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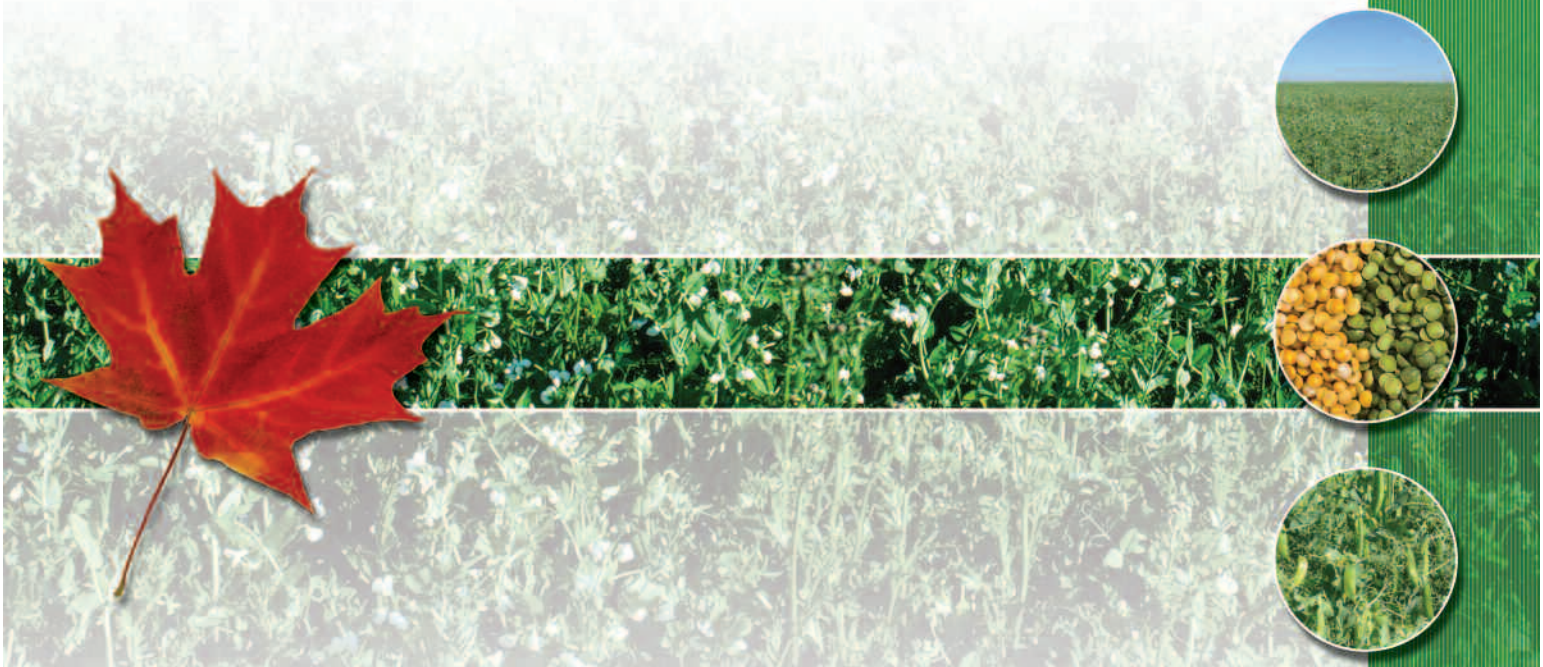

Crop Profile for Field Pea in Canada

Prepared by:

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Canada

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Crop Profile for Field Pea in Canada

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Acknowledgments

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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.

Use of Information

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.

Information on pesticides and pest control techniques are provided for information purposes only. No endorsement of any of the pesticides or pest control techniques discussed is implied.

This publication is not intended for use as a production guide. Growers are referred to provincial publications for crop production information for their region.

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.

Preface

National crop profiles are developed under the Pesticide Risk Reduction Program (PRRP), a joint program of Agriculture and Agri-Food Canada (AAFC) and the Pest Management Regulatory Agency (PMRA). The objective of the program is to reduce the risks to the environment and to human health from pesticide use in agriculture. To achieve this objective, the PRRP works with grower groups, industry and provinces to develop issue specific pesticide risk reduction strategies. The crop profiles provide baseline information on crop production and pest management practices and document pest management needs and issues faced by growers, information used in the development of risk reduction strategies.

Information contained in the crop profiles is developed through extensive consultation with stakeholders. Pest management information is collected by provincial focus groups through the "Canadian Expert Poll on Crop Protection" a software tool developed by the PMRA.

For detailed information on growing field peas, the reader is referred to provincial crop production guides, provincial ministry websites and other resources listed at the end of the document.

For inquiries regarding the contents of the profile, please contact:

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Crop Profile for Field Peas in Canada

Field peas (also known as dry peas), belong to the family of cool season legume crops (Leguminosae) 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 1,261,000 ha in 2007. Field peas are currently grown in Alberta, Saskatchewan and Manitoba (Table 2).

Crop Production

Industry Overview

Table 1. General Production Information

Canadian Production (2007)	2,520,000 metric tonnes 1,261,000 hectares
Farm gate value (2003)	$372 million
Domestic consumption (2007)	846,000 metric tonnes
Export (2007)	1,969,000 metric tonnes
Import (2007)	60,000 metric tonnes
Source(s): Statistics Canada	

