Crop Profile for Pear in Canada, 2016

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Preface

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

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

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

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

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

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Contents

List of Tables and Figures

Crop Profile for Pear in Canada

Pears (*Pyrus* spp.) are members of the Rosaceae (rose) family. Pears are native to Europe and Asia and have been cultivated for thousands of years.

The European or common pear, *Pyrus communis* subsp. *communis* is the species most commonly grown in North America. Grown in Europe since the 15th century, many cultivars have been developed. This type of pear was introduced into North America during the 17th century by European settlers. In Nova Scotia, French settlers planted pears following the establishment of Port Royal in 1604. In the 18th century, Jesuit Missionaries brought a pear variety from France, which was later called the 'Jesuit Pear' and it was distributed among French-speaking settlers in Ontario and the Northern United States. This rustic cultivar is known to carry important genetic material still sought after by breeders.

Crop Production

Industry Overview

Pears produced in Canada are mainly consumed fresh or processed into other fruit products including juice, preserves, canned or frozen pears and also baby food. Pears are a source of Vitamin A and B, phosphorus and iodine.

Canadian pear production acreage is declining in recent years in favour of production of fruits such as high-bush blueberries and high-density apple orchards. Canadian pear production was valued at 9.1 Million dollars in 2016. However, imports of fresh and processed pears greatly exceed Canadian production levels being valued at 129 Million dollars (Table 1).

Fire blight is still the most serious threat to pears. This bacterial disease not only reduces pear yields but also kills pear trees, and may be a significant factor in the decline in pear orchard acreage. Newer pear cultivars developed in Canada have increased resistance to fire blight compared to Bartlett pears.

Table 1. General production information, 2016

	Pear
Canadian production[1]	8,285 metric tonnes 895 hectares
Farm gate value[1]	$9,081 Million
Fruit consumption[2]	1.93 kg/ person (fresh) 0.19 kg/ person (processed)
Exports	Pear (fresh[3]): $0.47 Million Pear (processed[4]): $0.06 Million
Imports	Pear (fresh[3]): $117.1 Million Pear (processed[4]): $11.5 Million

[1] Source: Statistics Canada. Table 32-10-0364-01 (formerly CANSIM 001-0009) - Area, production and farm gate value of fresh and processed fruits, by province (database accessed: 2018-10-05).

[2] Source: Statistics Canada. Table 32-10-0054-01 (formerly CANSIM 002-0011) - Food available in Canada (database accessed: 2018-10-05).

[3] Source: Statistics Canada. Canada. Trade Data Online (Report). HS # 080830 - Fresh pears (database accessed: 2018-10-05).

[4] Source: Statistics Canada. Canada. Trade Data Online (Report). HS # 200840 - Pears o/w Prepared or preserved, whether or not sugared, sweetened or spirited (database accessed: 2018-10-05).

Production Regions

Commercial pear production is located in the Okanagan and Kootenay Valleys of the British Columbia interior, and the Niagara Peninsula and Norfolk County of Ontario. Some pears are also produced in the Annapolis Valley of Nova Scotia and the Montérégie region of Quebec.

In 2016, Ontario had the largest acreage with 510 ha of pear trees or 57% of the total national acreage, followed by British Columbia (259 ha or 29%). Quebec had about 72 ha (8%) and Nova Scotia had 44 ha (5%), see Table 2. Interestingly, despite its smaller acreage, British Columbia had a larger volume of production (4,980 metric tonnes or 60%) compared to Ontario which had a production of 2,741 metric tonnes (33%) for a value of 4.4 Million dollars. This apparent discrepancy might be explained by a greater acreage of more productive high-density orchards in British Columbia compared to Ontario. Also, the larger farm gate value observed in Ontario, despite a lower production compared to British Columbia, might be attributable to a higher share of the more valuable fresh fruit market, whilst British Columbia produce a larger volume of pear on a smaller acreage for the less lucrative processing market.

Table 2. Distribution of pear production in Canada, 2016

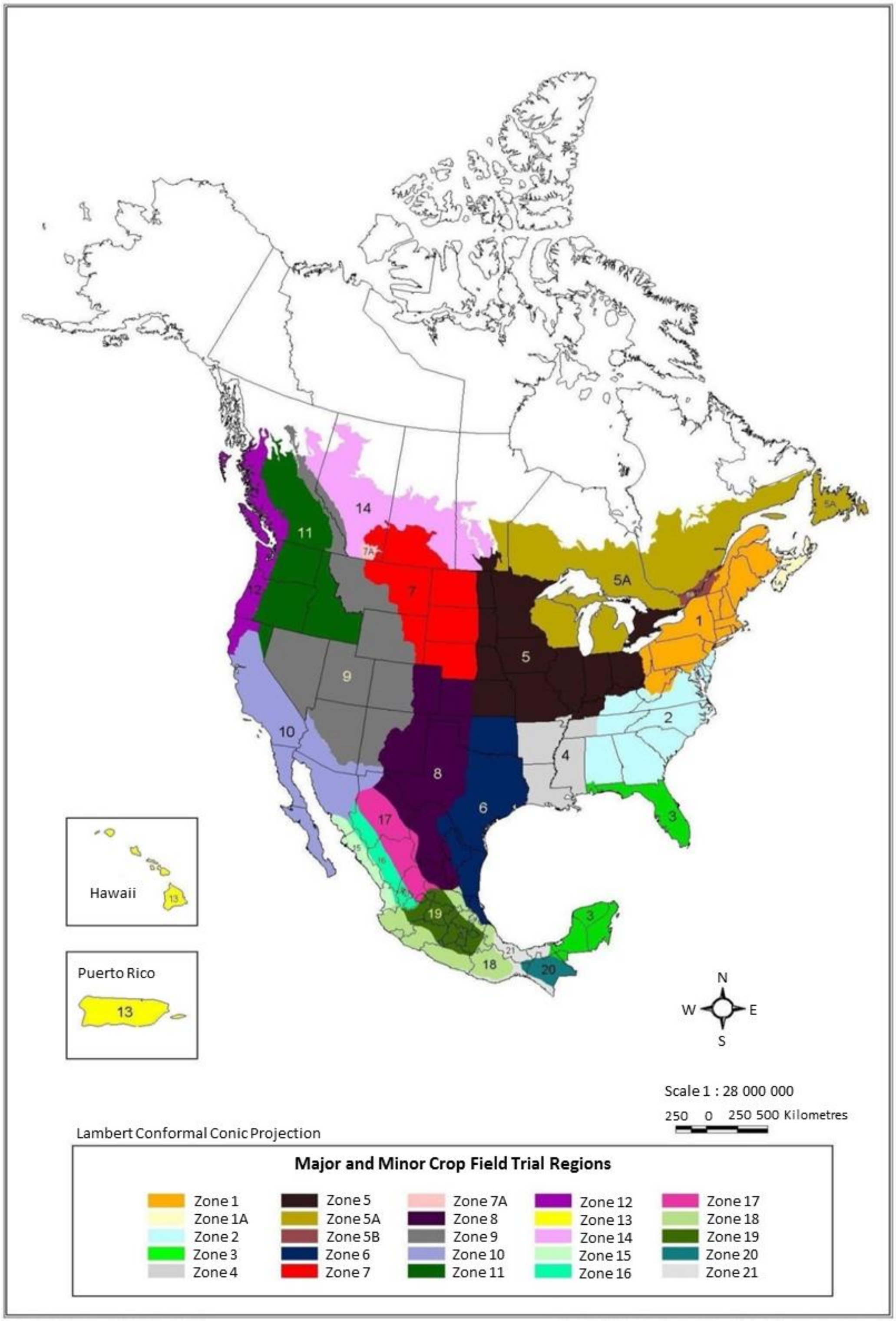
Production Regions	Cultivated area[1] (hectares) and percentage (%)	Marketed production[1] (metric tonnes) and percentage (%)	Farm gate value[1] ($)
British Columbia	259 ha (29%)	4,980 m. t. (60%)	$3.9 Million
Ontario	510 ha (57%)	2,741 m. t. (33%)	$4.4 Million
Quebec	72 ha (8%)	318 m. t. (4%)	$0.6 Million
Nova Scotia	44 ha (5%)	200 m. t. (2%)	$0.2 Million
Canada	895 ha	8,285 m. t.	$9.1 Million

[1] Source: Statistics Canada. Table 32-10-0364-01 (formerly CANSIM 001-0009)-Area, production and farm gate value of fresh and processed fruits, by province (database accessed: 2018-10-05).

North American major and minor field trial regions

The major and minor crop field trial regions were developed following stakeholder consultation and are used by the Pest Management Regulatory Agency (PMRA) in Canada and the United States (US) Environmental Protection Agency (EPA) to identify the regions where residue chemistry crop field trials are required to support the registration of new pesticide uses. The regions are based on a number of parameters, including soil type and climate but they do not correspond to plant hardiness zones. For additional information, on field trial regions and requirements, please consult the PMRA Regulatory Directive 2010-05 "*Revisions to the Residue Chemistry Crop Field Trial Requirements*" (www.hc-sc.gc.ca/cps-spc/pubs/pest/_pol-guide/dir2010-05/index-eng.php).

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



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

Cultural Practices

Pear trees are long-lived and can produce fruit for over 100 years. Pears grow best in areas with mild winters and warm growing conditions. While pear trees can withstand temperatures of -25°C without serious injury, temperatures below -30°C can cause long term damage. Trees fare best when planted in areas with little wind, a slight grade and a soil depth of at least one meter. Pear trees grow in many types of soil however sandy loam and clay loam are considered to be ideal. Pears are sensitive to wet soil conditions, so good drainage is important. The flower buds and fruit are sensitive to frost. Planting pear trees on a slope helps to reduce the risk of frost damage and improves drainage. Generally speaking, pear trees will not produce fruit unless they are pollinated with pollen from a complementary pollinating variety. That said, there are a few varieties that self-pollinate, such as the cultivar Duchess. Unlike some other fruits, pears are harvested by hand before ripening.

Clapp's Favorite, Bartlett, Flemish Beauty, Bosc and Anjou are the main pear cultivars grown in Canada. In Ontario, the main fresh market cultivars are Bartlett, Bosc and the fire blight resistant cultivar Cold Snap. Bartlett is the main processing cultivar for canned fruit. Swiss Bartlett, French Bartlett, Clapp's Favourite, AC Harrow Crisp and AC Harrow Gold are also used for processing.

