Crop Profile for Field Pea in Canada

Prepared by:

Pesticide Risk Reduction Program

Pest Management Centre

Agriculture and Agri-Food Canada

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The authors recognize the efforts of the Pest Management Regulatory Agency (PMRA),, provincial pest management representatives, industry specialists and growers in the gathering of information that was required, and the review and validation of the content of this publication.

Product trade names may be included and are meant as an aid for the reader to facilitate the identification of products in general use. The use of these trade names does not imply endorsement of a particular product by the authors or any of the organizations represented in this publication.

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Information contained in this publication is not intended to be used by growers as a production guide. Provincial publications should be consulted by growers for this information.

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Table of Contents

List of Tables

Crop Profile for Field Peas in Canada

Field peas (otherwise known as dry peas) belong to the family of cool season legume crops commonly referred to as pulses, which includes lentils, fababeans, kidney beans and chickpeas. Peas are native to Syria, Iraq, Iran, Turkey, Israel, Jordan and Lebanon and have been cultivated in Europe for several thousand years. They are now grown in all climatic zones, including the tropics where they are cultivated at high elevations. Both yellow and green cotyledon pea cultivars are grown and most varieties have a white flower. Field peas have been grown to a limited extent in western Canada ever since farmers started farming the prairies over 100 years ago. Immediately after the Second World War, there were only about 20,000 ha of peas grown in Manitoba. Pea production began to increase in 1977 and has been growing consistently since then. The opening of the European feed pea market in 1985 and the resulting high prices for peas stimulated field pea production in Canada and increased the pea acreage 17 fold from 74,400 ha in 1985 to 1,297,018 ha in 2002.

General Production Information

Canadian Production	2,124,000 metric tonnes 1,271,000 hectares
Farm gate value	$372 million
Domestic consumption	981,000 metric tonnes
Export	1,272,000 metric tonnes
Import	24,000 metric tonnes
Source (2003): Market Analysis Division, Agriculture and Agri-Food Canada http://www.agr.gc.ca/mad-dam/e/sd2e/hsd2ez.htm	

Production Regions

Field peas are grown mainly in the prairie provinces of Canada, with 69% of Canadian production originating from Saskatchewan, 22% from Alberta, and 8% from Manitoba.

Cultural Practices

Field pea is best adapted to the moist dark brown and black soil zones. The crop is relatively drought resistant and is productive in most years in the brown soil zone. It does not tolerate water-saturated or salt-affected soils. Well-drained, clay loam soils are ideal for pea production. Field pea can tolerate some hot weather or drought stress during flowering but these conditions may reduce yields.

Field pea production is most successful when grown in rotation with cereals, such as barley or spring durum wheat. Sowing field pea into standing cereal stubble helps protect the land from erosion and provides shelter for newly emerging seedlings. Spreading the cereal straw evenly in the field helps to prevent spring frost injury and mechanical problems such as air-seeder plugging and header plugging of harvest equipment. Most cereal diseases do not affect pulse crops. Soil-borne root rot disease in continuous cereal systems may cause average yield losses up to 10%. Grasshoppers do not thrive in pea crops and field pea is not a host for wheat midge. Being a shallow rooted crop (0.75 to 1 metre root depth), field pea is able to efficiently use soil moisture in stubble conditions when the top meter of the soil profile has been recharged

by fall or spring rains. Soil moisture below the depth of 1 metre is left in reserve for the following crop.
Peas are generally sprayed for weed control when the vines are less than 15 cm in length. This occurs usually in mid to late June, before canopy lodging. Varieties with fewer leaves have been developed to reduce lodging, however these varieties are less competitive with weeds.

Pea seed is highly susceptible to mechanical damage during harvest, handling or seeding operations. Dry seed (14% moisture or less) is brittle and can easily crack or split, leading to reduced germination. Moisturizing the seed with water before seeding can reduce mechanical injury.

Production Issues

The most important production problem facing pea growers relates to the erratic nature of yields. This characteristic has been confirmed in research plots where variability is much higher than those experienced with other field crops. The indeterminate growth habit of the pea vine creates special needs with respect to field preparation (fields must be flat and stone free), method of harvesting, and timing of harvesting. To some degree, breeders have solved the problem with semi-leafless varieties that stand up better than older, leafy varieties. Broadleaf and perennial weeds are a significant problem in pea crops. field peas are susceptible to mycosphaerella blight (ascochyta), powdery mildew, and sclerotinia stem rot, all of which must be managed carefully. The most serious insect problems are pea aphids, cutworms and grasshoppers.

