall out to produce "shotholes". Small, sunken, brown lesions may develop on immature fruit. Leaf and fruit symptoms are not common and may be seen in areas or years with higher rainfall.

Life Cycle: The bacterium overwinters in cankers, healthy buds and in the vascular system of the plant. In the spring, bacteria are disseminated by rain to blossoms and young leaves. The bacteria can survive in an epiphytic phase on the surface of symptomless leaves and blossoms and also on other plants or weeds in the orchard during the summer. Trees are particularly susceptible during autumn leaf fall, when fresh leaf scars may become infected. Frost damage in the spring may promote additional infections.

Pest Management

Chemical Controls: There are no pesticides registered for the control of bacterial canker.

Cultural Controls: The use of clean nursery stock is crucial to minimizing infection. Avoiding planting cherries in frost prone areas helps minimize winter injury and subsequent bacterial canker infections. Stresses on young or recently planted cherry trees should be minimized. Adequate moisture to prevent drought stress should be provided. Planting in areas with poor drainage should be avoided and nutrients and pH managed carefully. Trees with minor gumming may be able to recover. Small cankers can be cut out with a disinfected pruning knife. Affected branches are pruned throughout the season. Using a pruning technique known as "stubbing, as well as late pruning, reduce the risk of bacterial canker. If the infection has spread significantly, the tree may not be able to recover and the only possible control is to remove the tree before it infects others. Before planting new cherry trees, the soil may be tested for nematodes, as the ring nematode is possibly associated with increased losses due to bacterial canker.

Alternative Controls: None identified.

Cultivar Susceptibility: Dwarf sweet cherry trees are more susceptible to bacterial canker although there is no conclusive information as to the reason for this. It is possible that dwarf trees are more susceptblie to stress, which predisposes them to the disease. Outbreaks in dwarf trees will move to standard size trees. MM2 and MM60 rootstocks appear to have less susceptibility to bacterial canker.

Issues for Bacterial Canker

1. There are no chemical controls registered for control of this disease which is of significant concern to cherry growers. Fixed copper applied post harvest or prior to bud break may help control bacterial canker, however is not currently registered on sweet cherry.

2. There is concern that so much public research resources have been directed to Plum Pox Virus and that there is little time and resources spent on research required on bacterial canker of sweet cherry. It is believed that more public resources should be directed to the issue of bacterial canker on sweet cherry.

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

Pest Information

Damage: Botrytis cinerea is a common fungus that can cause fruit rot problems in the orchard and post-harvest in cherries. Botrytis infects the cherry blossoms following prolonged periods of wet, cool weather. When the wet weather persists, green fruit rot occurs. Other symptoms include blossom blight and smooth brown lesions on cherry fruit. Latent infections can cause rot as the fruit ripens. Botrytis rot of mature cherries may be mistaken for brown rot as the symptoms are very similar. Fruit develop a firm, brown decay and become covered with light brown spores. The disease can develop at cold temperatures and has the ability to spread at harvest and in storage. 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.

Pest Management

Chemical Controls: There are no products registered for the control of Botrytis on cherry but the fungicides applied for Monilinia (brown rot) help to control Botrytis also.

Cultural Controls: Prevention includes adequate air circulation, good sanitation and avoiding overcrowding and overhead watering late in the day. Harvesting and storing only sound fruit and avoiding injuring or bruising fruit at harvest will also reduce problems due to botrytis. Burying of culls and rotted fruit promptly and ensuring fruit is pre-cooled and kept in cold storage until it reaches its destination, will minimize problems due to botrytis. Control measures often target Botrytis and brown rot at the same time.

Alternative Controls: None identified.

Cultivar Susceptibility: None identified.

***Issues for** Botrytis Fruit Rot*

1. There are no fungicides registered for control of botrytis blossom blight.
2. There are no post-harvest fungicides registered for botrytis fruit rot of sweet cherries.

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. Powdery mildew causes early defoliation and prevents shoot growth of young, vigorous trees. Fruit infection appears as a white powdery covering on the cherry as the fruit ripens, resulting in unmarketable fruit.

Life Cycle: Powdery mildew overwinters as cleistothecia in bark crevices or in leaf litter. In the spring, the cleistothecia give rise to ascospores that cause primary infection of leaves, shoots and fruit. Conidia 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

Chemical Controls: Fungicide sprays are used as protectants. The use of propiconazole, fenbuconazole and myclobutanil to control cherry leaf spot and brown rot controls powdery mildew sufficiently on bearing plantings in Ontario. Myclobutanil, sulphur and pyraclostrobin are registered for powdery mildew. Fungicide rotation is used to help avoid resistance development.

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. The trend towards higher density plantings and later-maturing varieties has led to increased problems due to powdery mildew.

Alternative Controls: None identified.

Cultivar Susceptibility: Variety selection impacts powdery mildew development as varieties vary in their susceptibility to this disease.

Issues for Powdery Mildew

1. The trend towards higher density plantings and later-maturing varieties has increased powdery mildew incidence and severity.
2. Only pyraclostrobin is registered commercially on sweet cherry (high risk of resistance).

Root-Lesion Nematode (*Pratylenchus penetrans* and other spp.)

Pest Information

Damage: Root-lesion nematodes are most abundant in sandy soils, but can be found in all soil types. They penetrate roots just behind the tip by piercing cells and secreting enzymes. They cause reddish-brown markings on new roots which, when numerous, will turn large areas of the roots brown or black. Many fine lateral roots die and symptoms resemble black root rot.

Life Cycle: Nematodes are spread large distances through the movement of soil through tillage, erosion, livestock, by wind or in roots of plants. The population peaks in May-June and September-October each year.

Pest Management Root-lesion nematodes

Chemical Controls: Methyl dithiocarbamate and methyl bromide, two pre-plant soil fumigants are sometimes used when new plantings are being established.

Cultural Controls: Since many weeds are nematode hosts, weed control in and around a field is essential. Cover crops such as clovers and buckwheat should be avoided, as they are

excellent nematode hosts. Wheat or barley are better choices. Certain mustards and other crucifers, marigolds and specific sorghum x sudangrass hybrids may effectively reduce nematode populations in the soil. Increasing the carbon to nitrogen ratio in the soil, so that it falls between 11:1 and 20:1, can also reduce nematode populations. This can be achieved using chicken manure and straw. Soil should be sampled before and after application.

Alternative Controls: None identified.

Cultivar Susceptibility: None identified.

Issues for Root-lesion nematodes

1. None identified.

Cytospora Canker (*Leucostoma cincta)*

Pest Information

Damage: Cytospora canker is a significant disease of all stone-fruit trees. 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. Closer examination of dead limbs often reveals slightly sunken areas in the bark. Cytospora canker may often be misdiagnosed as bacterial canker.

Life Cycle: Small, black, fruiting bodies of the fungus often develop under the bark in the sunken 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.

Pest Management

Chemical Controls: There are no fungicides registered for cytospora canker.

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. Trees should be trained so that wide crotch angles develop between the trunk and the branches. Sporulating infections on scaffold limbs or trees should be pruned out as soon as possible, as they are a source of spores. Preventative measures are used to minimize winter injury, sunburn, rodent damage and insect damage. Trees are maintained in a vigorous state.

Alternative Controls: None identified.

Cultivar Susceptibility: None identified.

Issues for the Cytospora canker

1. There are no fungicides registered to control this disease in sweet cherries.

Little Cherry Disease- Little cherry virus (LChV-3)

Pest Information

Damage: Cherries on trees affected by LChV-3 are not fit for the fresh fruit market as they lack flavour, sweetness, size and colour. Fruit symptoms are most pronounced in the Lambert variety, in which fruit can be as small as half the normal size. The fruit colour is dull red, and its shape is pointed. It is common for some fruits on a branch to be more severely affected than others. Symptoms are similar on other varieties, but less severe and more variable. Little cherry virus is a regulated disease.

Life Cycle: The virus is spread from tree to tree by the apple mealybug and is readily transmitted by grafting. Transmission by pollen, seed, in the soil or by pruning tools has not been demonstrated. Ornamental, flowering cherries are symptomless carriers of the disease.

Pest Management

Chemical Controls: An apple mealybug control program is essential in orchards where little cherry disease has been found, however there are no chemical controls registered for the apple mealy bug in cherry.