Table 3. Pear production and pest management schedule in Canada

Time of Year	Activity	Action
Winter-dormancy (December to late March)	Plant Care	Winter prune trees; apply nitrogen and zinc sulphate (B.C.); spray if needed.
	Soil Care	Prepare sites of new plantings; apply lime if needed.
	Disease Management	Prune off shoots that have white tips (mildew) and cankers. Remove and burn any fire blight infected material that remains in the orchard.
	Insect Management	Apply delayed dormant oil spray for aphids, scale and mite eggs. At pruning, check tops of trees for presence of scale insects.
	Other	Apply rodenticides, as needed.
Spring-green tip to fruit set (late March to May)	Plant Care	Finish pruning trees; plant and prune new trees; install tree supports and begin training new trees; apply foliar nutrients as needed; place bees in fields when blossom begins; apply blossom thinning sprays; irrigate as needed; begin fertigation in established stands (in B.C.); apply post-bloom chemical thinners.
	Soil Care	Fertilize new trees; apply soil nutrients as needed; apply lime if needed.
	Disease Management	Monitor for scab, fire blight and powdery mildew infections; apply controls if needed.
	Insect Management	Apply oil spray for mite eggs reaching 13 mm (1/2 inch) in green to tight cluster; oil is also the preferred strategy for scale insect control; set out and monitor pheromone traps for moth pests (e.g. codling moth, oriental fruit moth); begin monitoring for spring-feeding caterpillars, pear psylla, mullein bug, plum curculio, mites, aphids, leafhoppers and beneficial arthropods; apply controls as needed.
	Weed Management	Monitor for weeds and apply controls if needed. Apply pre-emergent herbicides before June.
Summer – fruit growth (June to August)	Plant Care	Apply supplemental nutrient sprays as needed; irrigate as needed; begin fertigation of new trees (in B.C.); hand thin fruit; apply calcium for bitter pit and other calcium deficiencies if needed; have leaf analyses performed; continue training young trees; apply growth regulator to prevent drop as needed; monitor fruit maturity; summer prune and sucker removal, if needed.
	Soil Care	Apply boron if needed; take soil samples.
	Disease Management	Continue monitoring for scab and other diseases; prune out wood with cankers and fire blight; treat for pinpoint scab.
	Insect Management	Control codling moth as needed; continue monitoring for leafrollers, codling moth, apple maggot, pear psylla, mites, aphids, leafhoppers and beneficial organisms; begin monitoring for scales; apply controls as needed.
	Weed Management	Monitor for weeds and apply controls if needed. Mow sod and maintain alleyways.
	Other	Monitor for bird damage and use control measures if needed.
Fall – harvest period (September to November)	Plant Care	Harvest pears; irrigate as needed after harvest; remove dead, weak or diseased trees.
	Soil Care	Fumigate sites of new plantings as needed; take soil samples. Cover crops may offer an alternative to fumigation.
	Pest management	Fruit harvest assessment; examine cull fruit to help plan next year's pest control programs, e.g. any pest contributing to more than 2% of cull fruit requires a control strategy; apply rodenticides. Prune out, remove and burn shoots visibly affected by fire blight.

Abiotic Factors Limiting Production

Environment

Environmental conditions that affect pear growth include wind, shade and frost. High winds and excessive shade can adversely affect tree growth, fruit quality and production. Limb rubbing can downgrade fruit while hail and high winds can result in substantial losses. Late spring frost can destroy developing flower buds, whereas early autumn frost can damage fruit, rendering it unmarketable.

Harvest and Storage Conditions

Pears are harvested by hand for the fresh and processing market. Pears are picked before they ripen, at the mature green stage. Harvesting and storage of immature fruit will result in shriveling and the failure of the fruit to ripen while the storage of over mature fruit will result in internal breakdown. To increase the storage life of pears, they are typically stored at temperatures of -1°C to -0.5°C as quickly as possible after harvest. Delayed storage accelerates the ripening process. Pears can freeze at temperatures as high as -2.2°C, rendering them unmarketable.

Pears are prone to damage during harvesting and packing. Fruit stems may wound the skin of adjacent fruit. Puncture wounds make the fruit extremely susceptible to decay and also fungal or bacterial infection. Undamaged pears are also susceptible to fungal and bacterial rots if stored for prolonged periods of time. Decay and infections can be reduced by improved packing house sanitation.

Diseases

Key issues

Integrated pest management (IPM)

- Streptomycin is an important tool for the management of fire blight in pear (and apple) orchards. The potential loss of this disease management product through re-evaluation by PMRA and through resistance development is of concern to growers. The registration of new bactericides for fire blight management, and the evaluation of materials such as phosphorous acid and biopesticides is required.

- Additional research, development, and commercialization of fire blight resistant rootstocks and pear varieties are required.

Emerging Issues

- There is a need for the registration of fungicides for the management of pear trellis rust.

New disease management products

- There is a need for the registration of bactericides for the management of pear blossom blast.
- The registration of new classes of fungicides is required for early season scab management, including fungicides with multi-site activity. For resistance management programs to be effective there is a need to maintain registrations of multi-site materials for early-season scab control.

- Additional products are required for the management of post-harvest diseases of pear.

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

Disease	British Columbia	Ontario
Fire blight		
Pear blossom blast		
Pear scab		
Powdery mildew		
Trellis rust		
Phytophthora diseases		
Sooty blotch and flyspeck		
Sooty mould		
Pear stony pit		
Storage diseases		
Blue mould		
Grey mould		
Snow mould rot		
Widespread yearly occurrence with high pest pressure.		
Widespread yearly occurrence with moderate pest pressure OR localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure.		
Widespread yearly occurrence with low pest pressure OR widespread sporadic occurrence with moderate pressure OR sporadic localized occurrence with high pest pressure.		
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low pressure OR localized sporadic occurrence with low to moderate pest pressure OR pest not of concern.		
Pest is present and of concern, however little is known of its distribution, frequency and pressure.		
Pest not present.		
Data not reported.		

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

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

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

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

...continued

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

	Practice / Pest	Fire blight	Pear scab	Powdery mildew	Pear blossom blast (bacterial)
Decision making tools	Economic threshold				
	Use of predictive model for management decisions				
	Crop specialist recommendation or advisory bulletin				
	Decision to treat based on observed disease symptoms				
	Use of portable electronic devices in the field to access pathogen / disease identification / management information				
Suppression	Use of diverse product modes of action for resistance management				
	Soil amendments and green manuring involving soil incorporation as biofumigants, to reduce pathogen populations				
	Biopesticides (microbial and non-conventional pesticides)				
	Controlled atmosphere storage				
	Targeted pesticide applications (banding, spot treatments, use of variable rate sprayers, etc.)				
	Selection of pesticides that are soft on beneficial insects, pollinators and other non-target organisms				
This practice is used to manage this pest by at least some growers.					
This practice is not used by growers to manage this pest.					
This practice is not applicable for the management of this pest.					
Information regarding the practice for this pest is unknown.					

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

Fire Blight *(Erwinia amylovora)*

Pest Information

Damage: Fire blight is one of the most destructive bacterial diseases of pear trees in North America. The disease can affect blossoms, shoots, limbs and fruit. Symptoms vary with the part of the tree attacked and the time during the growing season that infection occurs and as a result may be difficult to diagnose. Infected blossoms and shoots become wilted, shrivelled and brown and the infected shoots may develop a characteristic shepherds crook. Infected fruitlets first appear water soaked and off-color then eventually turn brown to black and shrivel up.

Life Cycle: Fire blight overwinters in cankers that were formed on diseased branches the previous year. The bacterium becomes active in the spring as temperatures warm up and can be spread to healthy blossoms by rain splashing, pollinating insects and on pruning tools. Fire blight can move from infected blossoms and shoots into branches and trunks, eventually giving rise to cankers which can girdle the affected tissues. Insects are attracted by the ooze of bacterial cells can also disseminate the bacteria from canker to flowers.

Pest Management

Cultural Controls: Cultural controls include removing infected wood (cankers) during dormancy and pruning out summer shoot infections, at least 30 to 40 cm below visible signs of infection. The sterilization of pruning tools with bleach or denatured alcohol between each cut will prevent spread of the bacterium via pruning. The removal of secondary blossoms, which are very susceptible to infection, and of hosts near pear orchards helps to reduce infection. Ensuring that nursery stock is free from disease minimizes the potential of introducing fire blight into the orchard. Weekly monitoring will enable the early detection of the disease. Several epidemiological models (e.g., COUGARBLIGHT, MARYBLYT) predict the likelihood of blossom blight epidemics based on observed climatic conditions. The models can be used to aid decisions on the need for and timing of chemical applications. Following balanced fertilizer programs that include potassium and micronutrients and avoid excessive nitrogen can render a tree less susceptible to fire blight by minimizing the growth of succulent shoots that are very susceptible to fire blight infection.

Resistant cultivars: In British Columbia: Seuri, Shinko, Singo. In Ontario: AC Harrow Crisp, AC Harrow Gold, Harrow Delight, Harvest Queen and Harrow Sweet are resistant to fire blight. Varieties that are more susceptible include: Hosui, Shinseiki and also, Anjou, Barlett, Bosc, Flemish Beauty, and Starkrimson.

Issues for Fire blight

1. Streptomycin is an important tool for the management of fire blight in pear (and apple) orchards. The potential loss of this material through re-evaluation by PMRA and through resistance development is of concern to growers. The registration of new bactericides is required. The evaluation of materials such as phosphorous acid and biopesticides would be of benefit.
2. There is a need for the development of additional fire blight resistant cultivars.

3. Predictive models need refining to more accurately predict fire blight infection events in resistant cultivars.

Pear Blossom Blast (*Pseudomonas syringae* pv. *syringae*)

Pest Information

Damage: Blossoms and fruit buds become blackened and eventually die. Early stages can resemble fire blight. Black spots develop on leaves and fruits. Yield can be severely reduced.

Life Cycle: Infections caused by *Pseudomonas syringae* pv. *syringae* bacterium that exist on the surface of plant tissues, are more prevalent during cool, wet, spring weather. Tissues injured by cold temperatures and frost in the spring are most susceptible to infection, although the disease can be active all season. Proteins produced by the bacterium facilitate ice crystal formation, rendering plant tissues more susceptible to freezing injury and predisposing them to invasion by the bacterium.

Pest Management

Cultural Controls: Blossom blast can best be prevented by reducing the potential for frost damage by establishing orchards on sites with good air drainage or through the use of wind machines. The removal of affected tissues by pruning will reduce the amount of inoculum in the orchard.

Resistant cultivars: Cultivars more susceptible to blossom blast include Anjou and Bosc.

Issues for Pear Blossom Blast

1. There is concern that the incidence of pear blossom blast may rise with the increase in planting of fire blight resistant pear cultivars and the decrease in fire blight sprays that provided incidental control of pear blossom blast. There are no registered control products for blossom blast. There is a need to seek new registrations of bactericides against this disease.

Pear Scab *(Venturia pirina)*

Pest Information

Damage: Pear scab lesions can develop on leaves, fruit and shoots. Young lesions appear as velvety, pinpoint spots. Lesions on the fruit begin at the calyx end and then spread to the sides of the fruit. As the lesions enlarge, they become dark brown to black and coalesce. Heavily infected fruit may become deformed, cracked and unmarketable. Heavily infected leaves and fruit may drop. Twig infections are common. They begin as brown, velvety spots but then develop into corky, cankered areas.

Life Cycle: Scab overwinters in fallen leaves and within corky lesions on twigs. In the spring, ascospores (sexual spores) are produced within fungal fruiting bodies in infected tissues, then they are released and give rise to new infections. Infection periods begin in the spring during the green tip stage of development. Conidia (asexual spores) are produced within new lesions and are spread by splashing rain and wind, resulting in secondary spread of the disease. Late season infections may develop into pinpoint scab in storage.

Pest Management

Cultural Controls: Monitoring for scab from bud break until mid to late July will help determine the necessity and timing of sprays. Disking to cover leaf litter, where feasible, may reduce infection in the spring. Pruning of infected twigs may also be beneficial. The removal of unmanaged, host trees near pear orchards will remove a source of inoculum of the disease.