Production Regions

Table 2. Distribution of Field Pea Production in Canada

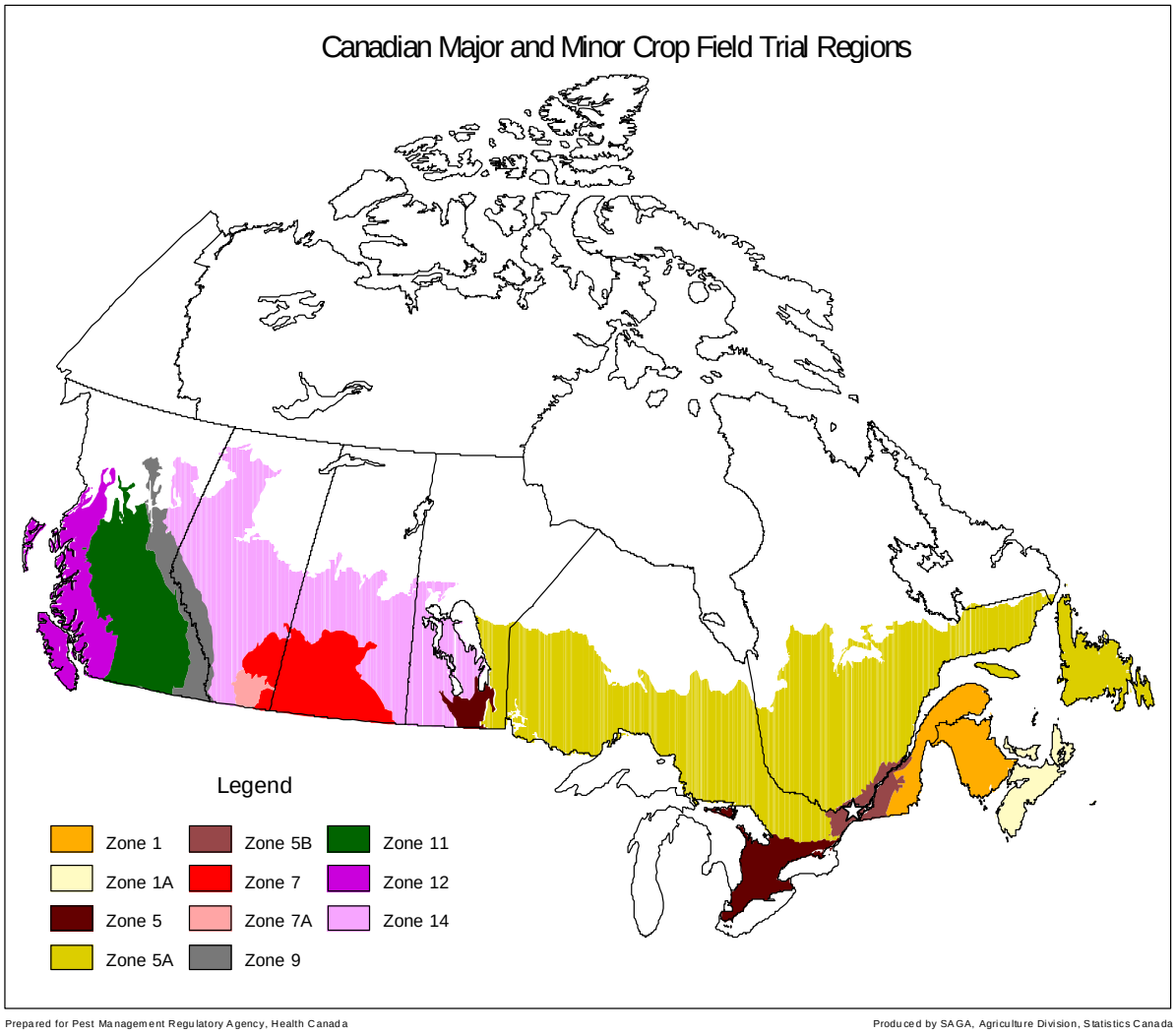
Production Regions	Production		% National Production
	hectares	tonnes	
Alberta	254,900	586,100	18%
Saskatchewan	1,121,000	2,126,900	79%
Manitoba	32,400	91,000	2%
Canada	1,410,300	2,806,300	

Source: Statistics Canada Catalogue No. 22-002-X1B, Vol. 85, no.8, Seasonal / ISSN 1488-9900 (2006)

Crop Production

Figure 1. Common Zone Map: Canadian Major and Minor Field Trial Regions

The major and minor crop field trial regions were developed following extensive stakeholder consultation and have been harmonized between the Pest Management Regulatory Agency (PMRA) of Health Canada and the Environmental Protection Agency of the USA. The identified regions are used for experimental studies in support of residue chemistry data requirements for the registration of new pesticide uses. The regions are based on soil type and climate and do not correspond to plant hardiness zones. For additional information, please consult the PMRA Directive 98-02 Residue Chemistry Guidelines (www.hc-sc.gc.ca/cps-spc/pubs/pest/_pol-guide/dir98-02/index-eng.php)



Cultural Requirements

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 field 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. . 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.

Field 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.

Field 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.

Table 3. Canadian field pea production and pest management schedule

Time of Year	Activity	Action
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 fungicides
	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

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

Abiotic Factors Limiting Production

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.

General Production Issues

1. 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.

2. 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, although to some degree, breeders have solved the problem with semi-leafless varieties that stand up better than older, leafy varieties.

Pest Management Overview

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. Broadleaf and perennial weeds are a significant problem in pea crops.

The following disease, insect and mite and weeds sections provide detailed information on pests affecting field pea. Pest management issues are presented at the beginning of each section and also with the write-ups for each pest. In each section, the issues are followed by a series of tables that provide information on pest occurrence, integrated pest management (IPM) practices and chemical controls as follows;

Tables 4, 8 and 12: Disease, insect or weed occurrence and severity and is presented on a provincial basis.

Tables 5, 9 and 13: Integrated pest management information is provided on an individual pest basis.

Tables 6, 10 and 14: List all fungicides, insecticides and herbicides registered for field pea.

Tables 7, 11 and 15: List registered pesticides on a disease, insect or weed group basis, respectively and provide stakeholder comments on efficacy.

Further information for each pest is provided under individual pest write-ups following the tables in each section.

For detailed information on pest management and growing the crop in specific regions, the reader is referred to provincial crop production guides, provincial ministry websites and other references listed in the Resources Section at the end of the document.

Diseases

Key Issues

- There is a need for the development and extension of management packages (IPM) for mycosphaerella blight. As part of this package, field pea varieties that are resistant to this disease, are required.
- There is concern that over time *Ascochyta pinodes* may develop resistance to registered fungicides.
- Pea prices have been low and thus farmers have been reluctant to spray for mycosphaerella blight. It may be that they are under-managing this disease due to cost concerns.
- 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.
- There is concern over the development of resistance of powdery mildew to the registered strobilurins. The development of alternative disease management techniques and rotation of fungicides is critical to prevent the build-up of resistance.
- There is a growing concern about the impact of root rot on yield. A better understanding of the impact of this disease needs to be developed.
- The prevalence of downy mildew is increasing in Alberta, possibly as a result of seed infections.