Cultural Controls: To control little cherry disease, growers are encouraged to purchase only certified virus-free stock, when available. Infected trees should be removed immediately and other hosts such as Japanese flowering cherry and wild bitter cherry must be destroyed.

Alternative Controls: None identified.

Cultivar Susceptibility: None identified.

Issues for Little Cherry disease

1. Recent research has revealed that there is more than a single virus causing little cherry disease in BC. An unrelated virus, called LChV-1 has been detected in numerous orchards in some areas of BC. The vector of LChV-1 is unknown. Additional research is needed to understand the epidemiology of this disease, which causes symptoms similar to those caused by LChV-3.

Minor Diseases

Alternaria Fruit Rot (*Alternaria alternata*)

Pest Information

Damage: Early symptoms of alternaria appear on green fruit as red rings, approximately 2 mm in diameter. The centres of the rings become brown and sunken as the cherries mature. The disease also develops on overripe fruit and fruit injured by physiological cracking and insects. A post-harvest storage rot may develop

Life Cycle: Under moist conditions, alternaria sporlulates on the surface of infected areas, producing a grey to dark green mould growth, which serves to spread the disease.

Pest Management

Chemical Controls: There are no chemical controls currently registered in Canada. This disease is often controlled by fungicides applied for the control of other diseases.

Cultural Controls: Cultural controls include maintaining good fertility and moisture levels in late summer and the avoidance of overhead irrigation.
Alternative Controls: None identified
Cultivar Susceptibility: None identified.

Issues for Alternaria Fruit Rot

1. None identified.

Cherry leaf Spot (*Blumeriella jappii*)

Pest Information

Damage: Cherry leaf spot or shot-hole, reduces flowering and weakens the tree. Leaves develop small purple to brown spots, with definite borders, in early summer. In July, the centres of the infected spots frequently fall out, giving a shot-hole appearance. The leaves turn yellow and fall. Cherry leaf spot often defoliates the tree by midsummer. Repeated defoliation makes the tree more susceptible to winter injury and may eventually kill it.
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 the spots. These spores are rain splashed to infect other leaves. Secondary spread and infection by spores continues repeatedly, whenever wet, warm weather occurs, until leaves fall in autumn.

Pest Management

Chemical Controls: Most fungicides applied to sweet cherry for brown rot control will control cherry leaf spot. Copper applied to sweet cherry for bacterial canker, helps to control leaf spot. Captan, ferbam propiconazole and sulpur are registered for control of leaf spot on sweet cherry.
Cultural Controls: Cultural controls include good pruning to allow for rapid drying of foliage and good spray penetration. There are no practical methods to reduce primary inoculum.
Alternative Controls: None identified.
Cultivar Susceptibility: None identified.

Issues for Cherry leaf spot

1. None identified.

Coryneum Blight (*Wilsonomyces carpophilus*)

Pest Information

Damage: On cherry fruit, coryneum blight causes small reddish-brown to purple spots, some of which appear scabby later in the season. Twig infections are not common, but shotholes in leaves are often found. This disease causes fruit symptoms that are more severe when there is frequent wet weather at husk fall.
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 resulting in new lesions.

Pest Management

Chemical Controls: There are no fungicides registered for coryneum blight in cherries. However the disease is controlled by fungicides used for brown rot or leaf spot.

Cultural Controls: Monitoring for the disease and pruning out infected twigs during dormancy is the most common approach to cultural control.

Alternative Controls: None identified.

Cultivar Susceptibility: None identified.

Issues for Coryneum blight

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

Rhizopus Rot (*Rhizopus* spp.)

Pest Information

Damage: Rhizopus spp. cause a soft rot of harvested or over-ripe stone fruits. Fungal growth and fruit decay are greatly retarded in cold storage but advance rapidly at warm temperatures, causing the loss of many fruits within a shipping container. Initial symptoms are dime-sized lesions, cinnamon or chocolate-coloured, which may be difficult to distinguish from early brown rot lesions. At warm temperatures, the fungus rapidly advances through the entire fruit.

Life Cycle: The fungus survives unfavorable environmental conditions as dark coloured zygospores in the remnants of rotted fruit in bins or on the orchard floor. Rotted fruit on the orchard floor provide a source of infection as the harvest season progresses. Infections develop on fruit injured by insects, hail or cracking. After harvest, *Rhizopus* rot can spread from fruit to fruit without injury at the point of contact. Rot progression is temperature dependent, with rapid fungal growth at the optimum temperature of 27^{o}C, but no spore germination or growth at 4^{o}C.

Pest Management

Chemical Controls: Pre-harvest fungicides, post-harvest fungicide dips and/or sprays, or impregnated fruit wrapping papers, all help prevent the disease. Dichloran is registered to control *Rhizopus* rot.

Cultural Controls: The harvesting of fruit before it is fully ripe will help reduce Rhizopus rot as this disease is more likely to be a problem where fruits are allowed to fully ripen on the tree or when over-mature fruit is harvested. Good sanitation of field bins or crates, the hydrocooler and the packinghouse will reduce the incidence of this disease. Since Rhizopus rot is a storage disease and since the fungus does not grow at temperatures below 4^{o}C, storage at temperatures below 4°C will control the disease. To minimize the incidence of Rhizopus rot, handle fruit carefully to avoid wounds, cool fruit quickly after harvest, keep storage containers and warehouses clean and keep hydrocooling water clean.

Alternative Controls: Some experimental biological controls have been tested. The status of commercialization is unknown.

Cultivar Susceptibility: None identified.

Issues for Rhizopus rot

1. There is a need for additional products for post-harvest disease control.

Table 3. Disease control products, classification and performance for Canadian Sweet Cherries production

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
boscalid (Lance)	carboxamide fungicide	7	RR	brown rot	**A**	Is the only chemical in this class of fungicides. Is easy to use, of relatively low cost and requires a low rate of application. There is no visible residue on the fruit and it has an attractive pre-harvest interval (0). It may cause some phytotoxicity on leaves.
captan (Captan, Maestro)	phthalimide fungicide	M4	R	brown rot	A^P	This material is seldom used due to market restrictions. It has a place for use early in the season before fruit matures. May cause burning of the leaves of some older varieties and it leaves a highly visible residue. Resistance and/or low efficacy suspected.
				cherry leaf spot		
chlorothalonil (Bravo)	chloronitrile fungicide	M5	R	brown rot	A	Timing of application is restricted by the long pre-harvest interval; is an eye irritant and an issue for worker exposure. Is relatively expensive. It is good for rotation early in the season and is mainly used during the blossom period as it cannot be used after the husk fall stage.
dichloran (Allisan)	aromatic hydrocarbon fungicide	14	R	Rhizopus rot		Post-harvest fruit dip only.

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
fenbuconazole (Indar 75 WSP)	triazole fungicide	3	R	brown rot	A	Is one of the more effective products currently used for brown rot control. Advantages include its non-visible residue, short pre-harvest interval, low rate of application and ease of use. It is at risk of resistance development because of the wide spectrum of registrations.
fenhexamid (Elevate WDG)	hydroxyanilide fungicide	17	R	brown rot	A^P	This fungicide is important in the rotation of control agents for brown rot. This product is safe to handle and is a low residue product from the standpoint of consumer visibility. It is expensive however. Provides good control of botrytis, although not registered for this disease. Some phytotoxicity is suspected (tipburning).
ferbam (Ferbam)	dithiocarbamate fungicide	M3	R	brown rot		
				leaf spot		
iprodione (Rovral)	dicarboximide fungicide	2	R	brown rot	A - A^P	Is the only fungicide for use on cherries in this class. Is often used close to harvest due to its pre-harvest interval. Does not work well in wet years as it is easily washed off by rain. Visible residue is an issue for consumers. Provides good control of botrytis although it is not registered for botrytis on cherries.
myclobutanil (Nova)	conazole fungicide	3	R	brown rot	I - A^P	Is locally systemic and rainfast and thus can be used in wet conditions.There may be some resistance. Solubag use makes handling and measurement difficult.
				powdery mildew	A	May be alternated with Cabrio and Kumulus. Considered to be the most effective product for powdery mildew . The class 3 fungicides are heavily relied upon and have a high risk of resistance due to overuse.