Table 1. Canadian pea production and pest management schedule

Time of Year	Activity	Action
October - March	Off-season	-
April	Plant care	-
	Soil care	Soil test
	Weed management	Monitor field for overwintering weeds
May	Plant care	Seed crop
	Soil care	Fertilize to recommended soil test
	Disease management	Use seeds treated with root rot fungcides
	Insect & mite management	Monitor for cutworms
	Weed management	Identify and scout for weeds
June	Insect & mite management	Monitor for cutworms Monitor grasshopper forecasts
	Weed management	Spray if necessary for broadleaf weeds and patch treat for perennials if practical.
July	Disease management	Scout for mycosphaerella blight and powdery mildew. Monitor provincial forecasts for these diseases.
	Insect & mite management	Monitor for grasshoppers and aphids and spray if necessary
	Weed management	Follow up on weed problems and observe results from control efforts
August	Plant care	Prepare for harvest and monitor timing of desiccant application
September	Weed management	Monitor for winter annual weed germination and treat or till if necessary

Adapted from BC Ministry of Agriculture, Food and Fisheries crop profiles.
Source(s): Pulse Canada

Abiotic Factors Limiting Production

Key Issues

- The improved predictability of yield and protein is required. The erratic nature of pea yields and protein content hinders the effective management of the crop as growers are unable to plan inputs according to final profitability.

Pod Shattering

Mature pods shatter very easily when dry, thus care must be taken to reduce shattering during swathing or straight combining. Harvesting during the humid part of the day and reducing the reel or pick-up speed can reduce shattering.

Lodging

Tall pea varieties will lodge when there is heavy vegetative growth, heavy seed set, or when there is increased disease pressure. Lodging, also a problem with some of the short, semi leafless peas, can increase problems with harvesting the crop.

Maturity and Growth Habit

Pea has an indeterminate growth habit. Flowering and pod filling will continue simultaneously or alternately as long as temperature and moisture allows growth to occur. A moisture or nitrogen stress is required to encourage seed set and maturity. A registered chemical desiccant can be used to stimulate this process..

Fall Frost

A killing frost in the fall on an immature pea crop can result in a greater amount of immature green seeds and can reduce the quality and value of the crop.

Storage

Due to the heavy respiration of pea seed, extra care should be taken to monitor the grain inside bins for moisture build-up or spoilage. Moisture condensation in the bin can be reduced with the use of aeration fans, cooling the grain in the fall and warming it in the spring. Pea seed is more susceptible to cracking and peeling if handled at temperatures below –20 °C.

Diseases

Key Issues

- There is a need for pea varieties resistant to mycosphaerella blight.
- There is a need for the development of disease modeling/forecasting tools.
- There is a need for the development of fungicide management tools, including fungicide rotations and the evaluation of new strobilurins.

Table 2. Degree of occurrence of disease pests in Canadian field pea production

	Degree of occurrence		
Major Diseases	**AB**	**SK**	**MB**
Mycosphaerella blight	E	E	E
Powdery mildew	E	E	E
Minor Diseases	**AB**	**SK**	**MB**
Root rot	E	E	E
Sclerotinia stem rot	E	E	E
Bacterial blight	E	E	E

Widespread yearly occurrence with high pest pressure
Localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure
Widespread yearly occurrence with low to moderate pest pressure
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low to moderate pest pressure
Pest not present
E – established
D – invasion expected or dispersing

Source(s): Ray McVicar, Penny Pearse, Saskatchewan Agriculture, Food, and Rural Revitalization (SAFRR)

Major Diseases

Mycosphaerella blight (*Ascochyta pinodes*)

Pest information

Damage: The pathogen produces irregular purple spots on leaves, stems, flowers and pods. These spots enlarge and coalesce, drying the tissues and causing blossom drop, stem blight and foot rot. Infected pods may produce infected seeds that are shrunken and discoloured. The impact on yield depends on the timing of the initial infection and weather conditions. When infections originate within the same field, disease can develop early, increasing the likelihood of damage. When initial infections occurs at the base of the plant, foot rot can occur, causing premature lodging and death of plant.

Life Cycle: Infections originate from the soil, stubble, or seed borne inoculum. The pathogen can disperse over long distances through the release of ascospores. Localized spread is assisted

by rain splashing, which carries conidia from plant to plant. Both ascospores and conidia are produced in lesions throughout the growing season.

Pest Management

Chemical Controls: Chlorothalonil, pyraclostrobin and azoxystrobin are registered for the post-emergent control of mycosphaerella blight. Fungicide seed treatments should be used when soil conditions are cool and wet in the early spring.

Cultural Controls: Early planting favours crop establishment and the use of disease-free seed helps to prevent the introduction of the pathogen into new areas. A four year crop rotation and planting as far as possible from fields planted to peas the preceding year helps to reduce infection from soil and stubble borne inoculum. Due to the ability of the pathogen to spread to current crops from infected pea stubble in neighboring fields, crop rotation is not sufficient to prevent infection.

Alternative Controls: Fields should be monitored for disease and control measures applied accordingly.

Resistant Cultivars: No commercial field pea varieties are resistant to the pathogen. Some varieties are more susceptible than others.

Issues for Mycosphaerella blight

1. There is concern that over time the pathogen may develop resistance to the registered fungicides. Pyraclostrobin, which is also registered for powdery mildew, should only be used twice per year in a crop to prevent the development of fungicide resistance.

