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# Crop Profile for Chickpea in Canada

Prepared by:

Pesticide Risk Reduction Program

Pest Management Centre

Agriculture and Agri-Food Canada

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Canada

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## **Crop Profile for Chickpea in Canada**

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### **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 to be used as a crop production guide. Provincial publications should be consulted by growers for crop production and pest management information.

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.

Since 2002, the PRRP has been collaborating with Pulse Canada to identify priority pest management [issues](#) and develop [risk reduction strategies](#) for pulse crops. For chickpea, ascochyta blight has been identified as a key priority and a risk reduction strategy has been developed for this disease. Information on the *Reduced-risk Strategy for Ascochyta Blight Management in Chickpea* is available here.

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

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# Crop Profile for Chickpea in Canada

Chickpea (*Cicer arietinum* L.) is the third most important food legume grown in the world. Worldwide, approximately 11 million hectares are grown, amounting to 9 million tons of production. A member of the family *Leguminosae*, chickpea, in association with the soil bacteria (generally called rhizobia), can fix nitrogen from the atmosphere. Chickpea is an ancient pulse crop first grown in Turkey about 7,000 B.C. It was traditionally grown in semi-arid zones of India and Middle Eastern countries. It is grown in over 45 countries and on all continents of the world. The crop provides a source of high quality protein to people in developing countries. In the developed countries, it is considered a health food.

Growers in Saskatchewan began commercially producing chickpeas in the mid -1990's with a relatively small acreage and the acreage has grown substantially over the ensuing years. 'Kabuli' chickpea is best adapted to the brown soil zone, while 'Desi' chickpea is best adapted to the brown and dark brown soil zones of Saskatchewan. Around 88% of the Canadian chickpea production is centered in these two soils zones in Saskatchewan, with the other 12% in Alberta (refer Table 2). Chickpea is not well adapted to saline soils, soils with high clay content, soils that are slow to warm up in the spring or to high moisture areas, since it will not tolerate waterlogged soil.

## Crop Production

### *Industry Overview*

A summary of crop production and export and import data is provided in Table 1.

**Table 1. General Production Information**

Canadian Production (2007)	244,800 metric tonnes 174,000 hectares
Farm gate value	-
Domestic consumption	-
Export (2007)	\$ 53.5 million
Import (2007)	\$ 3.6 million

Source(s): Statistics Canada

## ***Production Regions***

Chickpea is grown primarily in southern Saskatchewan, with a small amount grown in Alberta.