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
propiconazole (Topas 250E; Propiconazole 250E)	triazole fungicide	3	R	brown rot	A	Is considered very effective for control of brown rot. This product has a longer pre-harvest interval and a longer re-entry interval than Indar. It is relatively inexpensive and easy to mix. Growers have concerns of phytotoxicity on some varieties.The potential for resistance is a concern.
				leaf spot		
pyraclostrobin (Cabrio)	methoxy-carbamate fungicide	11	R	powdery mildew	A	Two applications are generally made, typicaly during the 2 week period following husk fall. Cabrio has received less use than either Kumulus or Nova during this period. Cabrio may also be used close to harvest if disease symptoms appear.
sulphur (Microscopic sulphur, Hollysul micro-sulphur, Kumulus DF, Green Earth Garden Sulphur)	inorganic	M2	R	brown rot	I	May be used by organic growers but is not that effective against brown rot.
				powdery mildew	A	Domestic label only; Kumulus is significantly less expensive than other powdery mildew fungicides although it has shorter residues and may cause russetting in hot weather; may be alternated with Nova or Cabrio. Lime sulphur may be applied just prior to leaf fall to reduce overwintering innoculum.
				leaf spot		Domestic label only
thiophanate-methyl (Senator)	thiophanate fungicide	1	RE	brown rot		

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
triforine (Funginex)	piperazine fungicide	3	R	brown rot	A^P	Is important as a rotational alternative early in the season. The product is easy to mix. It has limited post-infection activity. It has limited local systemic activity.
Sodium methyldithiocarbamate (Vapam)	dithiocarbamate fungicide	M3	R	nematodes		Used pre-plant only.
methyl bromide - this is classified as an insecticde	alkyl halide insecticde	8A	R	nematodes		Used pre-plant only.

[1] Common trade name(s), if provided in brackets, are for the purpose of product identification only. No endorsement of any product in particular is implied.

[2]The classification and the mode of action group are based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*. The document is under revision and up-to-date information can be found on the following web sites: herbicides:http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; insecticides:http://www.irac-online.org/documents/moa/MoAv5_1.pdf ; fungicides:http://www.frac.info/frac/index.htm

[3] R-full registration (non-reduced risk), RE-under re-evaluation (yellow), DI (red) -discontinued by registrant, PO (red) - being phased out as a result of re-evaluation by the PMRA, BI-biological, RR-reduced risk (green), OP-organophosphate replacement, NR-not registered. Not all end-use products will be classed as reduced-risk. Not all end use products containing this active ingredient may be registered for use on this crop. Individual product labels should be consulted for up to date accurate information concerning specific registration details. The information in these tables should not be relied upon for pesticide application decisions. Consult individual product labels for specific registration details. The following website can be consulted for more information on pesticide registrations: http://www.eddenet.pmra-arla.gc.ca/4.0/4.0.asp

[4] Please consult the product label on the PMRA web site (http://www.eddenet.pmra-arla.gc.ca/4.0/4.0.asp) for specific listing of pests controlled by each active ingredient.

[5] A – Adequate (green) (the pest control product (PCP), according to recommended use, maintains disease below economic threshold OR provides acceptable control), A^P – Provisionally Adequate (yellow) (the PCP, while having the ability to provide acceptable control, possesses qualities which may make it unsustainable for some or all uses), I – Inadequate (red) (the PCP, according to recommended use, does not maintain disease below economic threshold OR provides unacceptable control)

[6]Sources: Crop profile focus groups for British Columbia and Ontario (2005).

Table 4. Availability and use of disease pest management approaches for Canadian Sweet Cherries production

	Practice \ Pest	Brown rot	Bacterial canker	Botrytis fruit rot and blossom blight	Powdery mildew	Root-lesion nematode	Cytospora canker	Coryneum blight	Cherry little disease (ChV-3)	Alternaria fruit rot	Crown rot	Rhizopus rot
Prevention	equipment or facility sanitation; use of sterile media											
	mowing / mulching / flaming											
	removal of alternative or wild hosts											
	row or plant spacing (plant density)											
	seeding depth											
	water / irrigation management											
	crop residue removal / management											
	pruning out / elimination of infected plant material											
Avoidance	resistant varieties											
	planting / harvest date adjustment											
	crop rotation											
	choice of planting site											
	use of disease-free seed or transplants											
	optimizing fertilization											
	reducing mechanical damage / insect damage											
	thinning / pruning											
Monitoring	scouting											
	records to track diseases											
	soil analysis											
	weather monitoring for disease forecasting											
	grading out infected produce											
Decision making tools	forecasting models for treatment decisions											
	use of thresholds for treatment decisions											
Suppression	biological pesticides											
	environmental management (eg. as in greenhouses)											
	pesticide rotation for resistance management											
	soil amendments											
	controlled atmosphere storage											

no information regarding the practice is available

available/used

available/not used

not available

Source(s): Crop profile focus groups 2005 (British Columbia and Ontario)

Insects and Mites

Key Issues

- There is concern about the loss of broad spectrum, pesticides currently under re-evaluation including azinphos-methyl, diazinon, endosulfan and phosalone and the future avaialbility of effective materials.
- Adult fruit flies must be controlled with effective chemicals in the pre-oviposition period before the female matures and she can lay eggs. This is a very important criteria and concern when screening for new, alternative chemistries to replace organophosphate insecticides.
- Fruittree and European leafrollers in the Okanagan Valley are resistant to organophosphate insecticides such as diazinon and azinphos-methyl.
- Improved development models are required to assist in leafroller population forecasting and treatment decisions.
- Replacement pesticides for hard to control pests, such as the black cherry aphid and plum curculio, are needed, especially in Ontario.
- McDaniel mites are becoming an increasing problem as a result of sprays applied for other pests.
- There is concern about the potential for apple mealybug populations to increase if organophosphate insecticides are de-registered.
- Natural biological controls of San Jose scale such as the parasitoid *Prospaltella perniciosi* can be negatively impacted by the use of broad spectrum pesticides.
- Oriental fruit moth does not occur in BC and is a quarantine pest. All species, hybrids, varieties, fruit and seed of apricot, nectarine, peach, plum and quince from any country or province of Canada where Oriental fruit moth occurs, requires fumigation prior to entry into British Columbia.
- In Ontario, research on mating disruption trials for the control of Oriental fruit moth needs to be continued.

Table 5. Degree of occurrence of insect pests in Canadian Sweet Cherries production

	Degree of occurrence	
Major pests	**BC**	**ON**
Western cherry fruitfly	E	
Eastern cherry fruitfly		E
Leafrollers	E	DNR
Aphids	E	E
Plum curculio	DNR	E
Minor pests	**BC**	**ON**
European red mite	E	DNR
Two spotted spider mite	E	DNR
McDaniel mite	E	DNR
Rust mite	E	DNR
Apple mealy bug	E	DNR
San Jose scale	E	DNR
Pear sawfly	E	DNR
Eye spotted budmoth	E	DNR
Peach tree borer	E	DNR
American plum borer	DNR	DNR
Oriental fruit moth		DNR
Shothole borer	E	DNR
Ambrosia beetle	DNR	DNR
Apple and thorn skeletonizer	E	DNR
Green fruitworm	E	DNR

Widespread yearly occurrence with high pest pressure

Localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure

Widespread yearly occurrence with low to moderate pest pressure

Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low to moderate pest pressure

Pest not present

DNR - Data not reported

E – established

D – invasion expected or dispersing

Source(s): Crop profile focus groups 2005 (British Columbia and Ontario).

Major Insects and Mites

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

Pest Information

Occurrence: Rhagoletis cingulata is the is the predominant fruit fly species in cherry in Eastern Canada whereas *R. indifferens* is the most relevant species in British Columbia. The habits and appearance of *R. cingulata* in eastern Canada and *R. indifferens* in western Canada are difficult to distinguish. The black cherry fruit fly, *Rhagoletis fausta* is found in all cherry regions, but is less frequent than the aforementioned species.

Damage: Members of cherry fruit fly species attack sweet and tart cherries and wild species of cherries. Damage to the fruit occurs in two ways: feeding by the adults and feeding by the maggots. Primary damage results from the feeding of the larva within the fruit. Maggots and their frass within the fruit render the product unmarketable Larvae are undetectable from the exterior of the cherry, but are easily visible when the cherry is opened. There is zero tolerance for this insect in product. Cherry fruit flies have a very high reproductive capacity.