Powdery Mildew *(Erisyphe polygoni)*

Pest information

Damage: The pathogen causes white powdery spots, composed of conidia and mycelium, on lower leaves and stems. Severely affected crops become covered in a white mat of powdery spores. Infection can result in reduced yields, delayed maturity and reduced uptake of desiccants.

Life Cycle: Infection of pea crops usually begins at bloom (mid July) and continues well into the summer. Although the source of overwintering inoculum has not been confirmed, it is believed that initial infections may arise from ascospores produced in infested crop debris or from long distance spread of conidia originating from the United States. Once the disease is present in a field, conidia produced in infected tissues can cause continued spread of the disease throughout the growing season.

Pest Management

Chemical Controls: Sulphur is registered as a protectant fungicide for the control of the pathogen on field pea. It is only effective when applications are made prior to infection or at the first sign of infection. Repeated applications at 7-10 day intervals may be required if weather conditions are favourable for disease development. Pyraclostrobin and azoxystrobin are also effective in controlling the disease.

Cultural Controls: Early seeding allows the crop to mature past the stage of economic impact prior to extensive development of the disease.

Alternative Controls: Choosing a variety that is less susceptible to the disease is the best strategy for control.

Resistant Cultivars: The majority of field pea varieties grown in Canada are susceptible to powdery mildew. Currently, plant breeders are selecting for resistance to powdery mildew in most new pea lines. As of 2004, all pea varieties in cooperative varietal trials must be resistant.

Issues for Powdery Mildew

1. There is concern over the development of pathogen resistance to the registered strobilurins. The development of alternative disease management techniques and rotation of fungicides are critical to prevent the build-up of resistance.

Minor Diseases

Root Rot (*Pythium* spp., *Rhizoctonia solani*, *Aphanomyces* spp. and *Fusarium* spp.)

Pest information

Damage: The pathogens can attack the root systems and lower stems of pea plants at any time during the growing season. Symptoms include seed rots and seedling blight, stunting, root rot and wilt. Infection results in seed rots, seedling dieback and reduced vigour, growth and yield.

Life Cycle: Root rotting pathogens survive in the soil and may infect seeds, roots and stem bases in the spring. Continuous production of broadleaf crops in the same field can lead to a build-up of root rot and seedling rot pathogens.

Pest Management

Chemical Controls: Seed treatment using fungicides such as metalaxyl, captan and thiram or a combination of fludioxonil and metalaxyl can be used to protect the seedlings in the early stages of plant establishment.

Cultural Controls: Planting into a warm, firm seedbed will promote rapid emergence. Plant stress (poor fertility, water logging, drought, herbicide injury) increases the risk of root rot problems and should be avoided where possible. Using healthy seed with high germination capacity is important because vigorous seedlings have a better chance to withstand early-season infection. Slow emergence due to cool weather or poor seed can result in problems with seed decay and root rot. Cultivars with wrinkled seed release more nutrients when they germinate than those with smooth seed. Nutrients attract the mobile spores of *Pythium*, so pea lines with wrinkled seed are often more susceptible to seedling infection. Similarly, seed damaged by rough handling releases more nutrients during germination and is therefore susceptible to damping-off and seedling blights.

Alternative Controls: None identified

Resistant Cultivars: All pea cultivars are susceptible to seed decay, damping-off and root rot.

Issues for Root Rot

None identified

Sclerotinia stem rot (*Sclerotinia sclerotiorum*)

Pest information

Damage: This disease attacks many broadleaf crops, but is most severe on sunflower, field bean and canola. If infection occurs late in the growing season, there may be little effect on yield; however, the build up of sclerotia in a field may have a negative impact on subsequent broadleaf crops.

Life Cycle: *S. sclerotiorum* overwinters as sclerotia, small, black, resting bodies in the soil, away from the host. Sclerotia may remain viable in soil for three to five years. Sclerotia produce mycelium which causes localized spread of the pathogen or produce apothecia which release ascospores that are dispersed long distances by the wind. Ascospores colonize dying plant tissues such as senescing flower petals, and older or hail-damaged leaves. Once infection has established, it can spread very quickly by plant-to-plant contact, especially when there is moisture under a heavy crop canopy.

Pest Management

Chemical Controls: There are no fungicides registered for the control of sclerotinia stem rot in pea.

Cultural Controls: Peas should not be grown in rotation with broadleaf crops that are susceptible (e.g., sunflowers and canola) any more than one year in four. *S. sclerotiorum* thrives in damp, humid conditions within the crop canopy. Encouraging air movement through the use of semi leafless pea varieties will create less conducive conditions for disease development.

Alternative Controls: None identified.

Resistant Cultivars: There are no resistant varieties available. The semi leafless pea varieties may allow for better air movement through the crop canopy and thus an environment that is less conducive to the disease.

Issues for Sclerotinia Stem Rot

None identified

Bacterial Blight (*Pseudomonas syringae* pv. *pisi*)

Pest information

Damage: Bacterial blight is not common in the pea growing areas. Symptoms start as small, water-soaked spots on leaves, stems and pods. During wet weather, creamy white ooze may appear on the spots. When this material dries, the spots become dark brown and may appear shiny. At this stage, leaf spots appear translucent when held up to the light.