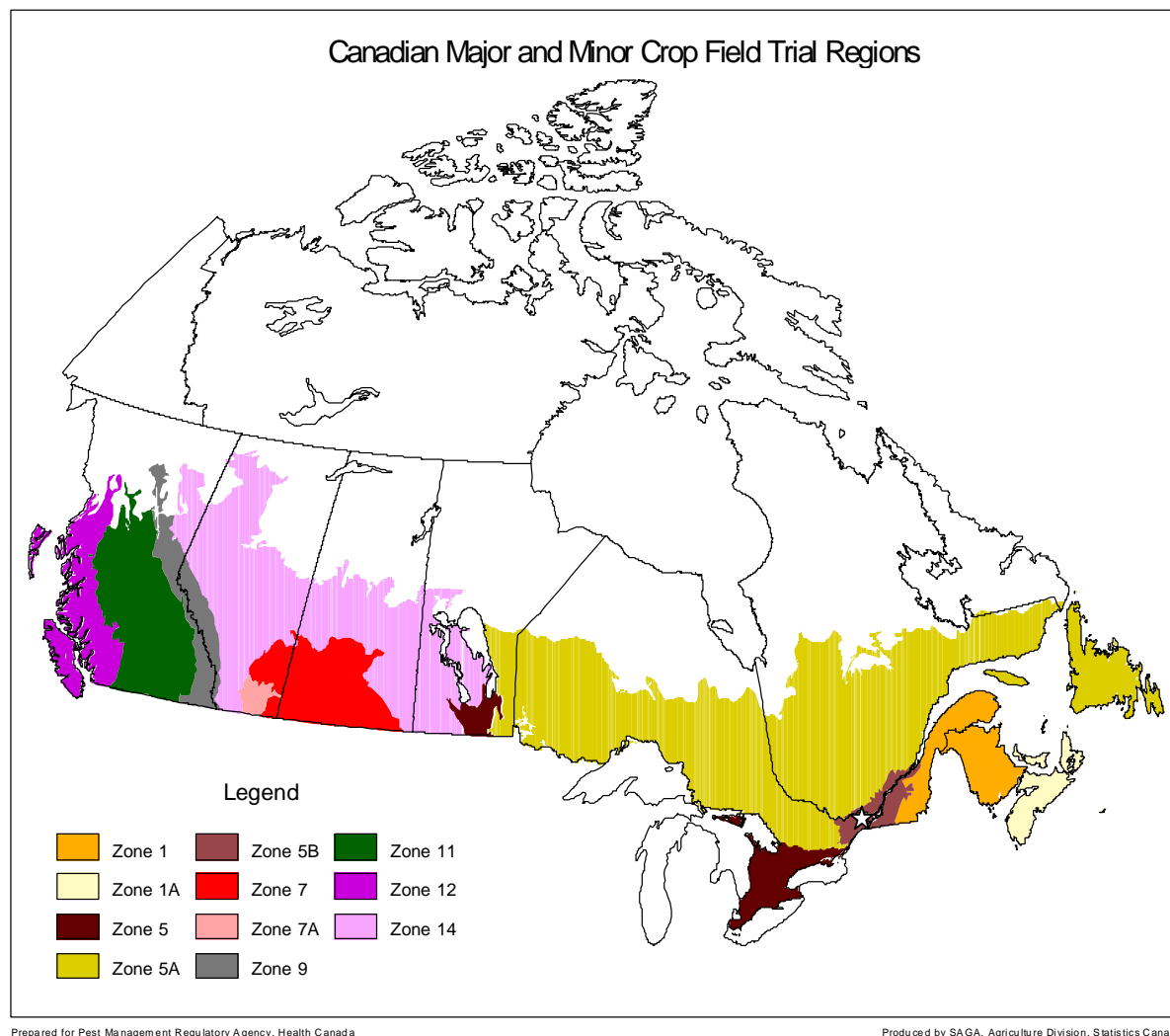
**Table 2. Distribution of Chickpea Production in Canada.**

<b>Production Regions</b>	<b>Production 2007</b>		<b>% National Production</b>
	<b>hectares</b>	<b>tonnes</b>	
Alberta	20,200	26,700	12
Saskatchewan	153,800	198,100	88
Canada	<b>174,000</b>	<b>224,800</b>	<b>100</b>

Source: Statistics Canada

**Figure 1: Common Zone Map: Canadian Major and Minor Crop 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](http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_pol_guide/dir98-02/index-eng.php)).



## ***Cultural Requirements***

Chickpea must be handled carefully to avoid damage to the seed coat. Dry seed (less than 14% moisture) is brittle and can easily crack or split, leading to reduced germination and increased risk of disease. If the field has a past history of soil borne diseases, the use of a fungicide seed treatment is recommended.

Under ideal conditions, with a nitrogen-fixing inoculant (rhizobium) developed specifically for chickpea, plants have the ability to fix 60-80 per cent of their nitrogen requirement from the atmosphere. The rhizobium may die if exposed to stresses such as high temperature, drying winds or direct sunlight. Peat based inoculants are applied directly to the seed with the use of a 'sticker' while granular inoculants are applied adjacent to the seed in the seedbed. When using peat based inoculants, producers are advised to plant the inoculated seed into moist soil as soon as possible after inoculation. Care should also be taken when using peat based inoculants and treating the chickpea seed. Any fungicide seed treatment should be allowed to dry before inoculant is applied.