Table 4. Degree of occurrence of disease pests in Canadian field pea production

	Degree of occurrence		
Diseases	**Alberta**	**Saskatchewan**	**Manitoba**
Mycosphaerella blight	E	E	E
Powdery mildew	E	E	E
Root rot	E	E	E
Sclerotinia stem rot	E	E	E
Bacterial blight	E	E	E
Downy mildew	E	DNR	DNR

Widespread yearly occurrence with high pest pressure

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

Widespread yearly occurrence with low to moderate pest pressure

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

DNR - data not reported

Pest not present

E – established

D – invasion expected or dispersing

Source(s): *Canadian Expert Poll on Crop Protection* field pea focus groups for Alberta and Saskatchewan (2007).

Table 5. Availability and use of disease management approaches for Canadian field pea production

	Practice \ Pest	Mycosphaerella blight	Powdery mildew	Root rot	Sclerotinia stem rot	Bacterial blight	Downy 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						
	choice of planting site						
Monitoring	scouting - trapping						
	records to track pests						
	field mapping of weeds						
	soil analysis						
	weather monitoring for disease forecasting						
Decision making tools	economic threshold						
	weather/ weather based forecast/predictive model						
	recommendation from crop specialist						
	first appearance of pest or pest life stage						
	observed crop damage						
	crop stage						
	calendar spray						
	biological pesticides						
	beneficial organisms & habitat management						
	pesticide rotation for resistance management						
	ground cover / physical barriers						

no information regarding the practice is available

available/used

available/not used

not available

Source(s): *Canadian Expert poll on Crop Protection* field pea focus groups for Alberta and Saskatchewan (2007).

Table 6. Fungicides registered on field pea in Canada.

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
azoxystrobin (Quadris Flowable Fungicide)	methoxyacrylates	respiration, C3: complex III: cytochrome bc1(ubiquinol oxidase) at Qo site (cyt b gene) / 11	RR	Asian (Soybean) Rust (*Phakopsora pachyrhyizi*)
				powdery mildew (*Microsphaera diffusa*, *Erysiphe pisi*, *E. polygoni*)
				ascochyta blight (*Ascochyta* spp.)
				mycosphaerella blight (*Mycosphaerella pinodes*)
				anthracnose (*Colletotrichum* spp.)
azoxystrobin / propiconazole (Quilt Fungicide)	methoxyacrylates / triazoles	respiration C3: complex III -cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene) / 11 and sterol biosynthesis in membranes G1: C14-demethylase in sterol biosynthesis (erg11/cyp51) / 3	R	Asian (Soybean) Rust (*Phakopsora pachyrhyizi*)
***Bacillus subtilis* QST 713 (Serenade Max)**	bacteria	unclassified (biological)	BI	white mold or Sclerotinia stem rot (*Sclerotinia sclerotiorum*)
				botrytis pod rot or Botrytis blight (*Botrytis cinerea*)
boscalid (Lance WDG Fungicide)	pyridinecarboxamides	respiration, C2: complex II: succinatedehydrogenase / 7	RR	ascochyta blight (*Ascochyta* spp.)
				gray mold (*Botrytis cinerea*)
				mycosphaerella blight (*Mycosphaerella* spp.)
captan (Captan Flowable Seed Treatment Fungicide)	phthalimides	multi-site contact activity / M4	R	protect seeds from rot in storage and after planting from seed decay, root rot, damping-off and seedling blight.

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
carbathiin / thiram (VitaFlo 280 Fungicide, Anchor Systemic Contact & Seed Protectant)	anilide (oxathiin) / dithiocarbamates and relatives	affect mitochondrial transport chain / 7 and multi-site contact activity / M3	RE	seed rot and seedling blight caused by *Mycosphaerella* (*Ascochyta*), *Fusarium* spp., *Rhizoctonia solani* and *Pythium.*
chlorothalonil (Bravo 500 Agricultural Fungicide)	chloronitriles (phthalonitriles)	multi-site contact activity / M5	R	ascochyta blight (*Mycospharella pinodes*)
fludioxonil (Maxim 480 FS Colourless Seed Treatment Fungicide)	phenylpyrroles	signal transduction E2; MAP/Histidine-Kinase in osmotic signal transduction (os-2, HOG1) / 12	RR	seed-borne and soil-borne disease caused by *Fusarium* spp. (including seedling diseases due to *F. graminearum*) and *Rhizoctonia* spp.
fludioxonil / metalaxyl-m and s-isomer (Apron Maxx RTA Seed Treatment Fungicide)	phenylpyrroles / acylalanines	signal transduction E2: MAP/Histidine-Kinase in osmotic signal transduction (os-2, HOG 1) / 12 and nucleic acids synthesis A1: RNA polymerase I / 4	RR, RE	seed-borne Ascochyta blight and foot root caused by *Ascochyta pinodes.* seed rot/pre-emergence damping-off, post-emergence damping-off and seedling blight caused by *Fusarium* spp., *Pythium* spp. and *Rhizoctonia* spp.
metalaxyl (Apron FL Seed Treatment)	acylalanines	nucleic acids synthesis A1: RNA polymerase I / 4	RE	seed rots and seedling blights downy mildew

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
metalaxyl-m and s-isomer (Apron XL LS Fungicide)	acylalanines	nucleic acids synthesis A1: RNA polymerase I / 4	RR, RE	*Pythium* damping-off early season *Phytophthora* root rot
propiconazole (Tilt 250E Fungicide)	triazoles	sterol biosynthesis in membranes G1: C14-demethylase in sterol biosynthesis (erg11/cyp51) / 3	R	Asian (Soybean) Rust (*Phakopsora pachyrhyizi*)
				powdery mildew (*Microsphaera diffusa*, *Erysiphe pisi*, *E. polygoni*)
pyraclostrobin (Headline EC Fungicide)	methoxycarbamates	respiration C3: complex III-cytochrome bc1 (ubiquinol oxidase) at Qo site(cyt b gene) / 11	R	mycosphaerella blight (*Mycosphaerella* spp.)
				powdery mildew (*Erysiphe* spp.)
				Asian soybean rust (*Phakopsora pachyrhizi*)
sulphur (Kumulus DF Water Dispersible Granular Fungicide and Acaricide)	inorganic	multi-site contact activity / M2	R	powdery mildew
thiram (Thiram 75WP Wettable Powder Fungicide)	dithiocarbamates and relatives	multi-site contact activity / M3	RE	seed decay, seedling blight and damping-off

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

[2]The classification and the mode of action group are based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action. The document is under revision and up-to-date information can be found on the following web sites: Herbicides: www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; Insecticides: www.irac-online.org/Crop_Protection/MoA.asp#area223 ; fungicides: www.frac.info/frac/index.htm