Life Cycle: Initial infections result from inoculum originating from seeds or infested residues of previous crops. The bacteria are spread from diseased to healthy plants by rain-splash. Hail or other physical injury to the plant may favour infection.

Pest Management

Chemical Controls:. There are no pesticides registered for the control of this disease in peas.

Cultural Controls: Practices that encourage rapid emergence of plants will lead to less damage from bacterial blight. Since bacterial blight is primarily seed-borne, obtaining disease-free seeds is important. Crop rotation is also an important method of controlling this disease, since bacteria can overwinter on crop residues.

Alternative Controls: None identified

Resistant Cultivars: There are no resistant varieties available.
Efficacy of Controls: The use of IPM measures as listed in the cultural practices above should be sufficient to limit losses.

Issues for Bacterial Blight

None identified

Table 3. Disease control products, classification and performance for Canadian field pea production

Control product (active ingredient / organism)[1]	Classification[2]	Mode of action – resistance group[3]	PMRA status of active ingredient[4]	Disease, pest, or group of pests targeted	Performance of product according to recommended use[5]	Notes
Azoxystrobin	strobilurin fungicide	11	RR	Mycosphaerella blight	A	
Captan	phthalmide fungicide	M4	RE	Root rot	A	
Chlorothalonil	aromatic fungicide	M5	RE	Mycosphaerella blight	A	
fludioxonil / metalaxyl	pyrolle/anilide fungicide	12 & 4	R	Root rot	A	
Metalaxyl	anilide fungicide	4	R	Root rot	A	

Continued on next page

Control product (active ingredient / organism)[1]	Classification[2]	Mode of action – resistance group[3]	PMRA status of active ingredient[4]	Disease, pest, or group of pests targeted	Performance of product according to recommended use[5]	Notes
Pyraclostrobin	strobilurin fungicide	11	R	Powdery mildew	A	
				Mycosphaerella blight	A	
Sulphur		M2	R	Powdery mildew	A	
Thiram	dithiocarbamate fungicide	M3	RE	Root rot	A	

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

[2] Chemical classification according to "The Compendium of Pesticide Common Names", see http://www.hclrss.demon.co.uk/class_pesticides.html

[3] The mode of action group is based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*

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

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

Source(s): Pulse Canada, Labels as per ELSE database on PMRA website

Table 4. Availability and use of disease management approaches for Canadian field pea production

	Practice \ Pest	Mycosphaerella blight	Powdery mildew
Prevention	tillage		
	residue removal / management		
	water management		
	equipment sanitation		
	row spacing / seeding depth		
	removal of alternative hosts (weeds/volunteers)		
	mowing / mulching / flaming		
Avoidance	resistant varieties		
	planting / harvest date adjustment		
	crop rotation		
	trap crops - perimeter spraying		
	use of disease-free seed		
	optimizing fertilization		
	reducing mechanical damage / insect damage		
	thinning / pruning		
Monitoring	scouting - trapping		
	records to track pests		
	field mapping of weeds		
	soil analysis		
	weather monitoring for disease forecasting		
	grading out infected produce		
Suppression	use of thresholds for application decisions		
	biological pesticides		
	pheromones		
	sterile mating technique		
	beneficial organisms & habitat management		
	pesticide rotation for resistance management		
	ground cover / physical barriers		
	controlled atmosphere storage		
	forecasting for applications		
no information regarding the practice is available			
available/used			
available/not used			
not available			
Source(s): Information in the crop profile for individual pests			

Insects and Mites

Key Issues

- The replacement of organophosphate insecticides with reduced risk insecticides is a priority in pea production.

Table 5. Degree of occurrence of insect pests in Canadian field pea production

	Degree of occurrence		
Major pests	**BC**	**ON**	**QC**
Grasshoppers	E	E	E
Cutworms	E	E	E
Aphids	E	E	E

Widespread yearly occurrence with high pest pressure
Localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure
Widespread yearly occurrence with low to moderate pest pressure
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low to moderate pest pressure
Pest not present
E – established
D – invasion expected or dispersing

Source(s): Pulse Canada

Major Insects and Mites

Grasshoppers (Order: Orthoptera)

Pest information

Damage: Pea is not the preferred crop for grasshoppers as they do not appear to feed on the foliage and dense vegetative growth creates an unfavourable habitat for the insect. However, grasshoppers can cause damage to field pea, especially during the flower to pod-filling stages. The severity of a grasshopper infestation will primarily depend on weather conditions and the level of grasshopper infestation during the previous summer. Grasshoppers occur in years where hot dry weather prevails and tend to pose regional problems. Warm, dry conditions in spring and early summer increases the survival of the hatchlings and the potential for subsequent damage to crops

Life Cycle: Grasshoppers generally have one generation per year in Canada. Egg-laying usually begins in late July and continues into the fall. The female places the egg pods in a cavity in the soil at the margins of fields. Most grasshoppers overwinter as eggs in the soil. Egg hatch usually begins in late April or early May, peaks about mid-June, and is complete by late June. A cool, wet spring will delay egg hatching and slow grasshopper development. These conditions also favour disease organisms that are detrimental to grasshoppers. Newly hatched grasshopper nymphs are about 5 mm in length and resemble the adults, but have wing pads instead of wings and, therefore, cannot fly. There are usually 5 or 6 nymphal instars. Nymphs mature in 35-55 days. The adults may live for 4-6 weeks after mating and egg laying.