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. Normally only one maggot develops in each fruit even if many eggs may have been deposited in the fruit. Larvae feed within the fruit for one to two weeks. At maturity larvae cut exit holes, drop to the soil and overwinter as pupae. Only one generation of cherry fruit flies develops each year, though some of the pupae may remain in the soil for two years. The western cherry fruit fly is prevalent in backyard sweet cherry trees, sour cherry trees and wild hosts providing reinfestation pressure.

Pest Management

Chemical Controls: Insecticide sprays such as azinphos-methyl (last date of use Dec 31, 2007), carbaryl, diazinon, dimethoate, imidacloprid and phosalone are available for control and are usually timed according to when fruit turns yellow to pink in colour. Continual spray coverage is important from pest emergence through harvest.

Cultural Controls: Unmanaged, alternate hosts located near the orchard should be eliminated. The control of cherry fruit fly on unmanaged trees and wild hosts will greatly reduce infestation pressure. All fruit should be removed at harvest. The use of landscape fabrics or other materials to impede downward movement of larvae in summer and upward movement of flies in early summer has been used successfully as part of IPM systems.

Alternative Controls: None identified

Cultivar Susceptibility: None identified.

Issues for the cherry fruit fly and the black cherry fruit fly

1. Adult flies must be controlled with effective chemicals in the pre-oviposition period before the female matures and she can lay eggs. This is a very important criteria and concern when screening for new, alternative chemistries to replace organophosphate insecticides.
2. Since the most effective crop protection materials are currently under review (eg. azinphos-methyl, diazinon and phosalone) there is concern about the future availability of effective materials.

Leafrollers: Fruittree Leafroller (*Archips argyrospilus*), European Leafroller (*Archips rosanus*), Obliquebanded Leafroller (*Choristoneura rosaceana*) and Threelined Leafroller (*Pandemis limitata*)

Pest Information

Damage: There are a number of species of leafrollers that attack cherries. Their distribution and prevalence varies between regions. Feeding by leafrollers is apparent as chewed flower parts, buds and leaves. Leaves are often rolled up and webbed together. Feeding on young fruit appears as deep, irregular holes resulting in deformed fruit with deep creases.

Life Cycle:. The fruittree and European leafrollers overwinter as eggs. Eggs hatch in the spring and the newly hatched larvae are dispersed 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. There is one generation per year. The obliquebanded leafroller and three lined leafroller have two generations per year. They overwinter as larvae in cocoons 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

Chemical Controls: A number of chemicals including carbaryl, diazinon, malathion and spinosad are registered.

Cultural Controls: Trees are pruned to open up the canopy to remove egg-masses and allow sufficient penetration of sprays, especially into the upper canopy where leafrollers are most active. Elimination or spraying of unmanaged host trees next to commercial host crops helps to reduce leafroller pressure. Monitoring is important to determine if pest levels warrant treatment.

Alternative Controls: Bacillus thuringiensis var. *kurstaki* provides some control of leafrollers. Furthermore the pheromone product Isomate®-CM/LR is registered in Canada.

Cultivar Susceptibility: None identified.

Issues for leafrollers

1. Fruittree and European leafrollers in the Okanagan Valley are resistant to organophosphate insecticides such as diazinon and azinphos-methyl.
2. Improved development models are required to assist in population forecasting and treatment decisions.

Aphids: Black Cherry Aphid (*Myzus cerasi*) and Mealy Plum Aphid (*Hyalopterus pruni*)

Pest Information

Damage: Aphids cause little direct fruit damage but can leave undesirable deposits of sticky honeydew on fruit that can promote sooty mould growth. Levels of tolerance for the black cherry aphid on young trees, are minimal.

Life Cycle: Aphids overwinter as eggs on the host plant. Eggs hatch at bud burst. 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

Chemical Controls: In Ontario, one insecticide spray at petal fall usually results in good control of black cherry aphid. In BC, sprays applied for fruit flies will control aphids also. Registered products are: carbaryl, diazinon, dimethoate, malathion and phosalone.

Cultural Controls: Monitoring is used to determine when controls are required. Infested terminals are removed.

Alternative Controls: A number of beneficial insects help to control aphids. Lady beetles, lacewings, syrphid flies and parasitic wasps can reduce aphids to non-damaging levels. However, where viruses are a concern, it is usually necessary to apply an insecticide.

Cultivar Susceptibility: None identified.

Issues for Aphids

1. Replacement pesticides for hard to control pests, such as the black cherry aphid, are needed, especially in Ontario.
2. Although currently available products are effective, there is concern about the loss of registrations with no replacements available.

Plum Curculio (*Conotrachelus nenuphar*)

Pest Information

Occurrence: Plum curculio occurs in all of eastern North America, but has not been reported as a problem in British Columbia.

Damage: Hosts include plum, apricot, cherry, apple, pear, gooseberry and chokecherry. Adult curculios feed on young fruit and cause the tissue around the feeding puncture to become very hard. A small pustule is often present, surrounded by a circular depression. The fruit becomes more deformed as it grows. On cherry, females chew a very small hole in the young fruit near the stem in which they lay an egg. Infested fruit may drop prematurely or may be infested at harvest, making it unmarketable.

Life Cycle: Adults overwinter and emerge in the spring to feed on buds, fruit spurs and developing fruit. Adult beetles lay eggs in fruit and after hatching, larvae feed within the

fruit. At maturity the larvae enter 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 host trees.

Pest Management

Chemical Controls: Azinphos-methyl, carbaryl and phosalone are registered for the control of plum curculio.

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

Alternative Controls: None identified.

Cultivar Susceptibility: None identified

Issues for Plum Curculio

1. Replacement products for hard to control pests, such as the plum curculio, are needed, especially in Ontario.

Minor Insects and Mites

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

Pest Information

Damage: Lightly infested leaves become speckled; heavily infested leaves become bronzed and covered with webbing. Injured leaves may fall.

Life Cycle: Red to orange-coloured, adult females overwinter beneath bark or in trash at the base of trees. In early spring they move up the tree trunk to leaves near the main limbs. They spread throughout the tree and produce several generations depending on temperature. Rust mites overwinter at the base of buds, under bud scales and leaf scars, or in bark crevices on branches and twigs. When the buds open, mites move to the flower parts and leaves. Around petal-fall, rust mites move onto fruit. Several generations are produced during the spring and summer. Overwintering forms of rust mite may appear in late July and move to overwintering sites on the tree.

Pest Management

Chemical Controls: Diazinon is registered for the control of mites in general. Endosulfan is registered for control of the plum rust mite. Dicofol is registered for the control of the European red mite, McDaniel mite and two spotted mites. Dormant oil is also registered for control of the European red mite on sweet cherry. Dormant oil sprays often reduce or eliminate the need for the summer treatment of this pest.

Cultural Controls: Healthy, well-maintained trees will tolerate higher mite populations than weak or stressed trees. Monitoring is important to determine treatment thresholds.

Alternative Controls: Several predatory mites are effective at controlling pest mite populations. Monitoring is important to determine if treatment thresholds are reached.

Cultivar Susceptibility: None identified.

Issues for mites

1. McDaniel mites are becoming an increasing problem as a result of sprays applied for other pests.

Apple Mealybug (*Phenacoccus aceris*)

Pest Information

Damage: The apple mealybug does not directly injure cherry, but is the primary vector of little cherry virus. Due to the seriousness of little cherry virus, there is no tolerance of this insect. Adult mealybugs are found in bark crevices, pruning scars and in the crotches of small twigs where they appear as small, white powdery patches.

Life Cycle: Apple mealybugs have one generation per year. They overwinter as nymphs on their host trees and become active in May. Eggs are laid from June to July, and nymphs are present from July to October.

Pest Management

Chemical Controls: There are no chemicals registered for this pest on cherries or other fruit trees. However sprays for the western cherry fruit fly in combination with dormant oil, will help control this pest.

Cultural Controls: There is no IPM program used for apple mealybug as it is controlled by pesticides that target the cherry fruit fly.

Alternative Controls: None identified.

Cultivar Susceptibility: None identified.

Issues for Apple Mealybug

1. There is concern about the potential for apple mealybug populations to increase if organophosphate insecticides are de-registered.