Chickpea should be seeded 3.5 to 6 cm deep, preferably into a firm, moist, weed-free seedbed to provide proper germination and assure inoculant survival. The best temperature for germination is 15°C, but, with Desi chickpeas, germination will begin at soil temperatures as low as 5°C. Kabuli chickpeas are more sensitive to cold and should not be seeded into soil colder than 10°C at placement depth. Seeding rates range from 90 -105 kg/ha for Desi types to 135-210 kg/ha for Kabuli types. The desired plant population is 33 - 44 seedlings/m<sup>2</sup>. Crop stands of this density provide better competition against weeds and will result in more uniform maturity and higher yields. Chickpea should be seeded as early as possible when the minimum average soil temperature reaches 5°C. Newly emerged seedlings are relatively frost tolerant and spring frost is not an issue. Chickpea should not be seeded into excessively wet soils.

Site selection is critical for chickpea since pest control agents are so limited. Planting chickpea adjacent to the previous year's chickpea stubble should be avoided. A different crop, such as a cereal, should be planted as a border strip adjacent to chickpea stubble to avoid crop loss and the rapid spread of ascochyta blight. Crop rotation is generally 1 in 4 years because of the aggressive nature of ascochyta blight, one of the major diseases of chickpea. A rotation such as this will allow for the breakdown of chickpea residue on which the pathogen survives. The majority of producers will follow this rotation, usually having chickpea following a cereal. For nitrogen fixation to occur, the chickpea strain of nitrogen-fixing inoculant (rhizobium) is required. Chickpea has a very specific relationship with rhizobium and it is essential that an inoculant specifically developed for chickpea is used. Superior seed quality is needed for successful chickpea production. It is recommended to have seed tested at an accredited seed testing laboratory to determine important factors such as percent germination, disease levels and seed purity.

Chickpea production is often successful in rotation with cereal grains such as durum wheat. Chickpea does not leave a lot of crop residue, so cereal crops with tall stubble grown before and after chickpea provide much-needed residue to protect the soil from erosion.

Chickpea can be planted on either summer fallow or stubble in the brown soil zone and on stubble in the dark brown soil zone. A soil test will provide a guideline for fertility needs. Fertility requirements for chickpea are not well defined. Based on limited data, the requirements for phosphorus, potassium and sulphur are similar to pea or lentil. A well-inoculated crop should not require nitrogen fertilizer.

Table 3. Canadian chickpea production and pest management schedule

Time of year	Activity	Action
<b>October - March</b>	-	Nothing done
<b>April</b>	Soil care	Soil test
	Weed management	Burn down herbicide treatments are used.
<b>May</b>	Plant care	Seeding
	Soil care	Fertilize
	Disease management	Seed treatments
	Insect & mite management	Monitoring
	Weed management	Identify and scout for weeds
<b>June</b>	Plant care	Monitor
	Disease management	Monitor /apply foliar fungicides if necessary
	Insect & mite management	Monitor
	Weed management	Spray if necessary for broadleaf weeds and patch treat for perennials if practical.
<b>July</b>	Disease management	Apply fungicides if necessary.
	Insect & mite management	Monitor
	Weed management	Follow up on weed problems and observe results from control efforts; late application of herbicide if necessary.
<b>August</b>	Plant care	Prepare for harvest.
	Disease management	Monitor
	Insect & mite management	Monitor
	Weed management	Monitor
<b>September</b>	Plant care	Harvest
	Weed management	Check for winter annual germination and treat or till if necessary.

## ***Abiotic Factors Limiting Production***

### **Maturity**

Chickpea is a long-season crop, while Saskatchewan typically has a short growing season. Under ideal conditions, it's growing season is long enough for some of the new varieties being introduced, but anything that sets the crop back can jeopardize the quality of the crop (eg. late seeding, slow germination, disease, hail/wind damage, etc).

### **Growth Habit**

A concern is that chickpea has an indeterminate growth habit. Flowering and pod filling will continue simultaneously or alternately as long as temperature and moisture permits growth to

occur. Since no chemical desiccants are registered for use on chickpeas, a moisture or nitrogen stress is required to encourage seed set and maturity.