Pest Management

Chemical Controls: There are no registered pesticides for grasshoppers in peas. It is usually possible to limit treatment to field perimeters, since this is the area where the insect does the most damage.

Cultural Controls: Cultural methods used to control grasshoppers include early seeding of crops, crop rotation, tillage and trap strips. The control of weeds in early spring can eliminate the green growth that serves as insect host in fields and should be conducted before grasshoppers have hatched.

Alternative Controls: Scouting and established thresholds for should be used. Grasshopper forecast maps are available from the provincial extension services.

Resistant Cultivars: There are no resistant varieties available.

Issues for Grasshoppers

None identified

Cutworm (Pale western- *Agrostis orthogonia* and Red Backed – *Euxoa ochrogaster*)

Pest information

Damage: Cutworms are only an occasional pest of pea crops. Usually, cutworms occur in patches within fields and the insect damages the crop by feeding on the seedlings at or near the soil line. There are several species of the insect that can cause damage to peas.

Life Cycle:

Pest Management

Chemical Controls: Cutworms may cause sufficient damage to require insecticide application. Permethrin is registered for control of red-backed cutworm. Chemical control is available when cutworms exceed economic thresholds (3 to 4/m^2). Spraying is most efficacious when applied at night.

Cultural Controls: The pale western cutworm prefers to lay its eggs in loose soil. Where this insect is a problem, summer fallow should be cultivated before the middle of August and left to crust over or cultivated after the middle of September. In the spring (May) a delay of 5 or more days between cultivation and seeding can prevent infestations. The larvae die if they feed after they hatch and then are deprived of food for several days or can not feed at all for 10-14 days. The downside of this technique is that it reduces the ability of the crop to compete with early germinating weeds. Other cultural methods centre on monitoring. Crop rotation is of limited use since the insect attacks a wide range of hosts.

Alternative Controls: None identified

Resistant Cultivars: There are no resistant varieties available.

Issues for Cutworm

None identified

Pea Aphid *(Acyrthosiphon pisum)*

Pest information

Damage: This insect is only an occasional pest of pea crops. The pea aphid weakens the plant directly by sucking its sap. In addition, pea aphid is responsible for transmitting virus diseases, especially in warmer climates.

Life Cycle: Although pea aphids rarely survive winter in the pea-growing regions, they may overwinter as eggs attached to the stems or leaves of alfalfa or clover. The eggs hatch in early spring and the young aphids feed on the newly emerged alfalfa or clover plants. During May and June, depending on weather and host plant conditions, the aphids develop wings and, with the aid of wind currents, fly to pea fields. The majority of aphids in pea fields are blown in on warm southerly winds from the United States in June or early July.

Pest Management

Chemical Controls: Dimethoate, malathion, methomyl and endosulfan are registered for use in peas. There is evidence that of these pesticides, only dimethoate is in use. Spray applications are recommended during the period when 50% of plants have flowering pods. To avoid a re-occurrence of the problem after spraying, the application of insecticide should be delayed until late flowering. Usually, one application per season should provide satisfactory control. Pea aphid populations usually begin to die off in mid- to late-August due to drying of the crop, parasitic wasps, disease and other causes.

Cultural Controls: Cultural controls centre on insect monitoring**.** Crop rotation is of limited use to suppress this pest because pea aphids attack a variety of hosts and populations can be blown in from long distances,.

Alternative Controls: Economic thresholds for aphids are available. Sampling to determine aphid density should be done when 50-75% of the pea plants are in flower. The threshold in Century peas is 1 to 2 aphids per 20 cm (8 in.) of plant tip at flowering if hand checking or 10 per sweep if using a sweep net. Trapper peas can tolerate higher levels of the pest. Plants infested before the flowers open recover without loss of yield. Economic losses can occur if there are more than 1 to 2 aphids per plant during the period between formation of the tenth node and the appearance of the first flower. Population estimates should be calculated by averaging the counts taken from at least five separate areas of the field.

Resistant Cultivars: The pest appears to have a preference for feeding on certain cultivars.