Resistant cultivars: Cultivars are available that are less susceptible to scab. Flemish Beauty and Seckel are highly susceptible to the disease.

Issues for Pear Scab

1. Pear scab resistance to systemic materials is of concern. Registration of new classes of fungicides for early season scab management is required. For resistance management programs to be effective there is a need to ensure access to materials with multi-site mode of action and for early-season scab control.

Fabraea Leaf Spot (*Fabraea maculata*)

Pest Information

Damage: Fabraea leaf spot attacks petioles, leaves, shoots and fruits of pear. Early symptoms on leaves are tiny, round, purplish-black spots, which quickly enlarge to 3 to 6 mm in diameter. Spots coalesce and severely infected leaves fall prematurely. Premature defoliation can result in undersized fruit and a failure of fruit buds to set for the following year. Fruit lesions are larger than those on leaves and cause the fruit to crack and drop. Small, inconspicuous lesions may develop on current season's shoots; however, these usually do not persist into the following growing season.

Life Cycle: The disease overwinters in infected leaf litter and first-year twig cankers. Conidia (asexual spores), produced in infected tissues, are spread by splashing water from rains or overhead irrigation. Wetting periods for infection may vary from 8 to 12 hours at temperatures of 10° to 25°C. The disease may advance rapidly in late summer as wind and rain distribute the conidia throughout the tree canopy. Foliage of all ages is susceptible to infection and under suitable conditions the disease can continue to spread throughout the season.

Pest Management

Cultural Controls: The elimination of fallen leaves from the orchard and mowing of fallen leaves to facilitate decomposition, will reduce a source of overwintering disease. Disease levels in the orchard can be monitored by the examination of the lowest leaves on individual ‘sample’ trees. One to ten infection sites and more than ten infections per 20 leaves, represent moderate and high risk, respectively.

Resistant cultivars: None available.

Issues for Fabraea Leaf Spot

None identified.

Powdery Mildew *(Podosphaera leucotricha)*

Pest Information

Damage: Powdery mildew produces a white powdery growth on new shoots and developing fruit. On pears, powdery mildew leaves black and russeting marks on the surface of young fruits and may render the fruit unmarketable.

Life Cycle: Pear are infected by *Podosphaera leucotricha* spread from infected apple orchards or neighbouring apple blocks. The spores (conidia) are dispersed by air currents and are favoured by warm temperatures. Powdery mildew is also favoured by moderate temperatures (10-25 °C) and high relative humidity, and does not overwinter in pear buds, as it does on apple. In the spring, primary infections develop on blossoms, young leaves and fruits. Infected tissues give rise to the white powdery fungal growth with spores that are dispersed to other tissues and cause secondary spread. Under suitable conditions, there can be several disease cycles during a season.

Pest Management

Cultural Controls: Pruning out twigs with white fungus growth is beneficial and provide better air circulation within the orchard. Avoiding areas with poor air circulation when establishing an orchard help to minimize powdery mildew development.

Resistant cultivars: None identified.

Issues for Powdery Mildew

None identified.

Trellis Rust (*Gymnosporangium sabine*)

Pest Information

Damage: Trellis rust causes bright yellow-orange spots on the surfaces of pear leaves, fruit and twigs. Within leaf spots, fruiting bodies develop on both upper and lower surfaces, with those of the lower surface becoming blister-like and eventually developing spores that infect juniper, the required second host, in the fall.

Life Cycle: Both pear and juniper hosts are required for the complete life cycle of trellis rust. Spores produced in gelatinous growths on juniper branches infect pear tissues resulting in the yellow-orange spots. In the fall, spores produced within the leaf spots on pear are windblown to susceptible juniper hosts where they cause infection. The disease overwinters on juniper.

Pest Management

Cultural Controls: The removal of juniper hosts within 1 to 2 km of the orchard or pruning out of swellings and galls on juniper, will break the disease cycle.
Resistant cultivars: None identified.

Issues for Trellis Rust

1. There is a need for further investigation on the biology, epidemiology and impact of trellis rust on pear.
2. There is a need for the registration of fungicides for the management of pear trellis rust.

Phytophthora Diseases: Crown, Root and Collar Rots (*Phytophthor*a spp.)

Pest Information

Damage: Phytophthora spp. cause sunken cankers on the lower trunk and roots of pear. Cankered tissues develop an orange-brown decay with a distinct margin. Young trees with smaller root systems may be killed within a few weeks while larger trees decline over a number of years. Chronically affected trees exhibit purple discolouration of foliage in the fall and premature leaf drop.
Life Cycle: The disease is more prevalent under conditions of excessive soil moisture and poor drainage. Phytophthora persists in orchard soils and in infected plant tissue. Under suitable moisture conditions, the fungus produces sporangia which give rise to motile zoospores which “swim” to susceptible tissues where they cause infection.

Pest Management

Cultural Controls: Avoiding planting sites with poorly drained soils and those prone to excessive wetness, will reduce the chances of phytophthora crown and root rot development.
Resistant cultivars: None identified.

Issues for Phytophthora Crown, Root and Collar Rots

None identified.

Sooty Blotch *(Gloeodes pomigena)* and Flyspeck *(Schizothyrium pomi)*

Pest Information

Damage: Sooty blotch and flyspeck cause losses by reducing fruit quality. Sooty blotch produces circular, olive green colonies with irregular margins on the surface of mature fruit, which may eventually cover a large proportion of individual fruits. Flyspeck produces circular groups of black shiny specks on the fruit surface.

Life Cycle: The sooty blotch fungus overwinters on infected twigs of apple and other woody plants. In the spring and early summer, spores are dispersed by rain to susceptible tissues. There are extensive secondary infections throughout the season. Flyspeck overwinters on twigs of a number of woody hosts outside the orchard. Ascospores (sexual spores) are released in the spring and cause primary infections on fruit and stem tissues. Conidia (asexual spores) produced in infected tissues are dispersed by air currents and cause secondary infections later in the season.

Pest Management

Cultural Controls: Pruning to improve air circulation in the tree canopy will help reduce disease incidence and severity. Thinning of fruit will also help reduce the development of these diseases.

Resistant cultivars: None identified.

Issues for Sooty Blotch and Flyspeck

None identified.

Pear Stony Pit (unidentified virus)

Pest Information

Damage: The severity of symptoms varies with cultivar. On susceptible cultivars such as Bosc, pits up to 6 mm deep develop in fruit. A stone-like mass develops at the base of each pit. Growth stops in affected tissues and the continued development of other parts of the fruit results in deformities, sometimes rendering fruits unmarketable. Leaves may exhibit vein banding and mottling or scabby spots may develop on the bark of young trees.

Life Cycle: Propagation methods such as grafting, budding and cuttings are known to transmit the disease, however the causal agent and its biology have not yet been determined.

Pest Management

Cultural Controls: Sanitation practices, including the use of virus-free planting and propagation stock, will reduce the chances of introduction and spread of the virus in the orchard. Removing trees showing virus symptoms will prevent other trees from becoming infected.

Resistant cultivars: Pear cultivars vary in their susceptibility to this disease with Bosc being the most susceptible.

Issues for Stony Pit

None identified.

Storage diseases: Blue Mould *(Penicillium expansum),* Grey Mould *(Botrytis cinerea)* and Snow Mould Rot *(*Low Temperature *Basidiomycete*)

Pest Information

Damage: Blue mould causes a soft, watery decay of pears in storage. There is a sharp line of demarcation between rotted and healthy tissues. Grey mould decay often begins at the calyx or stem ends of the fruit. Fruit infected by snow mould rot have dark brown spots of various sizes that are slightly sunken and sometimes have white mycelium near the centre of the lesion. Fruit with physical injury or that has been stored for prolonged periods, is more prone to decay.

Life Cycle: Blue mould infections can arise under suitable environmental conditions from spores on the surface of fruit or present in the packing house on decaying fruit. , In the orchard, botrytis grows and sporulates on dead and dying plant tissues and can establish itself on the stem and calyx extremities of the pears at harvest. Dump water (water used to move pears during packing and grading) may become contaminated through soil and crop debris in the harvest bins and result in fruit infections of snow mould rot and other pathogens. Under suitable conditions, infections may spread in storage through mycelial growth (botrytis and snow mould rot) and spore production. High humidity and delays in cooling fruit after harvest increase the chance of storage disease infections.

Pest Management

Cultural Controls: Careful handling, rapid cooling and prompt storage at harvest will help to minimize storage rots as the potential for infection is increased with wounding, high humidity and delays in cooling after harvest. The culling of damaged fruit prior to storage will reduce storage rot. Frequent changing of dump tank water (water used to move pears during packing and grading) is important as is following good sanitation measures in the handling and processing areas.

Resistant Cultivars: All pear varieties are susceptible.

Issues for Storage Diseases

1. Alternative products to thiabendazole are required for post-harvest disease control.

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

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

Table 6. Fungicides, bactericides and biopesticides registered for disease management in pear production in Canada

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
Agrobacterium radiobacter, strain K84	21106	biological	N/A	unknown	unknown	R
Aureobasidium pullulans DSM 14940 and DSM 14941	30552	biological	N/A	unknown	unknown	R
Bacillus amyloliquefaciens strain D747 (synonym to *B. subtilis)*	31887, 31888	biological	N/A	unknown	unknown	R
Bacillus subtilis, strain QST 713	28549, 31666, 33035	microbial: *Bacillus* spp. and the fungicidal lipopeptides they produce	44	F6: lipid synthesis and membrane integrity	microbial disrupters of pathogen cell membranes	R
benzovindiflupyr	31522, 31981	pyrazole-4- carboxamide	7	C2: respiration	complex II: succinate dehydrogenase	R
benzovindiflupyr + difenoconazole	31526	pyrazole-4- carboxamide + triazole	7 + 3	C2: respiration + G1: sterol biosynthesis in membranes	complex II: succinate dehydrogenase + C14-demethylase in sterol biosynthesis (erg11/cyp51)	R + RE
boscalid + pyraclostrobin	27985	pyridine-carboxamide + methoxy-carbamate	7 + 11	C2: respiration + C3: respiration	complex II: succinate-dehydrogenase + complex III: cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene)	R + R

…continued

Table 6. Fungicides, bactericides and biopesticides registered for disease management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
canola oil	32408, 32819	diverse	N/C	not classified	unknown	R
captan	4559, 9582, 14823, 23691, 24613, 26408, 31949	phthalimide (electrophile)	M04	multi-site contact activity	multi-site contact activity	R (RVD2018-12)
chloropicrin	25863, 28715	chloropicrin[4]	8B[4]	miscellaneous non-specific (multi-site) inhibitor[4]	miscellaneous non-specific (multi-site) inhibitor[4]	RE
copper hydroxide	25901	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
copper octanoate	31825	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
copper (present as copper oxychloride)	13245, 19146	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
copper (present as copper sulphate)	9934	inorganic (electrophile)	M01	multi-site contact activity	multi-site contact activity	R
cyprodinil + difenoconazol	30827	anilino-pyrimidine + triazole	9 + 3	D1: amino acids and protein synthesis + G1:sterol biosynthesis in membranes	methionine biosynthesis (proposed) (cgs gene) + C14-demethylase in sterol biosynthesis (erg11/cyp51)	RE + RE
difenoconazole	30004	triazole	3	G1: sterol biosynthesis in membranes	C14-demethylase in sterol biosynthesis (erg11/cyp51)	RE