San Jose Scale (*Quadraspidiotus perniciosus*)

Pest Information

Damage: The San Jose Scale is a pest of all tree fruits and many ornamental trees and shrubs. It can cause damage to the bark, kill areas of inner bark, girdle twigs and branches, cause small, brown, dead spots on leaves in the summer and cause fruit spots and deformities. Heavy infestations can cause a loss in tree vigour, growth and productivity.

Life Cycle: San Jose scale overwinters in the immature "blackcap" (second nymphal) stage on bark in tops of trees. Adults mature in spring and winged males fly or walk to reach pheromone-emitting females. The sedentary, shelled females produce living young called crawlers. Crawlers move to new feeding sites on fruit or bark, insert their sucking mouthparts to feed and then secrete a wax to form a shell. There are 2 to 3 generations per year.

Pest Management

Chemical Controls: Dormant oil and diazinon are registered for the control of San Jose scale. Dormant oil applied for European red mite control assists in the prevention of scale problems.

Cultural Controls: Remove large, old trees with encrusted scale. Infestations should be closely monitored if this pest is present because of the potential for injury.

Alternative Controls: None identified.
Cultivar Susceptibility: None identified.

Issues for San Jose scale

1. Natural biological controls of San Jose scale such as the parasitoid *Prospaltella perniciosi* can be negatively impacted by the use of broad spectrum pesticides.

Pear Sawfly (Pear Slug) *(Caliroa cerasi)*

Pest Information

Damage: .Pear sawfly larvae feed on the upper surface of pear and cherry leaves, skeletonizing the leaves which dry out and give a scorched appearance to the tree. High populations can defoliate trees.

Life Cycle: The pear sawfly overwinters as larvae in the soil and pupates in the spring. Adult sawflies emerge and lay eggs from May to July on leaves. Larvae feed on leaves and at maturity enter the soil to pupate. A second generation of adults appears in August and there may be a third generation in September.

Pest Management

Chemical Controls: There are no pesticides registered for the control of pear sawfly.
Cultural Controls: Monitoring is used to determine if treatment is required.
Alternative Controls: None identified.
Cultivar Susceptibility: None identified.

Issues for pear sawfly

None identified

Eyespotted Bud Moth (*Spilonota ocellana*)

Pest Information

Damage: In the spring, the eyespotted bud moth feeds on opening flower buds. It also burrows into shoots and can cause economic damage in non-bearing plantings. Summer larvae feed on the surface of fruit.

Life Cycle: The eyespotted bud moth overwinters as partially grown larvae in silken cocoons in the crotches of twigs and branches. During bloom, the young larvae emerge and build nests of leaves and blossoms where they feed mainly on leaves. The moths emerge in mid-June to late July following pupation in the nests. After mating, females lay eggs singly on leaves. Summer larvae tie dead leaves to fruit and feed on the fruit surface. In September, larvae seek overwintering sites on the trees.

Pest Management

Chemical Controls: Carbaryl, diazinon, endosulfan and spinosad are registered for the control of this pest. The eye spotted bud moth is generally controlled with pesticides applied for spring feeding caterpillars.

Cultural Controls: Eliminate nearby host trees on which the pest is not managed. Prune orchard trees to open the canopy (especially upper canopy) to allow for good air circulation and access for sprays. Manually remove and destroy larvae when observed. It is important to control the spring generation of bud moth larvae in order to reduce the need to control the summer generation that causes the economic damage. Monitoring is done to determine whether treatment is necessary.

Alternative Controls: Bacillus thuringiensis var. *kurstaki* should be applied during bloom.

Cultivar Susceptibility: None identified.

Issues for the eyespotted bud moth

None identified.

Peach Tree Borer (Synanthedon exitiosa)

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.

Life Cycle:. Pupation occurs in feeding tunnels. Adults 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.

Pest Management

Chemical Controls: If trap catches indicate a need for control, established trees may be sprayed with endosulfan. Applications should be done twice - in June and in July- for at least 2 consecutive years to obtain control.

Cultural Controls: It is important to monitor for this pest.

*Alternative Control*s: A mating disruption pheromone is available in Canada for peach tree borer and appears to be an effective control method.

Cultivar Susceptibility: None identified.

Issues for Peach Tree Borer

1. Endosulfan is the only product registered for the control of this insect. There is concern over the potential loss of this material. Reduced risk alternatives are required.

American Plum Borer (*Euzohera semifuneralis*)

Pest Information

Damage: The American plum borer attacks both sweet and tart cherries and a number of other fruit and ornamental trees. Injury occurs when the American plum borer larvae feed on the cambium of the tree, usually in the trunk between the ground and the first

scaffold branches. Sap flow and frass at trunk wounds are signs of attack. Wounds often do not heal properly and trees can be weakened or even killed.

Life Cycle: Larvae overwinter beneath the bark within a silken cocoon called a hibernaculum that is formed during mid to late October. Larvae resume feeding in early spring as temperatures rise and begin pupating in early to mid-April. The first-brood, adult moths emerge in early May. Eggs are laid on the trunk near wounds. The insect has two generations per year. Second generation moths are present from July through September.

Pest Management

Chemical Controls: Pesticides must be applied with a hydraulic gun directed at the trunk at the white-bud or petal-fall stage on tart or sweet cherries, when the first generation adults are emerging. Some pesticides will provide seasonal control of first and second generations with a single application at the white-bud or petal-fall stage.

Cultural Controls: Pheromone traps may be used to monitor the insect. However, alternate host plants, especially near wooded areas, can interfere with trap catches.

Alternative Controls: None identified.

Cultivar Susceptibility: None identified.

Issues for American plum borer.

1. None identified.

Oriental Fruit Moth (*Grapholitha molesta*)

Pest Information

Damage: The Oriental fruit moth attacks primarily *Prunus* spp., but is also known to attack apple and pear. Depending on the host crop, the larvae feed on shoots and fruit.

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 newly emerging fruits 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 occur.

Pest Management

Chemical Controls: There are no pesticides registered for control of this pest.

Cultural Controls: None identified.

Alternative Controls: A pheromone is available to monitor male moths. In spring, new growth should be inspected for larvae or feeding damage. Growing tips and fruit should be monitored for larvae as the season progresses

Cultivar Susceptibility: None identified.

Issues for Oriental fruit moth

1. This pest does not occur in BC and is a quarantine pest. All species, hybrids, varieties, fruit and seed of apricot, nectarine, peach, plum and quince from any country or province of Canada where Oriental fruit moth occurs, requires fumigation prior to entry into British Columbia.
2. In Ontario, research on mating disruption trials for the control of Oriental fruit moth needs to be continued.

Shothole borer (*Scolytus rugulosus*)

Pest Information

Damage: Characteristic damage of the shothole borer is the presence of small holes at the base of buds and sometimes clear gum or resin exuding from entry holes. Larvae feeding on the cambium will create a network of tunnels under the bark.

Life Cycle: This pest overwinters as mature larvae or pupae in the host. 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, to produce the overwintering larval generation. Two generations occur per year. Hosts include native and cultivated trees. Shothole borer infestations are currently on the increase. Cherry trees are the preferred host. Migration into orchards occurs from forested and urban areas.

Pest Management

Chemical Controls: There are no registered controls for this pest.

Cultural Controls: Since shothole borers are attracted to weakened and dead trees, removing dead and weakened wood from the orchard and following practices that encourage tree vigour, will help reduce problems due to shothole borer.

Alternative Controls: Placing trap logs around the orchard and destroying the trap logs before adult emergence will help to control this insect.

Cultivar Susceptibility: None identified.

Issues for Shotholer borer

None Identified.

Ambrosia beetle (*Xyloborus dispar*)

Pest Information

Damage Caused: Larvae tunnelling in the sapwood of small branches kills sapwood, causing wilting and dieback of leaves and delayed emergence in the spring. Young trees may be girdled.

Life Cycle: Ambrosia beetles overwinter as adults in the host plant. Adults appear in April. After mating, adults tunnel into a host to lay eggs. Larvae are present from May to July (in BC) and tunnel in sapwood and into heartwood. Larvae feed on the ambrosia fungus that develops in the tunnels. New adults remain in the host to overwinter. One generation occurs per year. Hosts include native and cultivated trees.