Issues for Pea Aphid

None identified

Table 6. Insect control products, classification and performance for Canadian field pea production

Control product (active ingredient / organism)[1]	Classification[2]	Mode of action – resistance group[3]	PMRA status of active ingredient[4]	Pests or group of pests targeted	Performance of product according to recommended use[5]	Notes
Dimethoate	aliphatic amide organothiophosphate	1B	RE	Pea aphids	A	
Permethrin	pyrethroid ester	3	R	Cutworms	A	
Malathion	aliphatic amide organothiophosphate	1B	RE	Grasshoppers	A	

[1] Common trade name(s), if provided brackets, are for the purpose of product identification only. No endorsement of any product in particular is implied.
[2] Chemical classification according to "The Compendium of Pesticide Common Names", see http://www.hclrss.demon.co.uk/class_pesticides.html
[3] The mode of action group is based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*
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Source(s): Pulse Canada, Labels as per ELSE database on PMRA website, Pest Management Regulatory Agency

Table 7. Availability and use of insect pest management approaches for Canadian field pea production

	Practice \ Pest	Grasshopper	Cutworm	Aphids
Prevention	tillage			
	residue removal / management			
	water management			
	equipment sanitation			
	row spacing / seeding depth			
	removal of alternative hosts (weeds/volunteers)			
	mowing / mulching / flaming			
Avoidance	resistant varieties			
	planting / harvest date adjustment			
	crop rotation			
	trap crops - perimeter spraying			
	use of disease-free seed			
	optimizing fertilization			
	reducing mechanical damage / insect damage			
	thinning / pruning			
Monitoring	scouting - trapping			
	records to track pests			
	field mapping of weeds			
	soil analysis			
	weather monitoring for disease forecasting			
	grading out infected produce			
Suppression	use of thresholds for application decisions			
	biological pesticides			
	pheromones			
	sterile mating technique			
	beneficial organisms & habitat management			
	pesticide rotation for resistance management			
	ground cover / physical barriers			
	controlled atmosphere storage			
	forecasting for applications			

no information regarding the practice is available

available/used

available/not used

not available

Source(s): Information in the crop profile for individual pests

Weeds

Key Issues

- There is concern over the development of resistance to herbicides in some weeds, such as lamb's quarters and pigweed. Resistance monitoring and management tools need to be established.

Table 8. Degree of occurrence of weed pests in Canadian field pea production

	Degree of Occurrence		
Major weeds	**AB**	**SK**	**MB**
Annual grasses	E	E	E
Temperate broadleaf weeds	E	E	E
Perennial weeds	E	E	E
Minor weeds	**AB**	**SK**	**MB**
Mustard species	E	E	E

Widespread yearly occurrence with high pest pressure
Localized yearly occurrence with high pest pressure OR widespread sporadic occurrence with high pest pressure
Widespread yearly occurrence with low to moderate pest pressure
Localized yearly occurrence with low to moderate pest pressure OR widespread sporadic occurrence with low to moderate pest pressure
Pest not present
E – established
D – invasion expected or dispersing

Source(s): Agriculture Food and Rural Revitalization (SAFRR)

Major Weeds

Peas compete poorly with weeds**,** particularly the semi-leafless varieties. Therefore, selection of a clean field is important. Perennial weeds such as Canada thistle and sow thistle should be controlled in the years prior to pea production. Field pea is susceptible to soil residues of some herbicides used in previous years.

Annual Grasses

Pest information

Damage: Wild oats (*Avena fatua*), wild millet (*Setaria viridis*) and volunteer cereals all occur in pea fields and are present throughout the growing region. These weeds occur in most years. Volunteer cereals can be more serious if harvesting problems the previous season led to shattering/spreading of harvested grain. Wild oats and wild millet are noxious weeds.

Life Cycle: Annual grasses reproduce by seed. Wild oat seeds can remain dormant in the soil for 7 to 8 years but most seeds germinate within 2 years. Warm, dry, fall conditions promote the loss of seed dormancy but dormancy can be induced again the following spring under wet

soil conditions and low temperatures. Wild oats prefer cool weather and moist soil. Wild millet infestations are more severe in years with prevailing hot and dry conditions.

Pest Management

Chemical Controls: As pea producers have adopted reduced tillage and soil conservation techniques, there has been a reduction in the use of pre-plant incorporated herbicides such as trifluralin and triallate for control of grassy weeds. This has led to increasing reliance on Group 1 graminicides such as quizalofop, fluazifop, clethodim and sethoxydim. These products are effective in a wide range of application stages on all of the grassy weed mentioned above.

Cultural Controls: Minimizing tillage tends to reduce populations of wild millet and wild oats because seed remains on the soil surface where it is exposed to weather and birds. Delayed seeding allows for early flushes of wild oats and volunteer cereals, but this technique favours competition from millet and leads to reduced yields. The use of clean, certified seed reduces the introduction of additional weed seed. Deploying harvesting techniques that minimize seed loss in the cereal crop the year prior to growing peas can lead to reduced populations of volunteer cereals. Fall tillage prior to freeze-up can do the same but this practice can leave the soil exposed to erosion.

Alternative Controls: None identified

Issues for annual grassy weeds

1. There is concern with the reliance on Group 1 graminicides and frequency of use of this chemistry. Repetitive use of Group 1 graminicides may lead to the development of weed populations resistant to the entire product chemical group or to members of the group. ACCase and trifluralin resistant wild oats and wild millet are already a concern in the prairies.