…continued

Table 6. Fungicides, bactericides and biopesticides registered for disease management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
difenoconazole + fludioxonil	31564	triazole + phenylpyrrole	3 + 12	G1: sterol biosynthesis in membranes + E2: signal transduction	C14-demethylase in sterol biosynthesis (erg11/cyp51) + MAP/histidine- kinase in osmotic signal transduction (os-2, HOG1)	RE + RE
dodine	15608	guanidine	U12	unknown mode of action	cell membrane disruption (proposed)	R
ferbam	20136, 20536	dithiocarbamate and relatives (electrophile)	M03	multi-site contact activity	multi-site contact activity	RE
fludioxonil	29528	phenylpyrrole	12	E2: signal transduction	MAP/histidine- kinase in osmotic signal transduction (os-2, HOG1)	R
fluopyram (nematicide)	30509	pyridinyl-ethyl-benzamide	7	C2: respiration	complex II: succinate-dehydrogenase	R
fluopyram + pyrimethanil	30510	pyridinyl-ethyl-benzamide + anilino-pyrimidine	7 + 9	C2: respiration + D1: amino acids and protein synthesis	complex II: succinate-dehydrogenase + methionine biosynthesis (proposed) (cgs gene)	R + R
fluxapyroxad	30562, 30565, 31697	pyrazole-4-carboxamide	7	C2: respiration	complex II: succinate-dehydrogenase	R
garlic powder	30601	biological	N/A	unknown	unknown	R
hydrogen peroxide + peroxyacetic acid	32907	inorganic	N/A	unknown	unknown	R (RVD2018-09, RVD 2018-10)

…continued

Table 6. Fungicides, bactericides and biopesticides registered for disease management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
kasugamycin	30591	hexopyranosil antibiotic	24	D3: amino acids and protein synthesis	protein sysnthesis (ribosome initiation step)	R
kresoxim-methyl	26257	oximino-acetate	11	C3: respiration	complex III: cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene)	RE
lime sulphur (calcium polysulphide)	16465	inorganic	M02	multi-site contact activity	multi-site contact activity	R
mancozeb	10526, 31267	dithiocarbamate and relatives (electrophile)	M03	multi-site contact activity	multi-site contact activity	RE (RVD2018-21)
methyl bromide	9564, 19498	alky halide[4]	8A[4]	miscellaneous non-specific (multi-site) inhibitor[4]	miscellaneous non-specific (multi-site) inhibitor[4]	PO[5]
mineral oil	27666, 33099	not classified	N/A	unknown		R
myclobutanil	22399	triazole	3	G1: sterol biosynthesis in membranes	C14-demethylase in sterol biosynthesis (erg11/cyp51)	R
oriental mustard seed meal (oil) (*Brassica juncea*)	30263	diverse	N/C	not classified	unknown	R
Pantoea agglomerans C9-1	28392, 28436	biological	N/A	unknown	unknown	R
penthiopyrad	30331	pyrazole-4-carboxamide	7	C2: respiration	complex II: succinate-dehydrogenase	R

…continued

Table 6. Fungicides, bactericides and biopesticides registered for disease management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
phosphites (mono and dibasic sodium, potassium and ammonium phosphite)	30449	not classified	N/A	unknown	unknown	R
polyoxin D zinc salt	32688, 32918	polyoxin	19	H4: cell wall biosynthesis	H4: chitin synthase	R
Pseudomonas flourescens A506	29285	biological	N/A	unknown	unknown	R
Pseudomonas syringae - strain ESC-10	29673	biological	N/A	unknown	unknown	R
pyrimethanil	28011, 30871	anilino-pyrimidine	9	D1: amino acids and protein synthesis	methionine biosynthesis (proposed) (cgs gene)	R
Reynoutria sachalinensis (extract)	30199	complex mixture, ethanol extract (anthraquinones resveratrol)	P05	P5: host plant defence induction	anthraquinone elicitors	R
streptomycin sulfate	10305	glucopyranosyl antibiotic	25	D4: amino acid and protein synthesis	protein synthesis	R
sulphur	873, 14653, 16249, 18836, 29487, 31869, 32475	inorganic (electophiles)	M02	multi-site contact activity	multi-site contact activity	R
thiabendazole	13975	benzimidazole	1	B1: cytoskeleton and motor proteins	ß-tubuline assembly in mitosis	R

…continued

Table 6. Fungicides, bactericides and biopesticides registered for disease management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Target Site[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
thiophanate-methyl	12279, 25343, 27297, 31784, 32096	thiophanate	1	B1: cytoskeleton and motor proteins	ß-tubuline assembly in mitosis	RE
trifloxystrobin	27529, 30427, 30619	oximino-acetate	11	C3: respiration	complex III: cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene)	R

[1]Source: Pest Management Regulatory Agency label database (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php). **The list includes all active ingredients registered as of October 11, 2018.** While every effort has been made to ensure all fungicides, bactericides and biofungicides registered in Canada on pear have been included in this list, some active ingredients or products may have been inadvertently omitted. 'Numerous products' is entered where there are more than ten products for an active ingredient. Not all end-use products containing a particular active ingredient may be registered for use on this crop. The product label is the final authority on pesticide use and should be consulted for application information. The information in this table should not be relied upon for pesticide application decisions and use. '

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

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

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

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

Insects and Mites

Key issues

Integrated pest management (IPM)

- With the loss of the broad-spectrum organophosphate (OP) insecticides, there is concern that previously minor pests, such as some spring feeding caterpillars and the Comstock mealybug (CMB), may increase in prevalence. There are concerns that CMB may vector viruses in tree fruits and grapes. Therefore, there is a need for continued monitoring of these pests so that control measures may be implemented if necessary.

- The development of early detection methods and a review of economic thresholds is required to help growers accurately time miticide applications.

- Information on the toxicity of pest control products to specific (beneficial) predatory mites is required by growers and advisors at time of registration, to enable best management practices to protect natural enemies.

- Further investigation is required on management approaches that conserve natural enemies of pear psylla in the orchard.

- There is a heavy reliance on neonicotinoids for control of pear psylla and there are concerns over developing resistance to this class of insecticides. There is a need for resistance testing for frequently used active ingredients. New insecticides, in classes other than the neonicotinoids are required for the management of pear psylla.

- Unmanaged host trees on private and public properties, especially those close to commercial orchards, are of concern as they can be a reservoir for pests.

Emerging issues

- Neonicotinoid insecticides are the only registered products that effectively control plum curculio. Because of the potential of resistance development and the potential loss of these materials due to concerns of toxicity to bees, there is a need to register non-neonicotinoid products effective against this insect.

…continued

Key issues (Continued)

Integrated pest management (IPM)

- Effective control products are required for brown marmorated stinkbug (BMSB). It is important that these controls be harmonized with the United States and not pose maximum residue levels (MRL) issues in foreign markets. Currently registered materials for BMSB only provide suppression of this pest and there are concerns that these materials may not provide sufficient efficacy under high pest pressure. In addition, there is a need to expand outreach to the general public to create awareness and further education on the importance and identification of BMSB.

- There is concern over the potential loss of pyrethroid insecticides as a result of re-evaluations currently underway. Apart from neonicotinoid materials, pyrethroids are the only products labelled for late season pear psylla control, and these compounds are also relied on for pre-harvest codling moth (CM) and for oriental fruit moth control.

New insect and mite pest management products and application technologies

- There is a need for the registration of new products in new chemical families for the management of a number of pests including: pear blossom midge, pear psylla, CMB, pear leaf blister mite, pear sawfly, tarnished plant bug and two-spotted spider mites.

- Since the loss of OP materials, there are limited options for pre- and post-bloom insecticide treatments. There is a need to register materials that can be used immediately before and after bloom which are non-toxic to pollinators that may be present in the orchard during that time.

Table 7. Occurrence of insect and mite pests in pear production in Canada[1,2]

Insect	British Columbia	Ontario
Pear Blossom Midge		
Plum Curculio		
Oriental Fruit Moth		
Codling moth		
Pear psylla		
Brown marmorated stinkbug		
Comstock mealybug		
Mites		
European red mite		
Pear rust mite		
Pearleaf blister mite		
Two spotted spider mite		
Mullein bug		
Tarnished plant bug		
Scale insects		
San Jose scale		
European fruit scale		
Pear sawfly (pear slug)		
Fruitworms		
Green fruitworm		
Spring feeding caterpillar complex		
Red-banded leafroller		
Fruit tree leafroller		
Eyespotted bud moth		
European leafroller		
Two generation leafrollers		
Obliquebanded leafroller (OBLR)		
Threelined leafroller		

Widespread yearly occurrence with high pest pressure.

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

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

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

Pest is present and of concern, however little is known of its distribution, frequency and pressure.

Pest not present.

Data not reported.

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

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

Table 8. Adoption of insect and mite pest management practices in pear production in Canada[1]

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

…continued

Table 8. Adoption of insect and mite pest management practices in pear production in Canada[1] (continued)

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

…continued

Table 8. Adoption of insect and mite pest management practices in pear production in Canada[1] (continued)

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

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

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

This practice is not applicable for the management of this pest

Information regarding the practice for this pest is unknown.

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

Plum Curculio *(Conotrachelus nenuphar)*

Pest Information

Damage: Plum curculio adults and larvae attack pears, damaging developing green tissues, blossoms and fruits. This insect can be very destructive if no controls are implemented. It is a significant pest, especially where plantings are adjacent to woodlots and fields. Females create feeding injuries next to each oviposition site, which develop into scar bumps on the fruits at harvest, making them unsuitable for fresh market sale.

Life Cycle: The adult plum curculio overwinters in debris, woodpiles and other protected sites adjacent to orchards. Adults fly into the orchards in the early spring. Emergence can be expected when 3 to 4 days of warm temperatures (above 16^{o} C) occur after a rain. Adults migrate to orchards from white bud to petal fall and feed on buds, flowers, leaves and young fruits. During this time females lay eggs in cavities of the developing fruit. After the eggs hatch, the larvae feed inside the fruit until they are fully grown, then they drop to the ground to pupate. Second generation adults emerge in two to three weeks and return to the trees to feed on the fruit before seeking overwintering sites.

Pest Management

Cultural Controls: Infestations occur during early season and can be revealed with frequent monitoring through the use of traps, checking for visual feeding injury and by shaking branches to drop adults onto cloths for counting. Populations of plum curculio can be reduced through winter mortality and predation by insects.

Resistant cultivars: None available.

Issues for Plum Curculio

1. Neonicotinoid insecticides are the only registered products that effectively control plum curculio. With concerns about resistance development and the potential loss of these materials, there is a need for the registration of non-neonicotinoid products that are effective against this insect.

Oriental Fruit Moth (*Grapholita molesta*)

Pest Information

Damage: The primary hosts of the Oriental Fruit moth (OFM) are peaches, nectarines and apricots. Apples and pears are alternative hosts. The larvae attack pear fruit usually from mid-season through to harvest. Pear shoots are not usually attacked. Codling moth larvae and damage may be confused with that of the OFM.

Life Cycle: Late stage larvae overwinter on or near the host and pupate in the spring. There may be up to four generations of OFM per year.