Pest Management

Chemical Controls: There are no pesticides registered for the control of this pest.

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.

Alternative Controls: Ethanol-baited Lindgren Funnel Traps can be used to detect adults.

Cultivar Susceptibility: None identified.

Issues for Ambrosia beetle

1. None identified.

Table 6. Insect control products, classification and performance for Canadian Sweet Cherries production

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
azinphos-methyl (Guthion Solupak 50 WP)	organophophate insecticide	Acetylcholine esterase inhibitors; 1B	PO (Last date of use Dec. 31, 2007)	plum curculio	A	The product is of concern due to worker exposure. The re-entry interval is relatively long at 15 days. Growers are concerned about the loss of registration in 2007.
				cherry fruit fly	A	Used in place of dimethoate which is phytotoxic on new varieties. Provides good residual control but has a long re-entry period. Leaves no visible residues on fruit. Is broad spectrum, controls other pests and is harmful to beneficials.
***Bacillus thuringiensis* ssp. *Kurstaki* (Bioprotec 3P F)**	biological insecticide	Microbial disruptors of insect mid-gut membranes; 11B2	RR , RE	leafrollers	A	Is the chemical of choice as is the "softest" chemical. BT is non-toxic to workers and is not disruptive to beneficial insects including bees. Bioprotec is easily washed off by rain, breaks down under sunlight and has a short residue period.

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
carbaryl (Sevin Brand XLR)	carbamate insecticide	Acetylcholine esterase; 1A	RE	cherry fruit fly	A	Sevin is used in rotation with other insecticides. Sevin has the shortest pre-harvest interval of all products used for cherry fruit fly. There is concern regarding residues in some markets. Can be harmful to beneficials; also controls pear sawfly.
				black cherry aphid		
				mealy plum aphid		
				eye spotted bud moth		
				leafrollers (fruittree and redbanded)		
				plum curculio		
				scale insects		

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
diazinon (Diazinon 500 EC)	organophosphate insecticide	Acetylcholine esterase inhibitors: 1B	RE	black cherry aphid	A	Applied in June. Does not provide long residual or systemic control of aphids and re-infestation may occur. May be included with dormant oil in April for the prevention of black cherry aphid and apple mealybug infestations.
				mites		
				eyespotted bud moth	A	Diazinon applied for budmoth will also control leafrollers. There are market restrictions on the use of this product.
				fruittree leafrollers	A	Diazinon when applied in May is used primarily for leafroller control. Diazinon has a longer residual effect that other pesticides available for leafroller control.
				San Jose scale		
				cherry fruit fly	A	Residues of diazinon are restricted in some markets.

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
dicofol (Kelthane 50W)	unclassified	Compounds with unknown mode of action;	R	European red mite	A[P]	Dicofol is seldom applied for mite control, but may be used post harvest. Suspected resistance limits the use of this chemical (BC).
				Two spotted mite		
				McDaniel mite		
dimethoate (Cygon 480 -Ag systemic)	organophosphate insecticide	Acetylcholine esterase inhibitors; 1B	RE	black cherry fruit fly		
				western cherry fruit fly	A	Cygon has been the most effective insecticide for cherry fruit fly but causes phytotoxic effects on most varieties. Provides long residual control.

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
endosulfan (Endosulfan 400E, Thiodan 50WP)	Cyclodiene organochlorine insecticide	Gamma-aminobutyric acid (GABA)-gated chloride channel antagonists; 2A	RE	black cherry aphid, green peach aphid and mealy plum ahpid		
				eye spotted bud moth		
				leafhoppers		
				peachtree borer	A	A drench of Thiodan to tree trunks is recommended primarily for young trees.
				plum rust mite	A	Rust mites do not frequently reach treatment thresholds. Thiodan is the only effective insecticide registered for their control. Applications of Thiodan will also control black cherry aphid.
imidacloprid (Admire 240F)	Neonicotinoid insecticide	Acetylcholine receptor agonists / antagonists; 4A	R	black cherry fruit fly		
				western cherry fruit fly	A	Also controls aphids and provides locally systemic activity. Is not phytotoxic as are other insecticides for cherry fruit fly. Potentially increases mite populations. There are market restrictions on the use of this product.

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
malathion (Malathion 25W, Malathion 500E)	organophosphate	1B	R	mealy plum aphid / black cherry aphid		
				fruittree leafrollers		
dormant oil (Premium emulsifiable dormant oil spray)	mineral oil		R	European red mite	A	The use of dormant oil normally alleviates the need for summer sprays for European red mite control; not harmful to beneficials. Will prevent apple mealybug and San Jose scale infestations.
				Pear pysylla		
				San Jose scale		
pheromone (Isomate-P Pheromone	N/A;	N/A;	R	peachtree borer	A	Use is expected to increase; is non-disruptive to beneficials.
phosalone (Zolone Flo Insecticide)	organophosphate	Acetylcholine esterase inhibitors 1B	RE	black cherry aphid		Easy to handle. Growers are concerned about the future availability of effective materials, since this product is under review.
				plum curculio		
				cherry fruit fly	A	Used in rotation with other insecticides. Has shorter residue than azinphos-methyl.

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
spinosad (Success 480 SC, Entrust 80W)	Spinosyn insecticide	Nicotinic Acetylcholine receptor agonists (allosteric) (not group 4); 5	RR	eye spotted bud moth		Use is likely to increase. Has a shorter residue than other materials and leaves no visible residue on fruit. Also controls earwigs and leafrollers.
				leafrollers (oblique-banded, three-lined, fruittree, European)	A	Provides new chemistry for resistance management. Will also control cherry fruit fly and budmoth when applied for leafroller control. It is not disruptive to beneficial insects.

[1] Common trade name(s), if provided in brackets, are for the purpose of product identification only. No endorsement of any product in particular is implied.

[2]The classification and the mode of action group are based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*. The document is under revision and up-to-date information can be found on the following web sites: herbicides:http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; insecticides:http://www.irac-online.org/documents/moa/MoAv5_1.pdf ; fungicides:http://www.frac.info/frac/index.htm

[3] R-full registration (non-reduced risk), RE-under re-evaluation (yellow), DI (red) -discontinued by registrant, PO (red) - being phased out as a result of re-evaluation by the PMRA, BI-biological, RR-reduced risk (green), OP-organophosphate replacement, NR-not registered. Not all end-use products will be classed as reduced-risk. Not all end use products containing this active ingredient may be registered for use on this crop. Individual product labels should be consulted for up to date accurate information concerning specific registration details. The information in these tables should not be relied upon for pesticide application decisions. Consult individual product labels for specific registration details. The following website can be consulted for more information on pesticide registrations: http://www.eddenet.pmra-arla.gc.ca/4.0/4.0.asp

[4] Please consult the product label on the PMRA web site (http://www.eddenet.pmra-arla.gc.ca/4.0/4.0.asp) for specific listing of pests controlled by each active ingredient.

[5] A – Adequate (green) (the pest control product (PCP), according to recommended use, maintains disease below economic threshold OR provides acceptable control), A^p – Provisionally Adequate (yellow) (the PCP, while having the ability to provide acceptable control, possesses qualities which may make it unsustainable for some or all uses), I – Inadequate (red) (the PCP, according to recommended use, does not maintain disease below economic threshold OR provides unacceptable control)

[6]Sources: Crop profile focus groups for British Columbia and Ontario (2005).