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

[4] Please consult the product label on the PMRA web site (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php) for specific listing of pests controlled by each active ingredient.
[5]Source: Pest Management Regulatory Agency

Table 7. Performance and use of fungicides for the control of diseases on field pea in Canada

Pests or Group of Pests targeted	Active ingredient[1]	Resistance group[2]	Stakeholder comments[3,4]	
			Performance[3]	Notes
ascochyta blight / Mycospahaerella blight	azoxystrobin	11	A	Application must be made at onset of flowering. Control is dependent on weather effects. Growers generally struggle with the economics of spraying.
	boscalid	7		
	fludioxonil / metalaxyl	12:04		Growers generally struggle with the economics of spraying.
	chlorothalonil	M5		Growers generally struggle with the economics of spraying.
	carbathiin / thiram	7 / M3	A	Controls seed borne ascochyta as well as root rots. Gradual loss in efficacy can occur with repeated use in same field. Growers generally struggle with the economics of spraying.
	pyraclostrobin	11	A	Rotation of fungicides is important in managing this disease. Could expand peas to the eastern side of the province. Growers generally have struggled with the economics of spraying.
anthracnose	azoxystrobin	11		
Asian (Soybean) Rust (*Phakopsora pachyrhyizi*)	azoxystrobin	11		
	azoxystrobin/ propiconazole	11;3		
	propiconazole	3		
	pyraclostrobin	11	A	
Botrytis blight/ botrytis pod rot/ gray mold	boscalid	7		
	Bacillus subtilis QST 713 (Serenade Max)	unclassified		
downy mildew	metalaxyl	4		

Pests or Group of Pests targeted	Active ingredient[1]	Resistance group[2]	Stakeholder comments[3,4]	
			Performance[3]	Notes
powdery mildew	azoxystrobin	11		
	pyraclostrobin	11	A	Most new varieties of pea are resistant to powdery mildew and thus use of crop protection products is not common.
	sulpher	M2		
	propiconazole	3		
root rot	captan	M4		
	fludioxonil/ metalaxyl	12; 4	A	Two modes of action control a wide variety of root rots.
	metalaxyl	4	A	Controls pythium at low end of rate range; some evidence of loss of control due to resistant strains.
	thiram	M3		
Seed rots/ damping off/ seedling blights	captan	M4		Not used.
	carbathiin/ thiram	7 / M3	A	Gradual resistance can occur with continued use in same fields.
	fludioxonil	12		
	fludioxonil / metalaxyl	12;4		Two actives control a wider spectrum of diseases.
	metalaxyl	4		
	metalaxyl-m	4		
	thiram	M3		Concern that gradual resistance may be developing.
white mould; sclerotinia stem rot	*Bacillus subtilis* QST 713 (Serenade Max)	unclassified		

[1] List includes all active ingredients registered as of Feb. 22, 2008. Please consult product labels on the PMRA web site (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php) for further information on pesticide use.

[2]The resistance 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. The document is under revision and up-to-date information can be found on the following web sites: Herbicides: www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; Insecticides: www.irac-online.org/Crop_Protection/MoA.asp#area223 ; Fungicides: www.frac.info/frac/index.htm

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

[4]Source(s) - "Canadian Expert Poll on Crop Protection" Focus Groups for Alberta and Saskatchewan (2007).

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 occur at the base of the plant, foot rot can occur, causing premature lodging and death of plant.

Life Cycle: Infections originate from 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

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

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

Chemical Controls: Several fungicides 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.

Issues for Mycosphaerella blight

1. There is a need for the development and extension of management packages (IPM) for mycosphaerella blight. As part of this package, field pea varieties that are resistant to this disease, are required.
2. There is concern that over time *Ascochyta pinodes* may develop resistance to registered fungicides.
3. Pea prices have been low and thus farmers have been reluctant to spray for mycosphaerella blight. It may be that they are under-managing this disease due to cost concerns.

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

Cultural Controls: Early seeding allows the crop to mature past the stage of economic impact prior to extensive development of the disease. Choosing a variety that is less susceptible to the disease is the best strategy for control.

Resistant Cultivars: Currently, plant breeders are selecting for resistance to powdery mildew in most new pea lines. There are some excellent varieties out now that are resistant to this disease.

Chemical Controls: Repeated fungicide applications at 7-10 day intervals may be required if weather conditions are favourable for disease development.

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.

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

Cultural Controls: Planting into a warm, firm seedbed will promote rapid emergence. Plant stress, due to poor fertility, water logging, drought and 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.

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

Chemical Controls: Fungicide seed treatments will protect seedlings in the early stages of plant establishment.

Issues for Root Rot

1. There is growing concern about the impact of root rot on yield. A better understanding of the impact of this disease needs to be developed.

Sclerotinia stem rot (*Sclerotinia sclerotiorum*)

Pest information

Damage: This disease attacks many broadleaf crops, but is most severe on sunflower, field bean and canola. In field peas, the disease causes a soft rot of pods, leaves and stems. Stem lesions become dry and bleached and yields may be significantly affected. However, if infection occurs late in the growing season, there may be little effect on yield. Sclerotia may contaminate harvested seed and 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 wind. Ascospores colonize dying plant tissues such as senescing flower petals and older or hail-damaged leaves. Once the infection is established, it can spread very quickly by plant-to-plant contact, especially when there is moisture under a heavy crop canopy.

Pest Management

Cultural Controls: Peas should not be grown in rotation with broadleaf crops that are susceptible to sclerotinia stem rot (e.g., sunflowers and canola) more than one year in four. *S. sclerotiorum* thrives in damp, humid conditions within the crop canopy.

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 provide an environment that is less conducive to the disease.

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

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 infections.

Pest Management

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.

Resistant Cultivars: There are no resistant varieties available.

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

Issues for Bacterial Blight

None identified.

Downy mildew (*Peronospora viciae*)

Pest information

Damage: Downy mildew first appears on the lower leaves of the plants. The undersides of the leaves become covered with a grey 'fluff' and the upper surfaces of the leaves develop a yellow blotching. Pods become covered with blotching and can become malformed with reduced seed set.

Life Cycle: The downy mildew fungus overwinters in seeds, in the soil and on pea trash. Systemic and leaf infections of seedlings may occur from these sources. The infected seedlings then act as a reservoir of disease for surrounding plants..

Pest Management

Cultural Controls: Sowing disease free seed, destroying infected tissue (tillage) after harvest and using a one in four year rotation helps to minimize this disease.