Pest Management

Cultural Controls: Control strategies for OFM in nearby peach, apricot and nectarine orchards can reduce late season migration of this insect into pear orchards. The use of pheromones for mating disruption will help manage this insect. Predictive models can also help the timing of insecticides' applications. As the rate of development of oriental fruit moth differs between apples, pears and stone fruit, different degree day accumulation methods are also used for modelling.

Resistant cultivars: None available.

Issues for Oriental Fruit Moth

None identified.

Codling Moth *(Cydia pomonella)*

Pest Information

Damage: Codling moth can cause significant economic loss in pears. Larvae enter the fruit from the sides, stem and calyx ends, bore to the core and feed in the seed cavity.

Life Cycle: The codling moth overwinters as a late stage larva under bark scales and in crevices. The larvae pupate in the spring and adults emerge in May or June. Female moths lay eggs on the fruit or on leaves near the fruit. After hatching, the young larvae may feed on the fruit surface before tunnelling into the fruit to feed on the pulp and seeds. At maturity, the larvae leave the fruit to pupate. Second generation moths emerge in July and August and the cycle repeats itself.

Pest Management

Cultural Controls: Sanitation practices contribute greatly in managing this pest. Practices such as the removal of all unmanaged apple or pear trees within 100 m of the orchard and the removal and destruction of fallen fruit and infested fruit found at thinning and harvest, help reduce pest numbers. Bands of corrugated cardboard may be placed around tree trunks and scaffold limbs in early August to collect pupating larvae. These bands are destroyed after harvest. Pheromone baited traps are also used to monitor the population and determine the necessity and timing of treatments. In some areas (e.g. BC interior), codling moth populations can be maintained below economic thresholds by the release of sterile moths, or by combinations of sterile moth release and pheromone mating disruption.

Resistant cultivars: Pear varieties vary in their susceptibility to codling moth injury.

Issues for codling moth

None identified.

Pear Psylla *(Cacopsylla pyricola)*

Pest Information

Damage: Pear psylla nymphs feed by sucking plant sap from tender tissues. Feeding can cause premature leaf drop, weaken fruit buds and reduce shoot growth. Heavy populations can cause significant crop loss and over time may result in tree mortality.

Life Cycle: Psylla overwinters as adults in protected places in and around the orchard. In early spring, the adults migrate to the pear trees and lay eggs on or near the buds. Later generation females lay their eggs on leaves of new shoots and suckers. Nymphs progress through five stages before becoming adults. Depending on weather conditions, psylla can have up to four overlapping generations per year. Psylla nymphs also excrete honeydew that supports the growth of sooty mould.

Pest Management

Cultural Controls: Nitrogen applications at levels that do not promote excessive vegetative growth and summer pruning to remove new growth will remove the favoured egg laying sites of adult psylla. Monitoring for this insect involves the use of visual techniques including beating trays to dislodge adults and the examination of fruit spurs and branch tips for eggs or nymphs. Economic thresholds have been established. Many natural predatory insects feed on psylla, but these may not maintain the pest below economic levels.

Resistant cultivars: None available.

Issues for Pear Psylla

1. Further investigation is required on management approaches that conserve natural enemies of pear psylla in the orchard.
2. There is a heavy reliance on neonicotinoids for control of pear psylla and there are concerns over developing resistance to this class of insecticides. Alternative control products for early season management are also required. New insecticides are required for alternation of chemistries for the management of pear psylla.

Brown Marmorated Stinkbug (*Halyomorpha halys*)

Pest information

Damage: Brown marmorated stinkbug (BMSB) can cause significant crop injury similar to other stinkbugs. It injects saliva with digestive juices and ingests the liquefied plant tissues. Its presence has been identified in Ontario. The BMSB has a broad host range including tree fruit, berries, grapes, ornamentals, grain crops, tomatoes, peppers and sweet corn. Injury is caused by feeding of adults and nymphs. Early season feeding can result in stunted fruit growth and late season feeding can cause dimpling marks on pears or sunken patches on the skin surface with very hard and pithy areas developing internally.

Life Cycle: The seasonal activity of BMSB differs from other stink bugs, with feeding in tree tops and outer rows in mid-June, and fruit discoloration noticeable by the end of June. BMSB can spread through natural means and is also a “hitchhiker” in cargo and vehicles. The BMSB overwinters as adults. In the spring, BMSB adults mate and lay eggs on a range of host plants. Adults are long-lived and females may lay several hundred eggs over an extended period of time. In the fall, the adults move back to protected overwintering sites which may include structures, where they are a nuisance pest.

Pest Management

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

Resistant cultivars: None available.

Issues for Brown Marmorated Stinkbug

1. The BMSB potential for damage is of great concern to growers. Careful monitoring of established colonies and the development of effective IPM strategies is required.
2. Insecticides currently registered for BMSB provide suppression only, and there are concerns that these materials will provide inadequate control under high pest pressure. Additional control products with full control efficacy are required. It is important that these controls be harmonized with the United States and not pose maximum residue limits (MRL) issues in foreign markets.
3. There is a need for domestic products to be made available for homeowners to control populations that threaten nearby commercial host crops.

Comstock Mealybug (*Pseudococcus comstocki*)

Pest Information

Damage: Comstock mealybugs (CMB) are sap-feeders which assemble on leaves or fruits. The insect secretes honeydew that supports the growth of unsightly sooty moulds. Feeding along fruit stems may result in fruit drop.

Life Cycle: The CMB overwinters as eggs that hatch from mid-April to May up to the petal fall stage in pear. Nymphs are present until early summer at which time adult females and males emerge. After mating, eggs are laid on the host. A second summer-generation of adults lay eggs in mid-summer and again in late summer, with these latter eggs overwintering.

Pest Management

Cultural Controls: The removal of trash in and around the pear orchard will eliminate overwintering sites. Comstock mealybug as other mealybug populations can be monitored by visual examination of crawlers’ activity on the terminal growth of the shoots. The presence of

ants may also be an indicator of the presence of Comstock mealybug, since honeydew attracts ants.
Resistant cultivars: None available

Issues for Comstock Mealybug

1. There are concerns that the CMB may become more prevalent now that the use of broad-spectrum materials such as organophosphate insecticides is limited.
2. The registration of replacement products for the control of this pest is required.
3. There are concerns that the CMB may be a vector of virus diseases in tree fruits and grapes. Careful monitoring is required so that controls may be implemented if necessary.

Mites: Pear Rust Mite *(Epitrimerus pyri)*, Pearleaf Blister Mite *(Eriophyes pyri)*, Two-Spotted Spider Mite *(Tetranychus urticae)*

Pest Information

Damage: Size, color and fruit set may be affected if mite populations are high for a long period of time. The pear rust mite causes smooth russeting on the leaves and fruits. The pearleaf blister mite causes reddish, russetted spots and fruit deformities. The two-spotted spider mite causes leaf blackening and drop.
Life Cycle: Pear rust mite and the pearleaf blister mite overwinter at the base of buds, under bud scales and leaf scars or in bark crevices on branches and twigs. When the buds open, the rust and blister mites move to the flowers and leaves. At petal fall, the mites move to the fruit. Rust mites have several generations during the spring and summer. The two spotted spider mite overwinters as adult females in bark crevices or in litter on the ground. This mite has many overlapping generations per year and during hot weather a generation can be completed in as little two weeks.

Pest Management

Cultural Controls: The removal of trash in and around the orchard will eliminate overwintering sites of the mites. Monitoring the orchard for mites on a weekly basis will help determine if treatments are necessary. Maintaining good weed control in the orchard and keeping the floor of the orchard clean will help to reduce mite numbers. To reduce the chance of spread of infestations, pears should not be planted in close proximity to other host crops such as cherry, apple, plum and peach. The removal of unmanaged host trees in the vicinity of the orchard will remove a source of infestation. Some beneficial predatory mites can keep the mites in check.
Resistant cultivars: None identified.

Issues for Mites

1. Information on the toxicity of pesticides to specific predatory mite species is required by growers and advisors when compounds are registered, to enable best management decisions to conserve these natural enemies.
2. Two spotted spider mites develop resistance to pesticides relatively quickly. The continued development of new active ingredients in new chemical families is required for resistance management.
3. Early detection methods are required to monitor mite activity and to accurately time miticide application when necessary.
4. Pearleaf blister mite levels have increased over the past three to five years in Ontario and with the impending loss of carbaryl (Sevin), there are limited products available for control of this pest. Replacement materials are required for use during the immediate post-bloom period. Trace blooms may be present during the application window, so materials that have low toxicity to pollinators are critical.

European Red Mite *(Panonychus ulmi)*

Pest Information

Damage: Feeding by European red mites (ERM) results in a stippling and bronzing of the foliage. Severe infestations may result in leaf necrosis, burn and defoliation of pear trees. Size, color and fruit set may be affected if mite populations are high for a long period of time. Yields can also decrease the year after a severe attack. Pears can suffer damage from even a small population of ERM.

Life Cycle: The European red mite overwinters as eggs on rough bark around buds. The eggs hatch in the spring throughout the bloom period and the immature mites move to the leaves to feed. The immature mites develop through larval stages and two additional nymphal stages before becoming adults. Following mating, eggs are laid on the foliage. There may be 6 to 8 overlapping generations per year, depending on temperature. Populations begin to decline in late summer when the overwintering eggs are produced.

Pest Management

Cultural Controls: Maintaining good weed control in the orchard will help to reduce mite numbers. Avoiding planting pears near other host trees such as cherry, apple, plum and peach will help to reduce the chance of an infestation. The removal of unmanaged host trees in the vicinity of the orchard will remove a source of infestation. Monitoring for pest mites and beneficial predatory mite species which can help keep pest mites in check weekly can ensure that treatments are applied only when needed.

Resistant cultivars: None available.

Issues for European Red Mites

1. Information on the toxicity of pesticides to specific predatory mite species is required by growers and advisors when compounds are first registered, to enable best management decisions to conserve populations of natural enemies.
2. European red mites are known to develop resistance to pesticides relatively quickly. There is a need for the continued development of new products in new chemical families for resistance management.

Plant Bugs:Tarnished Plant Bug (*Lygus lineolaris*) and Mullein bug (*Campylomma verbasci*)

Pest Information

Damage: Among the several species of plant bugs that attack pears, the tarnished plant bug is the most serious. It feeds by sucking plant sap on fruit buds and immature fruit which can result in aborted fruit buds and in a "dimpling" formation of the fruit. The mullein bug will attack pears in early summer, however it is most damaging to apples.

Life Cycle: The tarnished plant bug overwinters as an adult in weeds and under debris and also in protected areas such as woodlots and fence rows. The overwintering adult becomes active very early in the spring, attacking buds of early developing fruits. Eggs are laid in the foliage of the host plants. The eggs hatch, and nymphs feed on the host plant causing injury similar to that of adults. There may be three to five generations per year. The mullein bug develops through five nymphal instars to adulthood. It overwinters as eggs inserted deep into the bark of young apple trees. Eggs hatch during bloom until early petal fall. Nymphs start feeding on plant sap reached through leaf veins then become predaceous, feeding on European red mite and aphids. In Ontario, the adults move to mullein plants if there is no other food available, hence its name.

Pest Management

Cultural Controls: The elimination of debris and the control of weeds in the vicinity of the orchard will make the area less attractive to the tarnished plant bug. As the mullein bug is recognized as an important predator species of other pests later during the summer, it is important to ensure that any control measures for this insect are taken only when warranted.