## Fall Frost

A hard killing frost in the fall on an immature chickpea crop will increase the amount of green seeds, thus decreasing the quality and price of the crop.

## Storage

Producers must keep an eye on the moisture level of their chickpea crop, especially shortly after harvest. When a chickpea seed is harvested, the outside seed coat normally has a lower moisture level than the inside of the seed. As the chickpea sits in the bin, the moisture level evens out (sometimes referred to as the seeds temper or sweat) and the overall moisture level can rise. A crop that was harvested at a safe moisture level could have a moisture level higher than 14% a week later (the maximum moisture level to safely store the crop). If this is left untreated, the crop could heat and start to spoil. This is the main reason to put chickpea in a hopper-bottomed bin that has aeration, which when left on, can bring down the moisture level of the chickpea.

## Handling

Care needs to be taken when handling chickpea seed in order not to damage the beak, the protruding seedling root tip, or crack the seed coat, both of which can downgrade the quality of the seed. This is especially important under extreme cold conditions, such as hauling chickpea to the processor in the winter. The cold can cause the seed coat to become quite fragile and crack easily when handled.

Kabuli and Desi chickpea are handled in a slightly different way at seeding, due to their different seed coats. Kabuli chickpea have a very thin, cream-colored seed coat. The use of a fungicide seed treatment is recommended to protect the seed from soil borne diseases. Desi chickpea, on the other hand, has a thick, dark-coloured seed coat and does not usually require a seed treatment before planting.

## Soil Moisture Depletion

Chickpea has a deep tap-root, which allows it to use water from greater depths than other pulse crops. Due to its indeterminate growth habit and the fact that it continues growing into the fall, it

can deplete the subsoil moisture in the field. If the fall is dry and precipitation in winter is limited, yields of the cereal crop may be negatively affected the following year. This makes chickpea less attractive than other pulse crops, which have shallower root systems.

## General Production Issues

1. Seed quality is a very important factor for a successful chickpea crop. Seed should be tested for germination, disease levels and purity. Since ascochyta is such a major disease in chickpea and can be seed-borne, seed having no ascochyta should be used. If there is some seed-borne ascochyta present, a fungicide seed treatment should be used. Farmers are concerned about the cost of professionally applied seed treatments and are seeking ways to use “ready to apply” seed treatments to reduce costs.

2. Chickpea is susceptible to the soil residue from various herbicides used in previous years, so it is important to keep good records and take this into account when choosing a rotation.

## Pest Management Overview

Fungal diseases pose the most important constraints to chickpea production with ascochyta blight being the most problematic. This disease can cause up to 100% loss in susceptible varieties. Seedling blights are more of a problem on Kabuli chickpeas. Botrytis can cause problems during cool, moist weather and sclerotinia is more of a problem in wet years. Insects usually do not pose major problems, although grasshoppers can cause significant injury if they attack the crop in the seedling stage. Chickpeas are not strong competitors with weeds.

*The following disease, insect and mite and weed sections provide detailed information on pests affecting chickpea. Pest management issues are presented at the beginning of each section and are also included in 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 and chemical controls as follows;*

*Tables 4, 8 and 12: Disease, insect or weed occurrence and severity 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 registered fungicides, insecticides and herbicides for chickpea.*

*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 resources listed at the end of the profile.**

## Diseases

### Key Issues

- Diseases are the most critical production problem for chickpea in Canada.
- There is concern over the reliance on strobilurin fungicides as resistance has been discovered to this chemistry. To prevent widespread resistance, there is a need for the registration of different fungicide chemistries that can be used in rotation.
- There is a need for enhanced ascochyta-resistance breeding programs.
- There is a need for improved management tools and practices for ascochyta blight.
- There is a need for modeling, forecasting and decision making tools.
- Education is required on disease management, resistance management, disease identification and field scouting.