Annual Broadleaf

Pest information

Damage: Temperate broadleaf weeds (wild buckwheat, chickweed, cleavers, hemp nettle, volunteer canola, mustard spp.) are a problem in pea crops. Several of these species will germinate in multiple flushes over the early part of the season, making control with non-residual post-emergence chemicals difficult. Such species include cleavers, hemp nettle and chickweed. Recently, volunteer imidazilinone tolerant canola has presented a problem, since the imidazilinone herbicides (imazethapyr, imazamox) do not control these volunteers and can persist in soil creating crop rotation restrictions.

Life Cycle: Annual broadleaf weeds complete their life cycle in one year, going from seed germination, through growth, to seed production. Several of these species will germinate in multiple flushes over the early part of the season, making control with non-residual post-emergence chemicals difficult. Annual weeds are very adept at disseminating through the production of a large numbers of seeds. The critical stage for control of annual weeds is early in the growing season.

Pest Management

Chemical Controls: Reactive measures include the use of imidazilinone chemistries (Pursuit, Odyssey) either alone or mixed with graminicides. The use of metribuzin and MCPA sodium salts has been largely supplanted by these chemistries. Ethalfluralin and trifluralin are registered and are used primarily in the fall. A late-fall application of a phenoxy herbicide

such as 2, 4-D or MCPA can be used to control winter annual broadleaf weeds in fields planned for pea production.

Cultural Controls: Minimizing tillage will keep the weed seeds on the surface of the soil where they are exposed to predators and adverse weather conditions. Early seeding is important as allows the crop to better compete with annual grasses. Use of varieties that are leafy will provide better competition with weeds and is particularly useful for gaining control of later flushes of weeds that may emerge after a post-emergence chemical is applied. However, these leafy varieties are more susceptible to disease.

Alternative Controls: None identified

Issues for annual broadleaf weeds

1. The reliance on the imidazilinone chemistry to control annual broadleaf weeds in field pea crops is a concern. While the product group is well suited for the weed spectrum in peas, gaps in control in terms of volunteer imidazilinone-tolerant canola are an issue for growers who use this type of canola.
2. The move towards breeding semi-leafless peas has brought better standability, improved air circulation, and reduced disease in the crops but has led to less vigorous competition with weeds.

Perennial Broadleaf Weeds

Pest information

Damage: Canada thistle (*Cirsium arvensis*) and sow thistle (*Sonchus arvensis L.*) are noxious weeds and have been reported as becoming increasingly problematic. These weeds have flourished as more growers have adopted minimum tillage and continuous cropping.

Life Cycle: Both of these weeds spread by seed and by root parts. Thistle patches along the field margins are often a major source of invasion. Both thistle species have a deep, penetrating root systems and can survive by generating shoots from this underground root system. Both spread by seed as well, with sow thistle seeds travelling somewhat further in wind than those of Canada thistle.

Pest Management

Chemical Controls: If the weeds occur in small, distinct patches, monitoring and spot spraying is very useful. Field-scale infestations require a combination of control measures over several years. Careful record keeping on herbicide applications is essential to base decisions on when planning for future treatments, to minimize potential weed resistance problems and to prevent crop injury from herbicide carryover. The three main periods for controlling thistles are: in-crop, preharvest and post-harvest.

Cultural Controls: Maintaining good fertility will maximize crop vigour and competitiveness.

Alternative Controls: There are several beneficial options available for controlling perennial weeds and prevent damage to peas**.** These measures are deployed at other points in the rotation – not in-crop.

Issues for perennial broadleaf weeds

1. Preplanning and particular care is required to clean as much as possible the infested fields to be seeded to peas in the year of seeding.

Table 9. Weed control products, classification and performance for Canadian field pea production

Control product (active ingredient / organism)[1]	Classification[2]	Mode of action – resistance group[3]	PMRA status of active ingredient[4]	Pests or group of pests targeted	Performance of product according to recommended use[5]	Notes
Clethodim	cyclohexene oxime herbicide	1	R	Annual grasses	A	Resistance is a growing problem with the Group 1 chemistries.
Ethalfluralin	dinitroanaline herbicide	3	R	Broadleaf and grassy weeds	A^p	Controls some weeds but relies on good moisture for activity and requires tillage to incorporate – leading to soil conservation issues.
Fluazifop	aryloxyphenoxyprionic herbicide	1	R	Annual grasses	A	Resistance is a growing problem with the Group 1 chemistries.
Imazethapyr	imidazilinone herbicide	2	R	Broadleaf and grassy weeds	A^p	Will not control imi-tolerant volunteer canola
Imazethapyr + Imazamox	imidazilinone herbicide	2	R	Broadleaf and grassy weeds	A^p	Will not control imi-tolerant volunteer canola
MCPA Sodium salt	phenoxyacetic herbicide	4	R	Broadleaf weeds (annual)	A^p	Chiefly controls mustards, lambs quarters but not effective on the bulk of the weed spectrum prevalent in peas.
Metribuzin	triazinone herbicide	5	R	Limited broadleaf weed spectrum	I	-