Resistant cultivars: None available.

Issues for Tarnished Plant Bug and other Plant Bugs

1. There are limited control options for TPB and there is a need for the registration of additional pesticides for control.
2. The development of improved monitoring practices for more accurate timing of control measures is required.

Scale Insects: San Jose (*Quadraspidiotus perniciosus*) and European Fruit Scale (*Parthenolecanium corni*)

Pest Information

Damage: Scale insects injure pears by sucking moisture from plant tissues. Heavy infestations cause distorted growth and a decrease in the vigour of young trees, with severe infestations capable of killing tree limbs or a whole tree in 2 or 3 years. Heavy infestations of San Jose scale can "crust over" twigs and cause dieback. Feeding by San Jose scale causes fruit spotting and severe infestations may result in small, deformed fruit.

Life Cycle: The immature stages of both scales overwinter on bark. The scales mature in the spring and adults emerge at full bloom to petal-fall stages. The females bear live young (crawlers) that move to new feeding sites and begin feeding and forming a shell. There are two to three generations per year of the San Jose scale. The European fruit scale has one generation per year.

Pest Management

Cultural Controls: Pruning out heavily infested branches and avoiding long pruning stubs that interfere with spray coverage will help to control scale populations. If injuries are observed at harvest, a control measure may be warranted the following spring.

Resistant cultivars: None identified.

Issues for Scale Insects

None identified.

Spring Feeding Caterpillar Complex: Red-banded Leafroller (*Argyrotaenia velutiana*), Fruit Tree Leafroller (*Archips argyrospila*), European Leafroller (*Archips rosana*), and Other Leafrollers

Pest Information

Damage: Leafrollers feed on young developing leaves and bore into buds during early spring. Early season feeding causes corky scars and fruit indentation. Fruit can also drop prematurely. Larvae of some species web and roll terminal leaves, where they hide when not feeding. Leaf feeding, when severe, can reduce photosynthetic activity.

Life cycle: Spring feeding leafroller species develop through a number of stages: egg, larva, pupa to become adult butterfly or moth. The timing of the life stages differs amongst species with some species overwintering as eggs and others as larvae or pupae.

Pest management

Cultural controls: Egg masses can be removed during winter pruning. Monitoring involving the visual observation of feeding activity on terminal growth and flower petals is done in some areas. Economic thresholds exist in some provinces.

Resistant cultivars: None available.

Issues for Spring Feeding Leafrollers

1. With the loss of broad-spectrum organophosphate insecticides and reduced applications of early season insecticides, there is a concern that incidence of spring feeding caterpillar's species may rise in future years. The incidence of these species should be monitored closely to determine if controls are necessary.

Eyespotted Bud Moth (*Spilonota ocellana*)

Pest Information

Damage: The eyespotted bud moth has many hosts, and is a pest of apple, blackberry, cherry, peach, pear, quince, oak, raspberry, plum and other trees. Larvae feed on leaves and the surface of developing fruit. Summer feeding damage is similar to leafroller and fruitworm damage, but is not as severe.

Life Cycle: There are one or two generations per year. Immature larvae overwinter in cocoons attached to the bark of twigs and branches. In the spring, the larvae leave the cocoons and enter leaf and blossom buds. Spring larval feeding may completely destroy blossoms. The larvae pupate within "nests" made of leaves and blossoms and the adult moths emerge in late June and July. Following mating, the female moths lay eggs on the foliage. Larvae hatch and begin to feed.

Pest Management

Cultural Controls: Adults can be monitored with pheromone traps. Pruning to open up the canopy and allow better spray penetration will improve control. Removal of infestations on host trees in the vicinity of the orchard will eliminate potential pest reservoirs. It is important to control the spring generation of the bud moth to reduce the need to control the summer generation which causes economic damage.

Resistant cultivars: None identified.

Issues for Eyespotted Bud Moth

1. With the loss of Diazinon, there is a need for the registration of rotational products for summer control.

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

Pest Information

Damage: These leafrollers feed on flowers, fruit and foliage. First generation larvae feed on young fruit resulting in shallow grooves in the fruit skin. Second generation cause small pin holes which are susceptible to infection with rot pathogens leading to storage loss.

Life Cycle: These species have two generations per year, and more than 5 instars within each generation. Adult moths start laying eggs on the upper leaf surfaces in the spring. Following hatching, larvae feed on developing fruit and leaves and when fully grown, pupate within rolled leaves and emerge as adults. Second generation larvae are present in late summer. Larvae overwinter in protected places on the bark. In the spring, they resume feeding.

Pest Management

Cultural Controls: Pruning to open up the tree canopy and improve spray penetration is helpful in the control of leafrollers. Thinning fruits to reduce fruit crowding or touching can help reduce preferred feeding spots. Populations can be monitored by visual tree inspections, with the use of beating trays and pheromone traps. Control of the spring generation will minimize problems encountered with the second generation. The distribution of mating disruption pheromone, especially on the edge of orchards, help to reduce population levels of these two-generation leafrollers.

Resistant cultivars: None identified.

Issues for Two-Generation Leafrollers

None identified.

Pear Sawfly or Pear Slug *(Hoplocampa brevis)*

Pest Information

Damage: Larvae feed on the upper surface of pear leaves removing the photosynthetic layer. A high populations can defoliate pear trees.

Life Cycle: There are two generations per year in the British Columbia Interior and one generation per year in Ontario. Eggs are laid in flower buds during the spring. After hatching, larvae feed in young fruit which drop to the orchard floor. Larvae resemble small, black and elongated slugs, hence its common name. Pear sawfly overwinters as a pupa in a cocoon buried deep in the soil.

Pest Management

Cultural Controls: None available.

Resistant cultivars: None available.

Issues for Pear Sawfly

1. Pear sawfly has become a concern in select pear blocks in British Columbia and Ontario. Currently there are no products registered for the control of this pest. There is a need to register materials that can be used at the petal fall stage of development that are effective against pear sawfly.

Green Fruitworms (Family: *Noctuidae*)

Pest Information

Damage: A number of fruitworm species can attack pear. Fruitworm larvae feed on flower buds and blossoms causing petal fall drop and fruit abortion. Feeding can result in large corky scars and indentations or fruit distortion.

Life Cycle: The various fruitworms overwinter as adults, pupae or eggs. In the case of *Othosia hibisci*, a more common green fruitworm in Ontario, it begins emerging in early spring and lay its eggs on newly formed leaves. After hatching, larvae feed on leaves and forming fruit until early summer, then drop to the soil to pupate. There is one generation per year.

Pest Management

Cultural Controls: In the spring, fruit buds, blossom clusters and terminal leaves can be monitored for larvae by visual examination. During bloom, limb taps may be used to count larvae and determine whether treatments are necessary.

Resistant cultivars: None identified.

Issues for Green Fruitworms

None identified.

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

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

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
(E,E)-8,10-dodecadien-1-ol + 1-dodecanol + 1-tetradecanol + acetate of Z-8-dodecene-1-yl + acetate of E-8-dodecene-1-yl + Z-8-dodecene-1-ol	29352	not classified	N/A	Pheromone - behavioural mating disruption for peach borer and apple clearwing moth	R
(E, E)-8, 10-dodecadien-1-ol + 1-dodecanol + 1-tetradecanol + Z-11-tetradecen-1-yl acetate + Z-9-tetradecen-1-yl acetate + Z-11-tetradecen-1-ol + Z-11-tetradecenal	28814	not classified	N/A	Pheromone – behavioural mating disruption for codling moth and leafroller moths	R
(Z,Z)-3,13-octadecadien-1-yl acetate + (E,Z)-2,13-octadecadien-1-yl acetate + (Z,Z)-3,13-octadecadien-1-ol + (E,Z)-2,13-octadecadien-1-ol	30589	not classified	N/A	Pheromone - behavioral mating disruption for dogwood borer (*Synanthedon scitula*)	R
(Z,Z)-3,13 octadecadien-1-yl acetate + (E,Z)-3,13 octadecadien-1-yl acetate	27141	not classified	N/A	Pheromone - behavioral mating disruption for peach borer and apple clearwing moth	R
Z-8-dodecen-1-yl acetate + E-8-dodecen-1-yl acetate + Z-8-sodecen-1-ol	31419	not classified	N/A	Pheromone - behavioral mating disruption for oriental fruit moth	R

…continued

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
E, E-8, 10 dodecadien-1ol + 1-dodecanol + 1-tetradecanol	31589	not classified	N/A	Pheromone - mating disruption for codling moth	R
abamectin	24551, 31607	avermectin, milbemycin	6	glutamate-gated chloride channel (GluCl) allosteric modulator	RE
abamectin + cyantraniliprole	33023	avermectin, milbemycin + diamide	6 + 28	glutamate-gated chloride channel (GluCl) allosteric modulator + ryanodine receptor modulator	RE + R
cyantraniliprole	30895	diamide	28	ryanodine receptor modulator	R
acequinocyl	28641	acequinocyl	20B	mitochondrial complex III electron transport inhibitor	R

…continued

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
acetamiprid	27128	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	R
Bacillus thuringiensis subsp. *aizawai*, strain ABTS-1857	31557	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	R
Bacillus thuringiensis subsp. *kurstaki*, strain ABTS-351	11252, 24978, 26508	*Bacillus thuringiensis* and the insecticidal proteins they produce	11A	microbial disruptor of insect midgut membranes	R
Bacillus thuringiensis subsp. *kurstaki*, strain EVB113-19	26854, 27750, 32425	*Bacillus thuringiensis* and the insecticidal proteins they produce	11A	microbial disruptor of insect midgut membranes	R
canola oil	32408, 32819	not classified	N/A	unknown	R
carbaryl	22339	carbamate	1A	acetylcholinesterase (AChE) inhibitor	R
chlorantraniliprole	28981	diamide	28	ryanodine receptor modulator	R
chloropicrin	25863, 28715	chloropicrin	8B	miscellaneous non-specific (multi-site) inhibitor	RE
clofentezine	21035	clofentezine	10	mite growth inhibitor	R

…continued

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
clothianidin	29382, 29384	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	RES*
cyantraniliprole	30895	diamide	28	ryanodine receptor modulator	R
cyclaniliprole	32862, 32889	diamide	28	ryanodine receptor modulator	R
cyflumetofen	31284	beta-ketonitrile derivative	25A	mitochondrial complex II electron transport inhibitor	R
cypermethrin	15738, 28795, 30316, 32563	pyrethroid, pyrethrin	3A	sodium channel modulator	R (RVD2018-22)
deltamethrin	22478, 25573, 32446	pyrethroid, pyrethrin	3A	sodium channel modulator	RE
dimethoate	8277, 9382, 9807, 25651	organophosphate	1B	acetylcholinesterase (AChE) inhibitor	R
ferric sodium EDTA	28774	not classified	N/A	unknown	R
flonicamid	29796	flonicamid	29	chlordotonal organ modulator - undefined target site	R
flupyradifurone	31452	butenolide	4D	nicotinic acetylcholine receptor (nAChR) competitive modulator	R