Resistant Cultivars: There are some varieties that are partially resistant to downy mildew.

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

Issues for Downy Mildew

1. The prevalence of downy mildew is increasing in Alberta, possibly as a result of seed infections.

Insects and Mites

Key Issues

- The replacement of organophosphate insecticides with reduced risk insecticides is a priority in field pea production.
- Pea leaf weevil (*Sitona lineata*), is becoming an issue in southern Alberta.

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

	Degree of occurrence		
Major pests	**Alberta**	**Saskatchewan**	**Manitoba**
Grasshoppers	E	E	E
Cutworms	E	E	E
Pea aphid	E	E	E
Pea leaf weevil	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
DNR - data not reported
Pest not present
E – established
D – invasion expected or dispersing

Source(s): *Canadian Expert Poll on Crop Protection* field pea focus groups for Alberta and Saskatchewan (2007).

Table 9. Availability and use of insect pest management approaches for field pea production in Canada.

	Practice \ Pest	Grasshopper	Cutworm	Pea aphid	Pea leaf weevil
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				
	choice of planting site				
Monitoring	scouting / trapping				
	records to track pests				
	field mapping of weeds				
	soil analysis				
	grading out infected produce				
Decision making tools	economic threshold				
	weather/ weather based forecast/predictive model				
	recommendation from crop specialist				
	first appearance of pest or pest life stage				
	observed crop damage				
	crop stage				
	calendar spray				
Suppression	biological pesticides				
	pheromones				
	sterile mating technique				
	beneficial organisms & habitat management				
	pesticide rotation for resistance management				
	ground cover / physical barriers				
	controlled atmosphere storage				
	trapping				

no information regarding the practice is available

available/used

available/not used

not available

Source(s): *Canadian Expert poll on Crop Protection* field pea focus groups for Alberta and Saskatchewan (2007).

Table 10. Insecticides registered on field pea in Canada.

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
carbaryl (Sevin Brand 50W Carbaryl Insecticide)	carbamates	acetylcholine esterase inhibitors / 1A	RE	alfalfa looper
diazinon (Diazol 50W, Diazinon 50 W Insecticide)	organophosphates	acetylcholine esterase inhibitors / 1B	RE	seed corn maggot root maggots
dimethoate (Cygon 480 Systemic Insecticide, Lagon 480E Insecticide)	organophosphates	acetylcholine esterase inhibitors / 1B	RE	aphids
endosulfan (Thionex 50 WP, Thiodan 4EC)	cyclodiene organochlorines	GABA-gated chloride channel antagonists / 2A	RE	aphid weevil
lambda-cyhalothrin (Matador 120 EC Insecticide, Warrior Insecticide)	pyrethroids	sodium channel modulators / 3	R	bean leaf beetle cutworms grasshoppers pea aphid
malathion (Fyfanon 50%EC, Malathion 500E Insecticide)	organophosphates	acetylcholine esterase inhibitors / 1B	RE	leafhopper pea aphids pea moths pea weevil spider mites
methomyl (Lannate L Insecticide)	carbamates	acetylcholine esterase inhibitors / 1	RE	alfalfa looper pea aphid
naled (Dibrom Insecticide)	organophosphates	acetylcholine esterase inhibitors / 1B	RE	alfalfa looper aphids red spider mites

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
permethrin (Ambush 500 EC, Pounce 384 EC Insecticide)	pyrethroids	sodium channel modulators / 3	R	cutworms (army, black, dark-sided, pale western, red-backed and white)
pirimicarb (Pirimor 50 DF Dry Flowable Insecticide)	carbamates	acetylcholine esterase inhibitors / 1A	RE	pea aphid
potassium salts of fatty acids (Neudosan commerical, Opal Insecticidal Soap)	unclassified	unclassified	R	aphids
				mites
				whiteflies
thiamethoxam (Cruiser 5FS Seed Treatment)	neonicotinoids	nicotinic acetylcholine receptor agonists / antagonists/ 4A	R	potato leafhopper
				seed corn maggot
				wireworms

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

[2]The classification and the mode of action group are based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action. The document is under revision and up-to-date information can be found on the following web sites: Herbicides: www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; Insecticides:www.irac-online.org/Crop_Protection/MoA.asp#area223 ; Fungicides: www.frac.info/frac/index.htm

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

[4] Please consult the product label on the PMRA web site (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php.) for specific listing of pests controlled by each active ingredient.

[5]Source: Pest Management Regulatory Agency

Table 11. Performance and use of insecticides registered for the control of insect pests of field pea in Canada.

Pests or Group of Pests targeted	Active ingredient[1]	Resistance group[2]	Stakeholder comments[3,4]	
			Performance[3]	Notes
alfalfa looper	carbaryl	1A		Not used in peas.
	naled	1B		
	methomyl	1		
aphids	dimethoate	1B		
	endosulfan	2A		Rarely used
	naled	1B		
	potassium salts of fatty acids	unclassified		
aphids (pea)	dimethoate	1B	A	Must use the higher rate within the range if there are dense populations of phids. Used on less than 1% of hectares.
	lambda-cyhalothrin	3	A	Must be applied when temperatures are cool for maximum efficacy. Also has good efficacy for pea weevils
	malathion	1B		
	methomyl	1		Rarely used.
	pirimicarb	1A		
bean leaf beetle	lambda-cyhalothrin	3		
cutworms	lambda-cyhalothrin	3		
	permethrin	3	A	
grasshoppers	malathion	1B	A	Rarely used.
	lambda-cyhalothrin	3		

Pests or Group of Pests targeted	Active ingredient[1]	Resistance group[2]	Stakeholder comments[3,4]	
			Performance[3]	Notes
leafhopper	malathion	1B		
pea moths	malathion	1B		
pea weevil	malathion	1B		
potato leafhopper	thiamethoxam			
root maggot	diazinon	1B		Rarely used.
seedcorn maggot	diazinon	1B		Rarely used.
	thiamethoxam			
spider mites	malathion	1B		
	naled	1B		
	potassium salts of fatty acids	unclassified		
weevil	endosulfan	2A		Rarely used.
whiteflies	potassium salts of fatty acids	unclassified		
wireworms	thiamethoxam			

[1] List includes all active ingredients registered as of Feb. 22, 2008. Please consult product labels on the PMRA web site (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php) for further information on pesticide use.