**Table 4. Degree of occurrence of disease pests in Canadian chickpea production**

Disease	Degree of occurrence	
	Alberta	Saskatchewan
Ascochyta Blight	E	E
Botrytis Grey Mould	E	E
Root Rot	E	E
Sclerotinia Stem Rot	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		
DNR - Data not reported		
Source: <i>Canadian Expert Poll on Crop Protection</i> focus group for Saskatchewan (2007).		

**Table 5. Availability and use of disease management approaches for chickpea production in Canada.**

	Practice \ Pest	Ascochyta blight	Botrytis grey mould	Root rot	Sclerotinia white mold
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				
Prevention	tillage				
	residue removal / management				
	water management				
	equipment sanitation				
	row spacing				
	seedling depth				
	removal of alternative hosts (weeds/volunteers)				
	mowing / mulching / flaming				
Monitoring	scouting - trapping				
	records to track pests				
	field mapping of weeds				
	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				
	beneficial organisms & habitat management				
	pesticide rotation for resistance management				
	ground cover / physical barriers				
	controlled atmosphere storage				
no information regarding the practice is available					
available/used					
available/not used					
not available					
Source: Canadian Expert Poll on Crop Protection focus group for Saskatchewan (2007).					

**Table 6. Registered disease control products, classification and resistance groups for chickpea production in Canada.**

Regulatory Status as of February 22, 2008 <sup>5</sup>				
Control product (active ingredient / organism) <sup>1</sup>	Classification <sup>2</sup>	Mode of action / resistance group <sup>2</sup>	PMRA status of active ingredient <sup>3</sup>	Pests or group of pests targeted <sup>4</sup>
azoxystrobin (Quadris Flowable Fungicide, Dynasty 100FS)	methoxyacrylate	respiration C3: complex III -cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene) / 11	RR	Anthracnose ( <i>Colletotrichum</i> spp.)
				Ascochyta blight ( <i>Ascochyta</i> spp.)
				Mycosphaerella blight ( <i>Mycosphaerella pinodes</i> )
				Asian (Soybean) Rust ( <i>Phakopsora pachyrhizi</i> )
				Seed rot/pre-emergence damping-off, postemergence damping-off, and seedling root rot caused by <i>Rhizoctonia solani</i>
azoxystrobin/ propiconazole (Quilt Fungicide)	methoxyacrylate / triazole	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 ( <i>Phakopsora pachyrhizi</i> )
<i>Bacillus subtilis</i> QST 713 (Serenade Max)	bacteria	biological	BI	White mold or Sclerotinia stem rot ( <i>Sclerotinia sclerotiorum</i> )
				Botrytis pod rot or Botrytis blight ( <i>Botrytis cinerea</i> )
boscalid (Lance WDG Fungicide)	pyridinecarboxamide	respiration C2: complex II - succinate dehydrogenase / 7	RR	Gray mold ( <i>Botrytis cinerea</i> )
				White mold ( <i>Sclerotinia sclerotiorum</i> )
				Ascochyta blight ( <i>Ascochyta</i> spp.)