…continued

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
imidacloprid	24094	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	RES*
iron (present as ferric phosphate) used as bait	27085, 27096, 30025	not classified	N/A	unknown	R (RVD2018-23)
kaolin	27469	not classified	N/A	unknown	R
lambda-cyhalothrin	24984, 26837, 29052, 32427	pyrethroid, pyrethrin	3A	sodium channel modulator	RE
lime sulphur or calcium polysulphide	16465	not classified	N/A	unknown	R
malathion	4590, 8372	organophosphate	1B	acetylcholinesterase (AChE) inhibitor	R
mancozeb	8556, 23655, 25396	dithiocarbamate and relatives (electrophile)[4]	M03[4]	multi-site contact activity[4]	RE (RVD2018-21)
methoxyfenozide	27786	diacylhydrazine	18	ecdysone receptor agonist	R
mineral oil	9542, 14981, 18709, 21655, 23370, 27666, 28124, 29768, 33099	not classified	N/A	unknown	R
permethrin	14882, 16688, 24071, 24175,28877, 29886	pyrethroid, pyrethrin	3A	sodium channel modulator	RE

…continued

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
phosmet	23006, 29064	organophosphate	1B	acetylcholinesterase (AChE) inhibitor	RE
potassium salts of fatty acids	14669, 24363, 27886, 28146, 31433	not classified	N/A	unknown	R
pyridaben	25135	METI acaricide and insecticide	21A	mitochondrial complex I electron transport inhibitor	RE
spinetoram	28777, 28778	spinosyn	5	nicotinic acetylcholine receptor (nAChR) allosteric modulator	R
spinetoram + sulfoxaflor	31442	spinosyn + sulfoximine	5 + 4C	nicotinic acetylcholine receptor (nAChR) allosteric modulator + nicotinic acetylcholine receptor (nAChR) competitive modulator	R + R
spinosad	26835, 27825, 30382	spinosyn	5	nicotinic acetylcholine receptor (nAChR) allosteric modulator	RE
spirodiclofen	28051	tetronic and tetramic acid derivative	23	inhibitor of acetyl CoA carboxylase	R
spirotetramat	28953, 28954	tetronic and tetramic acid derivative	23	inhibitor of acetyl CoA carboxylase	R

…continued

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Group[2]	Resistance Group[2]	Mode of Action[2]	Re-evaluation Status (re-evaluation decision document)[3]
sulfoxaflor	30826	sulfoximine	4C	nicotinic acetylcholine receptor (nAChR) competitive modulator	R
sulfoxaflor + spinetoram	31442	sulfoximine + spinosyn	4C + 5	nicotinic acetylcholine receptor (nAChR) competitive modulator + nicotinic acetylcholine receptor (nAChR) allosteric modulator	R
sulphur	14653, 18836, 29487, 31869, 32475	sulphur	N/A	unknown	R
tebufenozide	24503	diacylhydrazine	18	ecdysone receptor agonist	RE
thiacloprid	28429	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	R
thiamethoxam	28408	neonicotinoid	4A	nicotinic acetylcholine receptor (nAChR) competitive modulator	RES*
thiram (repellent)	13258	dithiocarbamate and relatives (electrophile)	M03	multi-site contact activity	RE

…continued

Table 9. Insecticides and bioinsecticides registered for the management of insect and mite pests in pear production in Canada (continued)

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

[1]Source: Pest Management Regulatory Agency label database (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php). **The list includes all active ingredients registered as of October 11, 2018.** While every effort has been made to ensure all insecticides, miticides and biopesticides registered in Canada on pear have been included in this list, some active ingredients or products may have been inadvertently omitted. 'Numerous products' is entered where there are more than ten products for an active ingredient. Not all end-use products containing a particular active ingredient may be registered for use on this crop. The product label is the final authority on pesticide use and should be consulted for application information. The information in this table should not be relied upon for pesticide application decisions and use.

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

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

[4]Source: Fungicide Resistance Action Committee. *FRAC Code List 2017: Fungicides sorted by mode of action (including FRAC code numbering)* (www.frac.info/) (accessed September 13, 2018).

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

Weeds

Key Issues

- There is a need for registration of broad-spectrum contact herbicides with different modes of action in order to slow the development of glyphosate tolerance within weed populations, and to mitigate the impacts of resistant weed species including Canada fleabane and thistle.

- There is a need to investigate additional pre-emergent residual herbicides that are safe to use around young plantings in all tree fruit commodities.

- There is a need for testing of predictive models and of non-chemical methods for weed control such as flaming, rolling, cultivation and the use of mulches and long-term rotations . Assessments need to include efficacy, economics and environmental impacts of these methods.

Table 10. Occurrence of weeds in pear production in Canada[1,2]

Weed	British Columbia	Ontario
Annual broadleaf weeds		
Annual grass weeds		
Perennial broadleaf weeds		
Perennial grass weeds		
Widespread yearly occurrence with high pest pressure.		
Widespread yearly occurrence with moderate pest pressure OR localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure.		
Widespread yearly occurrence with low pest pressure OR widespread sporadic occurrence with moderate pressure OR sporadic localized occurrence with high pest pressure.		
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low pressure OR localized sporadic occurrence with low to moderate pest pressure OR pest not of concern.		
Pest not present.		
Data not reported.		

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

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

Table 11. Adoption of weed management practices in pear production in Canada[1]

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

…continued

Table 11. Adoption of weed management practices in pear production in Canada[1] (continued)

Practice / Pest		Annual broadleaf weeds	Annual grass weeds	Perennial broadleaf weeds	Perennial grass weeds
Decision making tools	Economic threshold				
	Crop specialist recommendation or advisory bulletin				
	Decision to treat based on observed presence of weed at susceptible stage of development				
	Decision to treat based on observed crop damage				
	Use of portable electronic devices in the field to access weed identification / management information				
Suppression	Use of diverse herbicide modes of action for resistance management				
	Soil amendments and green manuring involving soil incorporation as biofumigants to reduce weed populations				
	Biopesticides (microbial and non-conventional pesticides)				
	Release of arthropod biological control agents				
	Mechanical weed control (cultivation / tillage)				
	Manual weed control (hand pulling, hoeing, flaming)				
	Use of stale seedbed technique				
	Targeted pesticide applications (banding, spot treatments, variable rate sprayers, etc.)				
	Selection of herbicides that are soft on beneficial insects, pollinators and other non-target organisms				
This practice is used to manage this pest by at least some growers.					
This practice is not used by growers to manage this pest.					
This practice is not applicable for the management of this pest.					
Information regarding the practice for this pest is unknown.					

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

Annual, Biennial and Perennial Broadleaf and Grass Weeds

Pest Information

Damage: Crop losses can be very high if weeds are not controlled. **Broadleaf weeds** compete with the crop for light, water and nutrients. If not controlled, they will reduce sapling vigour and tree vitality. **Grasses** also cause significant problems in pear production because of their fast growth and ability to compete for necessary resources. Additionally, grass weeds are very tolerant to extremes in moisture and temperature, once established. They can be very difficult to eliminate and require control prior to seed-set due to their prolific seedling. **Perennial weeds** can become very large and very competitive, especially if they have been established for several years. Young trees compete poorly with weeds for moisture and nutrients. Weeds near tree trunks provide shelter to rodents that can girdle the tree by stripping the bark.

Life Cycle: **Annual weeds** complete their life cycle in one year, going from seed germination, through vegetative growth and flowering to new seed production. **Winter annuals** begin their growth and produce a vegetative rosette in the fall. They flower and produce their seeds early the following year. **Annual weeds** survive and spread through the production of large numbers of seeds which are present at all times in most arable land. Some weed seeds can remain viable in the soil for many years, germinating when conditions are suitable. **Biennial** weeds are plants that germinate in the spring and remain vegetative during the first summer. They overwinter as rosettes and flower the second summer and produce seeds. These weeds die at the end of the second growing season. **Perennial grass** and **broadleaf weeds** can live for many years. Perennials spread effectively through seed germination, root expansion and other vegetative means. Tillage practices can break up the underground root systems and promote the spread of perennial weeds. The critical stage of perennial weeds for damage is early in the growing season, as it is for annual weeds.

Pest Management

Cultural Controls: Good weed control in a pear orchard is critical during the first five to six years of growth. Controlling serious weed problems, including perennial weeds, prior to orchard establishment is important. Weeds along roadsides, ditches and fence lines can be controlled by mowing. Cleaning soil and debris from equipment when leaving each field will reduce the spread of weeds between fields. Tilling prior to planting and cultivation after planting can help reduce weeds. Monitoring for annual weeds during the first 2-3 weeks after weed emergence, is important if post emergence controls are to be applied. Mulches, mowing and cover crops will also help to control weeds. Many perennial weeds cannot be effectively controlled once established in a pear orchard.

Issues for Weeds

1. There is a need for registration of broad-spectrum contact herbicides with different modes of action in order to slow the development of glyphosate tolerance within weed populations, and to mitigate the impacts of resistant weed species including Canada fleabane and thistle.
2. There is a need to investigate additional pre-emergent residual herbicides that are safe to use around young plantings in all tree fruit commodities.

3. There is a need for testing of predictive models and of non-chemical methods of weed control such as flaming, cultivation, mulches, and long-term rotations. Assessments need to include efficacy, economics and environmental impacts of these methods.
4. The development of new, selective herbicides and bio-herbicides is required.
5. There is a need to survey for new weed species and to screen herbicides for control of these new pests.

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

Active ingredients registered for the management of **weeds** in pear are listed in *Table 12 Herbicides and bioherbicides registered for weed management in pear production in Canada*. This table also provides registration numbers for products registered on pear containing these active ingredients in addition to information about chemical family and regulatory status. For guidance about active ingredients registered for specific **weeds**, the reader is referred to individual product labels on the PMRA label database https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management.html and to provincial crop production guides.

Table 12. Herbicides and bioherbicides registered for weed management in pear production in Canada

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Family[2]	Resistance Group[2]	Site of Action[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
2,4-D (present as dimethylamine salt)	5931, 17511, 26163, 29248, 31332	phenoxy-carboxylic-acid	4	synthetic auxin	RES
ammonium soap of fatty acids	30012, 30515	not classified	N/A	inconnu	R
bentazon (present as sodium salt)	12221, 32661, 32827, 33011	benzothiadiazinone	6	inhibition of photosynthesis at photosystem II site B	R
carfentrazone-ethyl	28573, 33127	triazolinone	14	inhibition of protoporphyrinogen oxidase (Protox, PPO)	R
dichlobenil	12533	nitrile	20	inhibition of cell wall synthesis site A	R
fluazifop-p-butyl	21209	aryloxyphenoxy-propionate 'FOP'	1	inhibition of acetyl CoA carboxylase (ACCase)	R
flumioxazin	29231, 29235	N-phenylphthalimide	14	inhibition of protoporphyrinogen oxidase (Protox, PPO)	R
gibberellins A4 A7 + 6-benzyladenine	16636	growth regulator	N/A	unknown	R
glufosinate ammonium	23180, 28532, 32860	phosphinic acid	10	inhibition of glutamine synthetase	R