[2]The resistance 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. The document is under revision and up-to-date information can be found on the following web sites: Herbicides: www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; Insecticides: www.irac-online.org/Crop_Protection/MoA.asp#area223 ; Fungicides:www.frac.info/frac/index.htm

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

[4]Source(s) - "Canadian Expert Poll on Crop Protection" Focus Groups for Alberta and Saskatchewan (2007).

Grasshoppers (Order: Orthoptera)

Pest information

Damage: Field 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 increase 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

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

Resistant Cultivars: There are no resistant varieties available.

Chemical Controls: It is usually possible to limit treatment to field perimeters, since this is the area where the insect does the most damage.

Issues for Grasshoppers

None identified.

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

Pest information

Damage: Cutworms are only an occasional pest of field 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.

Life Cycle: The pale western and red-backed cutworms have similar life cycles. Both have one generation per year. Eggs are laid in soil in the fall. The eggs hatch in the spring and larvae begin to feed on stems at or below the soil surface. When full grown they enter a pre-pupal stage. Pupation occurs in the fall. Adults emerge in the early fall and following mating, lay eggs in the soil.

Pest Management

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 if they cannot 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 crops.

Resistant Cultivars: There are no resistant varieties available.

Chemical Controls: Cutworms may cause damage sufficient to require insecticide application. Chemical control is available when cutworms exceed economic thresholds (3 to 4/m^2). Spraying is most efficacious when done at night.

Issues for Cutworm

None identified.

Pea Aphid *(Acyrthosiphon pisum)*

Pest information

Damage: This insect is only an occasional pest of field pea crops. The pea aphid weakens the plant directly by sucking its sap. In addition, the 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

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. 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.

Chemical Controls: A number of insecticides are registered for use in peas. 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 provides 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.

Issues for Pea Aphid

None identified.

Pea leaf weevil *(Sitona lineata)*

Pest information

Damage: The pea leaf weevil attacks legume crops such as clover, alfalfa, lupins, fababeans and field peas. It is a relatively new insect pest on field peas, having first been noticed in Alberta in 1997. It has since expanded its range into Saskatchewan. In the spring, adult weevils feed at night on seedling leaves and cause a characteristic scalloping of leaf edges. Later in the season, the larvae feed on roots and nitrogen fixing nodules on the roots, which can result in significant yield losses. The worst damage occurs on field edges.

Life Cycle: Adults overwinter in protected sites such as stubble of perennial crops. They emerge from overwintering sites in the spring and feed on the foliage of peas, beans and alfalfa. Eggs are laid in the soil. Each female can lay up to 1,500 eggs. After hatching, larvae feed on roots. There is only one generation per season.

Pest Management

Cultural Controls: Crop specialists and researchers are working to develop an IPM approach to the management of this insect. The use of full-leaf varieties of peas is recommended as opposed to semi-leafless varieties.

Resistant Cultivars: Semi-leafless peas appear to be more susceptible than leafy pea varieties.

Chemical Controls: Seed treatments and foliar insecticide applications provide good control.

Issues for Pea Aphid

1. This insect is becoming problematic in Alberta.

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.
- Field pea is susceptible to soil residues of some herbicides used in the previous year.
- There is concern with the reliance on Group 1 graminicides and the frequency of use of this chemistry. Repetitive use of Group 1 graminicides may lead to the development of weed populations resistant to the entire chemical group or to members of the group.
- The move towards breeding semi-leafless peas has brought better standability, improved air circulation and reduced disease in the crop but has led to less vigorous competition with weeds.

Table 12. Degree of occurrence of weed pests in Canadian field pea production

	Degree of Occurrence		
Weeds	**Alberta**	**Saskatchewan**	**Manitoba**
Annual grasses	E	E	E
Annual broadleaf weeds	E	E	E
Perennial grasses	E	E	E
Perennial broadleaf weeds	E	E	E
Volunteer crops	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
DNR - data not reported
Pest not present
E – established
D – invasion expected or dispersing

Source(s): *Canadian Expert Poll on Crop Protection* field pea focus groups for Alberta and Saskatchewan (2007).

Table 13. Availability and use of weed pest management approaches for Canadian field pea production.

	Practice \ Pest	Annual grasses	Annual broadleaf weeds	Perennial grasses	Perennial broadleaf weeds	Volunteer crops
Prevention	tillage					
	residue removal / management					
	water management					
	equipment sanitation					
	seeding depth					
	row or plant spacing (plant density)					
	weed management on non-crop lands					
	weed management in non-crop years					
	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					
	choice of planting site					
Monitoring	scouting					
	field mapping of weeds/ records to track pests					
	soil analysis					
	weather monitoring for disease forecasting					
	grading out infected produce					
Decision making tools	economic threshold					
	weather/ weather based forecast/predictive model					
	recommendation from crop specialist					
	first appearance of pest or pest life stage					
	observed crop damage					
	crop stage					
	calendar spray					
Suppression	biological pesticides					
	habitat/ environment management					
	pesticide rotation for resistance management					
	soil amendments					
	ground cover / physical barriers					
	inter-row cultivation					
	mechanical weed control					

no information regarding the practice is available

available/used

available/not used

not available

Source(s): *Canadian Expert Poll on Crop Protection* field pea focus groups for Saskatchewan and Alberta (2007).

Table 14. Herbicides registered on field pea in Canada

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
amitrole (Nufarm Amirol 240 Liquid Herbicide)	triazole	inhibition of carotenoid biosynthesis / 11	R	Canada thistle, sow thistle, dandelion and annual weeds
bentazon (Basagran Forte Liquid Herbicide)	benzothiadiazole	inhibition of photosynthesis at photosystem II site B / 6	RE	broadleaf weeds and yellow nutsedge
carfentrazone-ethyl (Aim EC)	triazolinone	inhibition of protoporphyrinogen oxidase / 14	R	broadleaf weeds and defoliate/desiccate crop as a harvest aid
chlorthal (Dacthal W-75 Herbicide)	DCPA	inhibition of microtubule assembly / 3	RE	annual and perennial grassy and broadleaf weeds
clethodim (Select EC Post-emergence Herbicide, Centurion EC Post-emergence Herbicide)	cyclohexanedione	inhibition of acetyl CoA carboxylase / 1	R	grassy weeds
diclofop-methyl (Hoe-grass 284 Emulsifiable Liquid Herbicide)	aryloxyphenoxy propionate	inhibition of acetyl CoA carboxylase (ACCase) / 1	R	annual grasses
diquat (Reglone Desiccant)	bipyridylium	photosystem-1-electron diversion / 22	RE	desiccate crop and weeds
ethalfluralin (Edge Granular Herbicide)	dinitroanaline	inhibition of microtubule assembly / 3	R	volunteer cereal, annual grasses and broadleaf weeds
fenoxaprop-p-ethyl (Excel Super Post-emergent Herbicide)	aryloxyphenoxy propionate	inhibition of acetyl CoA carboxylase (ACCase) / 1	R	annual grasses and volunteer cereals