Regulatory Status as of February 22, 2008 <sup>5</sup>				
Control product (active ingredient / organism) <sup>1</sup>	Classification <sup>2</sup>	Mode of action / resistance group <sup>2</sup>	PMRA status of active ingredient <sup>3</sup>	Pests or group of pests targeted <sup>4</sup>
captan (Captan Flowable Seed Treatment Fungicide)	phthalimide	multi-site contact activity / M4	R	Storage rot
				Seed decay
				Root rot
				seedling blights and seed rots
				Damping-off
carbathiin/ thiabendazole (Crown Systemic and Contact Seed Protectant)	anilide (oxathiin) / benzimidazole	affect mitochondrial transport chain / 7 and mitosis and cell division B1: $\beta$ -tubuline assembly in mitosis / 1	RE	seedborne Ascochyta caused by <i>Ascochyta rabiei</i>
chlorothalonil (Bravo 500 Agricultural Fungicide)	chloronitrile (phthalonitrile)	multi-site contact activity / M5	R	Ascochyta blight
fludioxonil (Apron Maxx RTA Seed Treatment, Maxim 480 FS Colourless Seed Treatment)	phenylpyrrole	signal transduction E2: MAP/Histidine-Kinase in osmotic signal transduction (os-2, HOG1) / 12	RR	Ascochyta blight ( <i>Ascochyta rabiei</i> )
				seed rot/pre-emergence damping-off, and post- emergence damping-off caused by <i>Fusarium</i> spp., <i>Pythium</i> spp., and <i>Rhizoctonia</i> spp.
				seedling blight caused by <i>Fusarium</i> spp., and <i>Pythium</i> spp.
				seed rot and seedling blight caused by seed-borne <i>Botrytis</i> spp.
metalaxyl (Apron FL Seed Treatment)	acylalanine	nucleic acids synthesis A1: RNA polymerase I / 4	RE	seedling blights and seed rots caused by <i>Pythium</i> spp.
metalaxyl-m and s-isomer (Apron XL LS)	acylalanine	nucleic acids synthesis A1: RNA polymerase I / 4	RE, RR	early season <i>Phytophthora</i> root rot
				<i>Pythium</i> damping-off

Regulatory Status as of February 22, 2008 <sup>5</sup>				
Control product (active ingredient / organism) <sup>1</sup>	Classification <sup>2</sup>	Mode of action / resistance group <sup>2</sup>	PMRA status of active ingredient <sup>3</sup>	Pests or group of pests targeted <sup>4</sup>
propiconazole (Tilt 250E)	triazole	sterol biosynthesis in membranes G1: C14-demethylase in sterol biosynthesis (erg11/cyp51) / 3	R	Asian rust ( <i>Phakopsora pachyrhizi</i> )
				Powdery mildew ( <i>Microsphaera diffusa</i> , <i>Erysiphe pisi</i> , <i>E. polygoni</i> )
prothioconazole (Proline 480 SC)	triazole	sterol biosynthesis in membranes G1: C14-demethylase in sterol biosynthesis (erg11/cyp51) / 3	R	Asochyta blight ( <i>Asochyta rabiei</i> )
pyraclostrobin (Headline EC Fungicide)	methoxycarbamate	respiration C3: complex III - cytochrome bc1 (ubiquinol oxidase) at Qo site (cyt b gene) / 11	R	Ascochyta blight ( <i>Ascochyta rabiei</i> )

<sup>1</sup>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.

<sup>2</sup>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](http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm) ; Insecticides: [www.irac-online.org/Crop\\_Protection/MoA.asp#area223](http://www.irac-online.org/Crop_Protection/MoA.asp#area223) ; Fungicides: [www.frac.info/frac/index.htm](http://www.frac.info/frac/index.htm)

<sup>3</sup>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](http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php)

<sup>4</sup>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](http://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.

<sup>5</sup>Source: Pest Management Regulatory Agency

**Table 7. Performance and use of fungicides for the control of diseases on chickpea in Canada**

Pests or Group of Pests targeted	Active ingredient <sup>1</sup>	Resistance group <sup>2</sup>	Stakeholder comments <sup>3,4</sup>	
			Performance <sup>3</sup>	Notes
anthracnose ( <i>Colletotrichum</i> spp.)	azoxystrobin	11	A	This disease is not an issue in chickpea.
ascochyta blight ( <i>Ascochyta</i> spp.); Mycosphaerella blight ( <i>Mycosphaerella pinodes</i> )	azoxystrobin	11	A	Good efficacy; resistance concerns.
	boscalid	7	A	Must be applied as a protectant; used only on a small portion of areage.
	carbathiin/ thiabendazole (seedborne <i>A. rabei</i> )	7;1		
	chlorothalonil	M5	A	Used as a rotational option with strobiluran chemistry; good pod protector.
	fludioxonil	12	A	Used as a component of IPM approach.
	prothioconazole ( <i>A. rabei</i> )	3		
	pyraclostrobin ( <i>A. rabei</i> )	11	A	Good efficacy; resistance concerns.
damping off	captan	M4		
Asian (soybean) rust ( <i>Phakopsora pachyrhizi</i> )	azoxystrobin	11		
	azoxystrobin/ propiconazole	11; 3		
	propiconazole	3		
Gray mold ( <i>Botrytis cinerea</i> )	boscalid	7	A <sup>P</sup>	Grey mold treatments are a minor component of the use of boscalid; the bulk of the use is for this chemical is for ascochyta.
	Bacillus subtilis QST 713	biological		