…continued

Table 12. Herbicides and bioherbicides registered for weed management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Family[2]	Resistance Group[2]	Site of Action[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
glufosinate ammonium + glyphosate	25795, 26625	phosphinic acid + glycine	10 + 9	inhibition of glutamine synthetase + inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R + R
glyphosate (present as dimethylamine salt)	28840, 28977, 29774, 29775, 30319, 30516, 31090, 32314	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R
glyphosate (present as isopropylamine salt)	31913, 32181	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R
glyphosate (present as potassium salt)	numerous products	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R
glyphosate (present as isopropylamine and potassium salts)	32228, 32532, 33029, 33030	glycine	9	inhibition of 5-enolypyruvyl-shikimate-3-phosphate synthase (EPSPS)	R
indaziflam	30220, 30221, 30451, 32803, 32804	unknown	29	inhibition of cell wall synthesis site C	R
linuron	15544, 16279, 16363, 20193, 21353	urea	7	inhibition of photosynthesis at photosystem II site A (different behavior from group 5)	RES*
methyl bromide (fumigant, pre-plant soil application)	19498	alky halide[4]	8A[4]	miscellaneous non-specific (multi-site) inhibitor[4]	PO[5]

…continued

Table 12. Herbicides and bioherbicides registered for weed management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Family[2]	Resistance Group[2]	Site of Action[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
metribuzin	numerous products	triazinone	5	inhibition of photosynthesis at photosystem II site A	R
S-metolachlor and R-enantiomer	25728, 25729, 29347, 32847	chloroacetamide	15	inhibition of mitosis	RE
paraquat	8661, 33125	bipyridylium	22	photosystem-I-electron diversion	R
propyzamide (pronamide)	25595, 30264	benzamide	3	microtubule assembly inhibition	R
sethoxydim	24835	cyclohexanedione 'DIM'	1	inhibition of acetyl CoA carboxylase (ACCase)	R
simazine and related triazines	15902, 16370, 23181	triazine	5	inhibition of photosynthesis at photosystem II site A	R
terbacil	10628	uracil	5	inhibition of photosynthesis at photosystem II site A	R
trifluralin	23933, 28289	dinitroaniline	3	microtubule assembly inhibition	R

…continued

Table 12. Herbicides and bioherbicides registered for weed management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Family[2]	Resistance Group[2]	Site of Action[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
Plant Growth Regulators (PGR)					
1-methylcyclopropene	27778, 30872	not classified	N/A	plant growth regulator for post harvest use to control fruit ripening in storage	R
6-benzyladenine	28851	not classified	N/A	plant growth regulator for apple and pear thinning, sizing and enhanced return bloom	R
6-benzylaminopurine	29210	not classified	N/A	plant growth regulator for post-bloom thinning and enhancement of fruit size of apples and pears	R

…continued

Table 12. Herbicides and bioherbicides registered for weed management in pear production in Canada (continued)

Active Ingredient[1]	Product Registration Numbers[1]	Chemical Family[2]	Resistance Group[2]	Site of Action[2]	Re-evaluation Status (Re-evaluation Decision Document)[3]
Plant Growth Regulators (PGR) (continued)					
6-benzyladenine (BA) + gibberellins A_4A_7	16636	not classified	N/A	plant growth regulator for fruit development and for lateral branching and tree development	R

[1]Source: Pest Management Regulatory Agency label database (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php). **The list includes all active ingredients registered as of October 11, 2018.** While every effort has been made to ensure all herbicides, bioherbicides and plant growth regulators registered in Canada on pear have been included in this list, some active ingredients or products may have been inadvertently omitted. 'Numerous products' is entered where there are more than ten products for an active ingredient. Not all end-use products containing a particular active ingredient may be registered for use on this crop. The product label is the final authority on pesticide use and should be consulted for application information. The information in this table should not be relied upon for pesticide application decisions and use. '

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

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

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

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

Vertebrate Pests

Mice, Voles and Pocket Gophers

Mice and voles feed on the bark and roots of pear trees during the winter months or when food is scarce. Young pear trees may be girdled around the base of the trunk, resulting in tree death. Pocket gopher damage tends to be restricted to root feeding. Removing straw, weeds and sod from a 60 cm diameter area around the base of tree trunks, regularly mowing sod, removing dropped pears, applying white latex paint and thiram protectants on trunks during winter and using wire mesh around trees are all good rodent management techniques. Predators such as shrews, skunks, weasels, dogs, foxes, coyotes, owls, hawks and snakes will help keep rodent numbers down. Rodenticides may also be used to control rodents.

Deer

Deer feed on buds, spurs, shoots and leaves of pear trees. They have also been known to break branches and remove bark by antler rubbing. The severity of damage depends on the location of the orchard and local deer populations. If trees sustain significant damage at an early age (4 years and younger), they may never develop into commercially productive plants. Deer browsing can be reduced by the construction of wire or electric fences around the perimeter of the orchard or with the use of repellent products.

Resources

Integrated Pest Management/ Integrated Crop Management Resources for Production of Pear in Canada

British Columbia Ministry of Agriculture. *Tree Fruits Information on identification and management of insect and mite pests and plant diseases of tree fruit crops in British Columbia: Insects and Mites.*

https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/insects-and-plant-diseases/tree-fruits

British Columbia Ministry of Agriculture. *BC Tree Fruit Production Guide*.

https://www.bctfpg.ca/horticulture/

British Columbia Ministry of Agriculture. *BC Tree Fruit Production Guide: Integrated Pest Management.*

https://www.bctfpg.ca/ifp-organics/integrated-pest-management/

British Columbia Ministry of Agriculture and British Columbia Fruit Growers' Association. 2010. *Integrated Fruit Production Guide for Commercial Tree Fruit Growers, Interior of British Columbia*. For purchase: British Columbia Central Branch Library. Branch Call Number: 634.05 T78.

https://vpl.bibliocommons.com/item/show/1127085038_integrated_fruit_production_guide_for_commercial_tree_fruit_growers

Ontario Ministry of Agriculture, Food and Rural Affairs. *Publication 360, 2018-19 Fruit Crop Protection Guide.*
http://www.omafra.gov.on.ca/english/crops/pub360/p360toc.htm

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

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

Perennia. On behalf of the Nova Scotia Department of Agriculture. *Fruit Production* (production and pest management publications) http://www.perennia.ca/agriculture/commodity-information/

Provincial Crop Specialists and Provincial Minor Use Coordinators

Province	Ministry	Crop Specialist	Minor Use Coordinator
British Columbia	British Columbia Ministry of Agriculture www.gov.bc.ca/agri	Maria Jeffries Plant Health Coordinator Maria.Jeffries@gov.bc.ca	Caroline Bédard Caroline.Bedard@gov.bc.ca
Ontario	Ontario Ministry of Agriculture, Food and Rural Affairs. www.omafra.gov.on.ca	Amanda Green Tree Fruits Specialist amanda.green@ontario.ca Kathryn Carter Fruit Crop Specialist kathryn.carter@ontario.ca	Jim Chaput jim.chaput@ontario.ca
Quebec	Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec www.mapaq.gouv.qc.ca	Gérald Chouinard Tree Fruit Specialist gerald.chouinard@irda.qc.ca Caroline Turcotte Fruit Crop Specialist caroline.turcotte@mapaq.gouv.qc.ca	Mathieu Coté mathieu.cote@mapaq.gouv.qc.ca
Nova Scotia	Nova Scotia Department of Agriculture www.novascotia.ca/agri/	N/A	Jason Sproule sproulejm@gov.ns.ca
	Perennia www.perennia.ca	Michelle Cortens Tree Fruits Specialist mcortens@perennia.ca	

National and Provincial Fruit Grower Organizations

Provincial:

British Columbia Fruit Growers Association: www.bcfga.com

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

Norfolk Fruit Growers Association: www.nfga.ca

Nova Scotia Fruit Growers Association: www.nsapples.com

Ontario Fruit and Vegetable Growers Association: www.ofvga.org

Les producteurs de pommes du Québec : https://lapommeduquebec.ca/

Certified Organic Associations of BC (COABC):
https://www.certifiedorganic.bc.ca/

National:

Canadian Horticultural Council: www.hortcouncil.ca

Appendix 1

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

Information on the occurrence of disease, insect and mite and weed pests in each province is provided in Tables 4, 7 and 10 of the crop profile, respectively. The colour coding of the cells in these tables is based on three pieces of information, namely pest distribution, frequency and pressure in each province as presented in the following chart.

<table>
<tr><th>Presence</th><th colspan="4">Occurrence information</th><th rowspan="2">Colour Code</th></tr>
<tr><td rowspan="15">Present</td><td rowspan="13">Data available</td><th>Frequency</th><th>Distribution</th><th>Pressure</th></tr>
<tr><td rowspan="6">Yearly - Pest is present 2 or more years out of 3 in a given region of the province.</td><td rowspan="3">Widespread - The pest population is generally distributed throughout crop growing regions of the province. In a given year, outbreaks may occur in any region.</td><td>High - If present, potential for spread and crop loss is high and controls must be implemented even for small populations.</td><td>Red</td></tr>
<tr><td>Moderate - If present, potential for spread and crop loss is moderate: pest situation must be monitored and controls may be implemented.</td><td>Orange</td></tr>
<tr><td>Low - If present, the pest causes low or negligible crop damage and controls need not be implemented.</td><td>Yellow</td></tr>
<tr><td rowspan="3">Localized - The pest is established as localized populations and is found only in scattered or limited areas of the province.</td><td>High - see above</td><td>Orange</td></tr>
<tr><td>Moderate - see above</td><td>White</td></tr>
<tr><td>Low - see above</td><td>White</td></tr>
<tr><td rowspan="6">Sporadic - Pest is present 1 year out of 3 in a given region of the province.</td><td rowspan="3">Widespread - as above</td><td>High - see above</td><td>Orange</td></tr>
<tr><td>Moderate - see above</td><td>Yellow</td></tr>
<tr><td>Low - see above</td><td>White</td></tr>
<tr><td rowspan="3">Localized - as above</td><td>High - see above</td><td>Yellow</td></tr>
<tr><td>Moderate -see above</td><td>White</td></tr>
<tr><td>Low - see above</td><td>White</td></tr>
<tr><td rowspan="2">Data not available</td><td colspan="3">Not of concern: The pest is present in commercial crop growing areas of the province but is causing no significant damage. Little is known about its population distribution and frequency in this province; however, it is not of concern.</td><td>White</td></tr>
<tr><td colspan="3">Is of concern: The pest is present in commercial crop growing areas of the province. Little is known about its population distribution and frequency of outbreaks in this province and due to its potential to cause economic damage, is of concern.</td><td>Blue</td></tr>
<tr><td>Not present</td><td colspan="4">The pest is not present in commercial crop growing areas of the province, to the best of your knowledge.</td><td>Black</td></tr>
<tr><td>Data not reported</td><td colspan="4">Information on the pest in this province is unknown. No data is being reported for this pest.</td><td>Grey</td></tr>
</table>

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https://www.craaq.qc.ca/en/Publications-du-CRAAQ/tree-fruit-field-guide-to-insect-mite-and-disease-pests-and-natural-enemies-of-eastern-north-america/p/PAUT0077

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http://www.agr.gc.ca/resources/prod/doc/pmc/pdf/1185385723877_e.pdf

Canadian Horticultural Council, Apple Working Group Document: *Fire Blight of Apple and Pear in Canada: Economic Importance and Strategy for Sustainable Management of the Disease.* April 2005.
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Childers, N.F., J.R. Morris and G.S. Sibbett. 1995. *Modern Fruit Science*. Horticulture Publications, 3906 NW 31 Place; Gainesville, Florida 32606. 632 pp, pages 274-292. ISBN: 09383780110. Available at the Federal Science Library:
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