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
fluazifop p-butyl (Venture L Herbicide, Component #2 Post-emergent Herbicide	aryloxyphenoxy propionate	inhibition of acetyl CoA carboxylase (ACCase) / 1	R	annual and perennial grasses
glufosinate ammonium/glyphosate (Roundup Fast Forward Preharvest Herbicide)	phosphinic acid / glyphosate	inhibition of glutamine synthesis / 10 and inhibition of EPSP synthesis / 9	R	pre-harvest control of quackgrass and Canada thistle and harvest management.
glyphosate (Roundup Original Liquid herbicide, Vantage Plus Maxx Herbicide)	glyphosate	inhibition of EPSP synthesis / 9	RR	annual and perenial weeds prior to planting, post harvest or pre-harvest
imazamox (Odyssey WDG Herbicide, Solo WDG Herbicide)	imidazolinone	inhibition of acetolacate synthases (ALS) or acetohydroxyacid synthase (AHAS) / 2	RR	broadleaf and grassy weeds
imazethapyr (Pursuit 240 Herbicide)	imidazilinone	inhibition of acetolacate synthases ALS (acetohydroxyacid synthase AHAS) / 2	R	broadleaf and grassy weeds
metribuzin (Sencor 480F Flowable Herbicide, Lexone DF Toss-N-Go Dispersible Granules)	triazinone	inhibition of photosynthesis at photosystem II site A / 5	RE	annual broadleaf weeds

Regulatory Status as of February 22, 2008[5]				
Active ingredient / organism (product)[1]	**Classification[2]**	**Mode of action / resistance group[2]**	**PMRA status of active ingredient[3]**	**Pests or group of pests targeted[4]**
paraquat (Gramoxone Liquid Herbicide with Wetting Agent)	bipyridylium	photosystem-l-electron diversion / 22	R	annual grass and broadleaf weeds, top-growth control of perennial grass and broadleaf weeds
prometryne (Gesagard 480 SC Herbicide)	triazine	inhibition of photosynthesis at photosystem II site A / 5	RE	annual grass and broadleaf weeds
quizalofop-p-ethyl (Assure II Herbicide)	aryloxyphenoxy propionate	inhibition of acetyl CoA carboxylase(ACCase) / 1	R	annual and perennial grasses
sethoxydim (Poast Ultra Liquid Emusifiable Herbicide)	cyclohexanedione	inhibition of acetyl CoA carboxylase/ 1	RE	annual grasses, wild oats, volunteer cereals and quackgrass
tepraloxydim (Equinox EC Herbicide)	cyclohexanedione	inhibition of acetyl CoA carboxylase (ACCase) / 1	R	annual grasses and quackgrass
triallate (Extra Strength Avadex BW Herbicide)	thiocarbamate	inhibition of lipid synthesis - not ACCase inhibition / 8	RE	wild oats
trifluralin (Treflan QR5 Granular Herbicide, Triflurex 40 EC Herbicide)	dinitroaniline	inhibition of microtubule assembly / 3	RE	annual grasses and annual broadleaf weeds

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

[2]The classification and the mode of action group are based on the classification presented in the Pest Management Regulatory Agency Regulatory Directive DIR99-06, Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action. The document is under revision and up-to-date information can be found on the following web sites: Herbicides: www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; Insecticides: www.irac-online.org/Crop_Protection/MoA.asp#area223 ; Fungicides:www.frac.info/frac/index.htm

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

[4] Please consult the product label on the PMRA web site (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php.) for specific listing of pests controlled by each active ingredient.

[5] Source: Pest Management Regulatory Agency

Table 15. Performance and use of herbicides for the control of weeds in field pea in Canada.

Pests or Group of Pests targeted	Active ingredient[1]	Resistance group[2]	Stakeholder comments[3,4]	
			Performance[3]	Notes
annual broadleaf weeds	ethalfluralin		A[P]	Controls some weeds but requires good moisture for activity and tillage to incorporate, leading to soil conservation issues.
	glyphosate	9	A	Must be applied as pre-seeding burn-off. Controls tough to kill weeds including cleavers and hempnettle.
	imazamox	2	A	Controls a broad spectrum of broad leaf weeds. There are some group 2 resistant broadleaf weeds on the prairies. Will not control imidazolinone tolerant volunteer canola.
	imazethapyr	2	A	Gives residual control of small seeded, shallow germinating weeds. The product has a multi-year follow crop guideline. There are group 2 resistant broadleaf weeds on the prairies. Will not control imidazolinone tolerant volunteer canola.
	metribuzin	5	A[P]	Controls mustard species but does not control wild buckwheat and volunteer canola. Requires high water volume to minimize burn.
	trifluralin		A[P]	Controls some weeds but requires good moisture for activity and tillage to incorporate, leading to soil conservation issues.

Pests or Group of Pests targeted	Active ingredient[1]	Resistance group[2]	Stakeholder comments[3,4]	
			Performance[3]	Notes
annual grasses	clethodim	1	A	Provides broad spectrum grass control. Resistance is a growing problem with Group 1 chemistries.
	ethalfluralin	3	A[P]	Setaria species resistant to group 3 herbicides are present on the prairies.
	fenoxaprop-p-ethyl	1	A	There are no broadleaf partners for tank mixing in this crop. Resistance is a growing problem with Group 1 chemistries.
	fluazifop-p-butyl	1	A	There are no broadleaf partners for tank mixing in this crop. Resistance is a growing problem with Group 1 chemistries.
	glyphosate	9	A	Cleans up a wide variety of volunteer cereals and grass weeds just prior to seeding.
	imazamox	2	A	Controls volunteer cereals and setaria. Residual nature means follow cropping must be adhered to. There are group 2 resistant grass weeds in SK.
	imazethapyr	2	A[P]	Good control of Setaria species and barnyard grass and suppresses wild oats. There are group 2 resistant wild oats on the prairies.
	quizalofop-p-ethyl	1	A	Resistance is a growing problem with the group 1 chemistries.
	sethoxydim	1	A	There are group 1 resistant grass weeds (wild oats, setaria).
	trifluralin		A[P]	Controls some weeds but requires good moisture for activity and tillage to incorporate, leading to soil conservation issues.