Table 7. Availability and use of insect pest management approaches for Canadian Sweet Cherries production

	Practice \ Pest	Western cherry fruit fly	Eastern cherry fruit fly	Leafrollers (single generation)	Leafrollers (2 generation)	Aphids/ black cherry aphid	Plum curculio	MiteS	Apple mealybug	San Jose scale	Pear sawfly	Eyespotted bud moth	Peach tree borer	American plum borer	Oriental fruit moth	Shothole borer	Ambrosia beetle	Green fruitworm	Apple & thorn skeletonizer
Prevention	equipment sanitation																		
	mowing / mulching / flaming																		
	removal of alternative hosts (weeds/volunteers)																		
	row or plant spacing (plant density)																		
	seeding depth																		
	water / irrigation management																		
	crop residue removal / management																		
	pruning out / removal of infested material																		
Avoidance	resistant varieties																		
	planting / harvest date adjustment																		
	crop rotation																		
	choice of planting site																		
	use of pest-free seed																		
	optimizing fertilization																		
	reducing mechanical damage																		
	thinning / pruning																		
	trap crops / perimeter spraying																		
	repellents																		
Monitoring	scouting - trapping																		
	records to track pests																		
	soil analysis																		
	weather monitoring for degree day modelling																		
	grading out infected produce																		

	Practice \ Pest	Western cherry fruit fly	Eastern cherry fruit fly	Leafrollers (single generation)	Leafrollers (2 generation)	Aphids/ black cherry aphid	Plum curculio	MiteS	Apple mealybug	San Jose scale	Pear sawfly	Eyespotted bud moth	Peach tree borer	American plum borer	Oriental fruit moth	Shothole borer	Ambrosia beetle	Green fruitworm	Apple & thorn skeletonizer
Decision Making Tools	forecasting / degree day modelling for treatment decisions																		
	use of thresholds for treatment decisions																		
Suppression	biological pesticides																		
	environmental management (eg. as in greenhouses)																		
	pesticide rotation for resistance management																		
	soil amendments																		
	controlled atmosphere storage																		
	ground cover / physical barrier																		
	pheromones (eg mating disruption)																		
	sterile mating technique																		
	beneficial organisms & habitat management																		
	trapping																		

no information regarding the practice is available

available/used

available/not used

not available

Source(s): Crop Profile focus groups 2005 (British Columbia and Ontario).

Weeds

Key Issues

- There have been no weed management issues identified.

Table 8. Degree of occurrence of weed pests in Canadian Sweet Cherries production

	Degree of occurrence	
Weed	**BC**	**ON**
Annual grasses	E	E
Annual broadleaf weeds	E	E
Perennial grasses	E	E
Perennial broadleaf weeds	E	E

Widespread yearly occurrence with high pest pressure
Localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure
Widespread yearly occurrence with low to moderate pest pressure
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low to moderate pest pressure
Pest not present
E – established
D – invasion expected or dispersing
Source(s): Crop profile focus groups 2005 (British Columbia and Ontario)

Major and Minor Weeds

Annual and Perennial Weeds

Pest Information

Damage: Weeds compete with orchard trees for moisture and nutrients. Annual grass weeds that occur in sweet cherries include annual bluegrass, wild oats and barnyardgrass. Annual broadleaf weeds are common weeds in cherry orchards. The most important are the species whose seeds are not killed by soil fumigation, such as sweet clover.

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

Chemical Controls: Residual and non-residual herbicides are used to control orchard floor vegetation. The rotation of herbicides is dependent on the spectrum of weeds to be controlled.

Cultural Controls: Mechanical weeding, hand weeding, cover cropping and mulching are used to control weeds. Cover crops are grown between orchard trees and alleys as effective weed control, as well as protection from leaching and erosion. Mulches are occasionally used but are generally considered to be more expensive than herbicides. Early season weed control is used to minimize the impact of competition and reduce weed seed development. Tillage and cultivation are used only in the year prior to planting.

Alternative Controls: None identified.

Issues for Weeds

None identified

Table 9. Weed control products, classification and performance for Canadian Sweet Cherries production

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
bentazon (Basagran)	benzothiadiazinone	6	RE	Annual broadleaf weeds		
				Perennial broadleaf weeds		
dichlobenil (Casoron)	nitrile herbicide	20	R (Re-evaluation complete)	Annual grasses		
				Annual broadleaf weeds		
				Perennial grasses		
				Perennial broadleaf weeds		
fluazifop-p-butyl (Venture)	Aryloxyphenoxy propionates	1	R	Annual grasses		
				Quackgrass		
glyphosate (Touchdown, Roundup)	Glycines	Inhibition of EPSP synthase; 9	RR	Weeds	A	Glyphosate is the main systemic herbicide used in sweet cherry plantings (BC). Controls a broad spectrum of weeds. There is a risk of tree uptake through root suckers.
metribuzin (Sencor, Lexone)	triazinone herbicide	5	R (Re-evaluation complete)	Annual grasses		
				Annual broadleaf weeds		
				Perennial grasses (seedlings)		

Regulatory status as of May 8, 2006					Stakeholder comments[6]	
Control active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action – resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**	**Performance of product according to recommended use[5]**	**Notes**
paraquat; diquat (Gramoxone PDQ)	Bipyridyliums	Photosystem-1- electron diversion; photosystem-1-electron diversion; 22; 22	R (Re-evaluation complete); RE	Annual grasses	A[P]	Gramoxone is less phytotoxic than glyphosate via root sucker absorption. It has no systemic activity.
				Annual broadleaf weeds		
pendimethalin (Prowl)	dinitroaniline herbicide	Microtubule assembly inhibition; 3	RE	Annual weeds	A	Prowl provides residual activity against common weeds.
s-metolachlor (Dual Magnum)	Chloroacetamides	Inhibition of VLCFA's; 15	RR	Annual weeds	A	Provides residual control of common weeds.
sethoxydim (Poast Ultra)	Cyclohexanediones	1	R	Annual grasses		
				Perennial grasses		
2,4-D amine (2,4-D amine 500)	Phenoxy carboxylic acids	4	RE	Annual broadleaf weeds		
				Perennial broadleaf weeds		

[1] Common trade name(s), if provided in brackets, are for the purpose of product identification only. No endorsement of any product in particular is implied.

[2]The classification and the mode of action group are based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*. The document is under revision and up-to-date information can be found on the following web sites: herbicides:http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; insecticides:http://www.irac-online.org/documents/moa/MoAv5_1.pdf ; fungicides:http://www.frac.info/frac/index.htm

[3] R-full registration (non-reduced risk), RE-under re-evaluation (yellow), DI (red) -discontinued by registrant, PO (red) - being phased out as a result of re-evaluation by the PMRA, BI-biological, RR-reduced risk (green), OP-organophosphate replacement, NR-not registered. Not all end-use products will be classed as reduced-risk. Not all end use products containing this active ingredient may be registered for use on this crop. Individual product labels should be consulted for up to date accurate information concerning specific registration details. The information in these tables should not be relied upon for pesticide application decisions. Consult individual product labels for specific registration details. The following website can be consulted for more information on pesticide registrations: http://www.eddenet.pmra-arla.gc.ca/4.0/4.0.asp

[4] Please consult the product label on the PMRA web site (http://www.eddenet.pmra-arla.gc.ca/4.0/4.0.asp) for specific listing of pests controlled by each active ingredient.

[5] A – Adequate (green) (the pest control product (PCP), according to recommended use, maintains disease below economic threshold OR provides acceptable control), A^p – Provisionally Adequate (yellow) (the PCP, while having the ability to provide acceptable control, possesses qualities which may make it unsustainable for some or all uses), I – Inadequate (red) (the PCP, according to recommended use, does not maintain disease below economic threshold OR provides unacceptable control)

[6] Sources: Crop profile focus groups for British Columbia and Ontario (2005).

Table 10. Availability and use of weed pest management approaches for Canadian Sweet Cherry production

	Practice \ Pest	Annual grasses	Annual broadleaf weeds	Perennial grasses	perennial broadleaf weeds
Prevention	equipment sanitation				
	mowing / mulching / flaming				
	row or plant spacing (plant density)				
	seeding depth				
	water / irrigation management				
	weed management on non-crop lands				
	weed management in non-crop years				
	tillage / cultivation				
Avoidance	planting / harvest date adjustment				
	crop rotation				
	choice of planting site				
	use of weed-free seed				
	optimizing fertilization				
Monitoring	scouting				
	field mapping of weeds / record of resistant weeds				
	soil analysis				
	grading of grain / produce for weed contamination				
	visual field inspection				
Decision Making Tools	use of thresholds for treatment decisions				
Suppression	biological pesticides				
	habitat/ environment management				
	pesticide rotation for resistance management				
	soil amendments				
	ground cover / physical barriers				
	inter-row cultivation				
	mechanical weed control				

no information regarding the practice is available

available/used

available/not used

not available

Source(s): Crop Profile focus groups 2005 (British Columbia and Ontario).

Vertebrate Pests

Key Issues

- Acoustic deterrents for birds are problematic in inhabited areas.
- There are no safe biochemical repellents available for birds in Canada.
- There is concern over the lack of research on bird pests.