Continued on next page

Control product (active ingredient / organism)[1]	Classification[2]	Mode of action – resistance group[3]	PMRA status of active ingredient[4]	Pests or group of pests targeted	Performance of product according to recommended use[5]	Notes
Quizalofop	penoxypronpionic herbicide	1	R	Annual grasses	A	Resistance is a growing problem with the Group 1 chemistries.
Sethoxydim	cyclohexene oxime herbicide	1	R	Annual grasses	A	Resistance is a growing problem with the Group 1 chemistries.
Trifluralin	dinitroanaline herbicide	3	R	Broadleaf and grassy weeds	A^p	Controls some weeds but relies on good moisture for activity and requires tillage to incorporate – leading to soil conservation issues.

[1] Common trade name(s), if provided brackets, are for the purpose of product identification only. No endorsement of any product in particular is implied.
[2] Chemical classification according to "The Compendium of Pesticide Common Names", see http://www.hclrss.demon.co.uk/class_pesticides.html
[3] The mode of action group is based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*
[4] R-full registration (non-reduced risk), RE-under re-evaluation, DI-discontinued, BI-full registration (biological), RR- full registration (reduced risk), OP-full registration (organophosphate replacement), NR-not registered. Not all end-use products will be classed as reduced-risk. Not all end use products containing this active ingredient may be registered for use on this crop. Individual product labels should be consulted for up to date accurate information concerning specific registration details. The information in these tables should not be relied upon for pesticide application decisions. The following website can be consulted for more information on pesticide registrations: http://www.eddenet.pmra-arla.gc.ca/4.0/4.0.asp
[5] A – Adequate (the pest control product (PCP), according to recommended use, maintains disease below economic threshold OR provides acceptable control), A^P – Provisionally adequate (the PCP, while having the ability to provide acceptable control, possesses qualities which may make it unsustainable for some or all uses), I – Inadequate (the PCP, according to recommended use, does not maintain disease below economic threshold OR provides unacceptable control)

Source(s): Pulse Canada, Labels as per ELSE database on PMRA website, Pest Management Regulatory Agency, Saskatchewan Agriculture, Food and Rural Revitalization (SAFRR).

Table 10. Availability and use of weed pest management approaches for Canadian field pea production

	Practice \ Pest	Annual grasses	Annual broadleaf	Perennial broadleaf
Prevention	tillage			
	residue removal / management			
	water management			
	equipment sanitation			
	row spacing / seeding depth			
	removal of alternative hosts (weeds/volunteers)			
	mowing / mulching / flaming			
Avoidance	resistant varieties			
	planting / harvest date adjustment			
	crop rotation			
	trap crops - perimeter spraying			
	use of disease/weed free seed			
	optimizing fertilization			
	reducing mechanical damage / insect damage			
	thinning / pruning			
Monitoring	scouting - trapping			
	records to track pests			
	field mapping of weeds			
	soil analysis			
	weather monitoring for disease forecasting			
	grading out infected produce			
Suppression	use of thresholds for application decisions			
	biological pesticides			
	pheromones			
	sterile mating technique			
	beneficial organisms & habitat management			
	pesticide rotation for resistance management			
	ground cover / physical barriers			
	controlled atmosphere storage			
	forecasting for applications			

no information regarding the practice is available

available/used

available/not used

not available

Source(s): Information in the crop profile for individual pests

References used in this document

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Government of Alberta www.agric.gov.ab.ca/navigation/crops/pulses/

Government of Manitoba www.gov.mb.ca/pulse/agriculture/crops/pulsecrops

Government of Saskatchewan www.agr.gov.sk.ca
Dry Pea in Saskatchewan (Fact sheet, 2003)
Special Crop Report (2003)
Guide to Crop Protection 2003

Pulse Canada www.pulsecanada.com

Saskatchewan Pulse Growers www.saskpulse.com

Statistics Canada www.statcan.ca

Government of British Columbia www.agf.gov.bc.ca

Table 11. Research contacts related to pest management in Canadian field pea production

Name	Organization	Pest type	Specific pests	Type of research
Bruce Gossen	AAFC Saskatoon, SK	Diseases	All	IPM, breeding
Byron Irving	AAFC Brandon, MN	Weeds, diseases and insects	All	IPM, general agronomy
Dave McAndrew	AAFC Morden, MN	All	Agronomy/all	IPM, general agronomy
Eric Johnson	Scott Research Station, Scott, SK	Weeds	All	IPM
Neil Harker	AAFC Lacombe, AB	Weeds	Weeds	IPM Weeds
Penny Pearse	SAFRR , Regina, SK	Diseases	Extension/all	IPM
Ray McVicar	SAFRR, Regina, SK	Weeds, diseases and insects	Extension/all	IPM
Rick Holm	University of Saskatchewan, Saskatoon, SK	Weeds, diseases	Agronomy	IPM, general agronomy
Yantai Gan	AAFC Swift Current, SK	Weeds, diseases and insects	All	IPM - systems