Pests or Group of Pests targeted	Active ingredient[1]	Resistance group[2]	Stakeholder comments[3,4]	
			Performance[3]	Notes
perennial broadleaf weeds	glyphosate	9	A^P	Control of Canada and sow thistle as well as dandelions either prior to seeding the crop or after the crop has been harvested. This strategy does not allow control of shoots or plants that emerge in the crop.
perennial grasses	clethodim	1	A	Provides in-crop strategy for weeds but control is only for a few weeks.
	glyphosate	9	A	Controls quackgrass shoots that have emerged prior to the crop emerging or after harvest.
	sethoxydim	1	A^P	Provides suppression only of quackgrass in-crop.
Volunteer crops	glyphosate	9	A	Controls first flushes of volunteer wheat, oats and barley.
	imazamox	2	A	Controls volunteer wheat, barley and oats. Will not control imidazolinone tolerant volunteer canola.
	sethoxydim	1	A	Controls volunteer cereals; excellent activity.

[1] List includes all active ingredients registered as of Feb. 22, 2008. Please consult product labels on the PMRA web site (www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php) for further information on pesticide use.

[2]The resistance 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. The document is under revision and up-to-date information can be found on the following web sites: Herbicides: www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm ; Insecticides: www.irac-online.org/Crop_Protection/MoA.asp#area223 ; Fungicides: www.frac.info/frac/index.htm

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

[4]Source(s) - "Canadian Expert Poll on Crop Protection" Focus Groups for Alberta and Saskatchewan (2007).

Annual Grasses

Pest information

Damage: Peas, particularly the semi-leafless varieties compete poorly with weeds.Wild oats (*Avena fatua*), green foxtail (*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 and spreading of harvested grain. Wild oats and green foxtail 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. Foxtail infestations are more severe in years with prevailing hot and dry conditions.

Pest Management

Cultural Controls: Minimizing tillage tends to reduce populations of foxtail 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 foxtail 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 also reduces volunteer cereals but this practice can predispose the soil to erosion. The selection of clean fields for the planting of field pea is important.

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 for control of grassy weeds. This has led to increasing reliance on Group 1 graminicides. These products are effective on all of the grassy weeds mentioned above.

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 chemical group or to members of the group. ACCase and trifluralin resistant wild oats and foxtail are already a concern in the prairies.
2. Field pea is susceptible to soil residues of some herbicides used in previous years.

Annual Broadleaf weeds

Pest information

Damage: Peas, particularly the semi-leafless varieties compete poorly with weeds. Temperate broadleaf weeds including wild buckwheat (*Polygonum convolvulus*), chickweed (*Stellaria* spp.), cleavers *Galium aparine*), hemp nettle (*Galeopsis tetrahit*), volunteer canola and mustard species. 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. Volunteer imidazolinone tolerant canola can present a problem, since the imidazolinone

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 vegetative growth and flowering, to seed production. 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

Cultural Controls: Minimizing tillage will keep weed seeds on the surface of the soil where they are exposed to birds and adverse weather conditions. Leafy varieties provide better competition with weeds and are particularly useful for gaining control of later flushes of weeds that may emerge after a post-emergence chemical is applied. However, leafy varieties are more susceptible to disease.

Chemical Controls: A number of herbicide strategies exist for the management of annual weeds in field pea including in crop herbicides and late fall treatments in fields planned for pea production.

Issues for annual broadleaf weeds

1. The reliance on the imidazolinone 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 field peas, gaps in control in terms of volunteer imidazolinone-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 crop but has led to less vigorous competition with weeds.

Perennial Broadleaf Weeds

Pest information

Damage: Canada thistle (*Cirsium arvensis*) and sow thistle (*Sonchus arvensis*) 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 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 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

Cultural Controls: Maintaining good fertility will maximize crop vigour and competitiveness. There are several beneficial options available for controlling perennial weeds and preventing damage to peas**.** These measures are deployed at other points in the rotation, not in-crop. Perennial weeds such as Canada thistle and sow thistle should be controlled in the years prior to pea production.

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 for use when planning 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, pre-harvest and post-harvest.

Issues for perennial broadleaf weeds

1. Field pea is susceptible to soil residues of some herbicides used in the previous year.

Resources

IPM/ ICM Resources for production of field pea in Canada

There are numerous resources that pertain to integrated pest management in crop production and these are found on the websites for the extension services for Saskatchewan Agriculture and Food and Alberta Agriculture. See http://www.agriculture.gov.sk.ca/ (click on 'Production') and http://www.agric.gov.ab.ca (Click on 'Agriculture and Food Publications'). Specific to peas, the following three publications are up-to-date summaries of IPM/ICM techniques.

- **'Controlling Field Pea Diseases in Direct Seeding Systems'** by Alberta Agriculture. See http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex2990
- **'Field Pea - Production and Management'** by Manitoba Agriculture Food and Rural Initiatives. See http://www.gov.mb.ca/agriculture/crops/pulsecrops/bhe01s01.html
- **'Dry Pea Production'** by Saskatchewan Agriculture and Food. See http://www.agriculture.gov.sk.ca/Default.aspx?DN=a9ef6986-c209-45b6-801b-16175c910c24

Provincial Pulse Crop Specialists and Provincial Minor Use Coordinators

Province	Ministry	Crop Specialists	Minor Use Coordinators
Alberta	Alberta Agriculture, Food and Rural Development	Mark Olson	Jim Broatch (jim.broatch@gov.ab.ca)
Saskatchewan	Saskatchewan Agriculture, Food and Rural Revitalization	Ray MacVicar	Ray MacVicar (rmacvicar@agr.gov.sk.ca)
Manitoba	Manitoba Agriculture, Food and Rural Initiatives	Bruce Brolley	Jeanette Gaultier (Jeanette.Gaultier@gov.mb.ca)

National and Provincial Pulse Grower Organizations

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Research contacts for pulse crops in Canada

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

References

Alberta Pulse Growers www.pulse.ab.ca

Government of Alberta http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex17

Government of Manitoba http://gov.mb.ca/agriculture/crops/pulsecrops/bhe01s01.html

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 http://www.statcan.gc.ca/

Government of British Columbia http://www.gov.bc.ca/al/