Deer, bears, birds and rodents are the primary vertebrate pests of cherry orchards. Cherry orchards are generally fenced at planting to protect the trees from ungulates such as deer (and elk in BC). The animals chew buds, spurs, shoots and leaves and trees that are damaged when they are young may not develop into commercially productive plants. Woven wire fences at least 2.4 m 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 include destroyed fruit as well as broken tree limbs. Birds such as starlings, robins and crows often attack cherries. Starlings, which cause the most severe damage, can cause serious crop loss.

Field mice *(meadow mice, meadow voles) (Microtus sp.)*

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

Chemical Controls: Registered active ingredients include diphacinone, chlorophacinone, and zinc phosphide. Tree trunks can also be treated with repellents containing thiram which discourages rodent feeding because of the taste.

Cultural Controls: Vegetation in and around the orchard is managed to discourage rodents. Maintaining a weed free strip within tree rows reduces mouse habitat. Physical barriers placed around tree trunks are occasionally used.

Alternative Controls: A number of wild predators help to keep the mouse population in check including hawks, coyotes, foxes and weasels.

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, cedar waxwings and gulls.

Life cycle:

Pest Management

There are four types of bird repellent methods currently available to growers:

- Acoustical repellents: Acoustical repellents rely on sound to scare birds away. Birds have a hearing range similar to humans. Therefore, acoustical repellents can be irritating to humans if used in populated areas.
- Visual repellents: Birds generally have very good eyesight and react to both movement and things that resemble their enemies (eg. osprey kites). However, visual deterrents are not as effective as acoustical ones and visual deterrents are usually used together with acoustical systems.
- Physical exclusion: Nets are either draped directly on top of the trees, or fastened to an overhead structure which totally encloses the orchard. However birds can often get under the netting and cause more damage when they cannot escape the enclosure.
- Biochemical repellents: currently, no products are registered in Canada for food use.

Once birds establish, they are difficult to deter from feeding on the crop. Controls must start early in the season. An integrated approach, using a variety of these repellent methods must be used.

Issues for Birds

1. Acoustic deterrents are problematic in inhabited areas.
2. There are no safe biochemical repellents available in Canada.
3. There is concern over the lack of research on bird pests.

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www.agf.gov.bc.ca

BC Fruit Growers' Association
Penny Gambell, President
http://www.bcfga.com/index.html

Canadian Horticultural Council
Ken Forth, President
http://www.hortcouncil.ca/chcmain.htm

External Web Link Connects From OMAF
http://www.gov.on.ca/OMAFRA/english/external_links/croplink.htm#Weeds

Factsheets, Newsletter Articles, Web Articles by subject category
http://www.gov.on.ca/OMAFRA/english/crops/hort/tender_fruit.html

Government of Newfoundland and Labrador Forest Resources and Agrifoods
www.gov.nf.ca/fra/

Manitoba Agriculture, Food and Rural Initiatives
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Ohio State University.
Keith L. Smith, Associate Vice President for Ag. Admin. and Director
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Prince-Edward Island Agriculture, Fisheries, Aquaculture and Forestry
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Saskatchewan Fruit Growers Association
Sandy Purdy, President
http://www.saskfruit.com/

University of California, Davis
Rick Melnicoe, Director
http://www.wrpmc.ucdavis.edu/index.html

Washington State University
Dr. Catherine H. Daniels, Director of Washington State Pest Management Resource Service
http://wsprs.wsu.edu/CropProfiles.html

Weed Biology
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Table 11. Research contacts related to pest management in Canadian Sweet Cherries production

Name	Organization	Pest type	Specific pests	Type of research
Cline, J.A.	University of Guelph, Ontario Agricultural College	Abiotic		Sustainable and economically viable orchard physiology and management systems for peach, cherry and plum
Miles, N.W.	University of Guelph, Ontario Agricultural College	Abiotic		Improvement of germplasm for peach, nectarine, plum and sweet cherry tree fruit crops
Zandstra, J.W.	University of Guelph, Ontario Agricultural College	Abiotic		Management and variety evaluation of fruit crops in southwestern Ontario
Rott, M	Canadian Food Inspection Agency, Sidney Laboratory	Disease, virus	Cherry rusty mottle disease	Development of RT-PCR diagnostic techniques for the detection of cherry rusty mottle disease
James, D	Canadian Food Inspection Agency, Sidney Laboratory	Disease, virus	Cherry rasp leaf disease	Optimization of detection and sequencing of RNA1 of the flat apple isolate of cherry rasp leaf virus to determine RT-PCR target efficiency (RNA1 vs RNA2)
Sanfacon, H.	Agriculture and Agri-Food Canada, Reesearch branch, Pacific Agri-Food Research Centre (Summerland)	Disease, virus	Several	Plant virus disease control
Vrain T, Lane W, Wiersma P	Agriculture and Agri-Food Canada, Research branch, Pacific Agri-Food Research Centre (Summerland)	Insect, nematode, abiotic	Several	Genetic regulation and engineering of horticultural crops, with emphasis on tree fruits and small fruit crops
Subramanian, J.	University of Guelph, Ontario Agricultural College	Abiotic		Genetic improvement of tree fruit crops (Prunus spp) through conventional and biotechnological approaches
Bowley, S.	University of Guelph, Ontario Agricultural College	Abiotic		Application of SSR markers for DNA fingerprinting of Prunus and Fragaria varieties
McFadden-Smith, W.	URMULE	Insect, disease	Mites	Pyramite (pyridaben) label expansion, product registration

Name	Organization	Pest type	Specific pests	Type of research
Carter, Neil	Ontario Ministry of Agriculture and Food (OMAF)	Disease, weed, insect		IPM Specialist
Celetti, Michael	Ontario Ministry of Agriculture and Food	Disease		Pathology Program Lead
DeEll, Jennifer	Ontario Ministry of Agriculture and Food			Fresh Market Quality Program Lead
Fraser, Hannah	Ontario Ministry of Agriculture and Food	Insect		Entomology Program Lead
Fraser, Hugh	Ontario Ministry of Agriculture and Food			Horticulture Engineer
Huffman, Leslie	Ontario Ministry of Agriculture and Food	Weed		Weeds Program Lead
Huisman, Adrian	Ontario Tender Fruit Producers Marketing Board (OTFPMB)			CEO
Ker, Kevin	Private Consultant			Private Consultant
Kessel, Christoph	Ontario Ministry of Agriculture and Food			Plant Nutrition
Lay, William (Bill)	University of Guelph			Sweet Cherry Breeding Program technician
Leenaars, Audie	Ontario Fruit Testing Association (OFTA)			
Luffman, Margie	Agriculture and Agri-Food Canada (AAFC)			
Pree, David, J.	Agriculture and Agri-Food Canada	Insect		Research Entomology
Roberts, Wayne	Ontario Tender Fruit Producers Marketing Board	Disease, insect, weed		Pesticides Co-ordinator

Name	Organization	Pest type	Specific pests	Type of research
Slingerland, Ken	Ontario Ministry of Agriculture and Food	Disease, insect, weed		Tender Fruit and Grape Specialist
Stobbs, Lorne	Agriculture and Agri-Food Canada	Virus		Research Virology
Verhallen, Anne	Ontario Ministry of Agriculture and Food			Soil Management Specialist
Gambell, Penny	BC Fruit Growers Association			President
Jesperson, Gayle	BCMAFF	Disease		plant pathologist for tree fruit
Philip, Hugh	BCMAFF	Insect		entomologist for tree fruit
Campbell, Jim	BCMAFF			tree fruit crop specialist
Sholberg, Peter	Pacific Agri-Food Research Centre (Summerland)	Disease		plant pathology
Bedford, Karen	Pacific Agri-Food Research Centre (Summerland)	Disease		plant pathology research assistant
Bernardy, Mike	Pacific Agri-Food Research Centre (Summerland)	Virus		virology and molecular biology
French, Chris	Pacific Agri-Food Research Centre (Summerland)	Virus		virology and molecular biology
Rochon, Diane	Pacific Agri-Food Research Centre (Summerland)	Virus		virology and molecular biology
Thistlewood, Howard	Pacific Agri-Food Research Centre (Summerland)	Insect	Cherry fruit fly	Research entomology
Thiessen, Waldo	Prairie Fruit Growers' Association			President