Pests or Group of Pests targeted	Active ingredient <sup>1</sup>	Resistance group <sup>2</sup>	Stakeholder comments <sup>3,4</sup>	
			Performance <sup>3</sup>	Notes
Phytophthora root rot (early season)	metalaxyl-m and s-isomer	4		
Powdery mildew ( <i>Microsphaera diffusa</i> , <i>Erysiphe pisi</i> , <i>E. polygoni</i> )	propiconazole	3		
Seed rot/ damping -off and seedling root rot ( <i>Rhizoctonia solani</i> )	azoxystrobin	11		
	fludioxonil	12		
Seedling blight ( <i>Fusarium</i> spp.)	fludioxonil	12	A	
Seedling blight ( <i>Pythium</i> spp.)	fludioxonil	12	A	Controls a variety of seedling diseases including seedborne ascochyta.
	metalaxyl-m and s-isomer	4		
	metalaxyl	4	A <sup>P</sup>	Crop insurance requires that chickpea seed be treated with a seed treatment.
Seed rot and seedling blight (seedborne <i>Botrytis</i> spp.)	fludioxonil	12		
Seedling blights and seed rots	captan	M4		
Seedborne ascochyta caused by <i>Ascochyta rabiei</i>	carbathiin/ thiabendazole	7;1	A	About 50% of acres are treated with this product; provides good, incidental control of Fusarium.

Pests or Group of Pests targeted	Active ingredient <sup>1</sup>	Resistance group <sup>2</sup>	Stakeholder comments <sup>3,4</sup>	
			Performance <sup>3</sup>	Notes
Root rot	captan	M4		
Storage rot	captan	M4		
White mold (Sclerotinia stem rot) ( <i>Sclerotinia sclerotiorum</i> )	boscalid	7	A <sup>P</sup>	Must be applied as a preventative treatment.
	<i>Bacillus subtilis</i> QAT 713	biological		

<sup>1</sup> 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](http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php)) for further information on pesticide use.

<sup>2</sup>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](http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm) ; Insecticides: [www.irac-online.org/Crop\\_Protection/MoA.asp#area223](http://www.irac-online.org/Crop_Protection/MoA.asp#area223) ; Fungicides: [www.frac.info/frac/index.htm](http://www.frac.info/frac/index.htm)

<sup>3</sup>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<sup>P</sup> – 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)

<sup>4</sup>Source(s) - *Canadian Expert Poll on Crop Protection* Focus Group for Saskatchewan (2007).

## Ascochyta blight (*Ascochyta rabiei*)\*

### ***Pest Information***

**Damage:** Ascochyta blight caused by *Ascochyta rabiei*, is the most serious disease of chickpea in western Canada. The pathogen causes lesions on leaves, stems and pods. There is a risk of yield loss if symptoms occur on the upper half of the canopy or if there is significant moisture during the vegetative, flowering or podding seasons. Up to 90% yield loss can occur in Kabuli and up to 50% yield loss in Desi chickpeas.

**Life Cycle:** The pathogen is seed and residue-borne. Pycnidia are formed within the foliar lesions and give rise to spores (conidia) that ooze out when conditions are moist. The spores are spread by rain splashing to neighbouring plants. The spores require a minimum of 24 hours of rainfall or humid conditions to germinate and penetrate the plant. There can be multiple infection cycles within one season. The pathogen survives for several years on exposed crop residue.

### ***Pest Management***

**Cultural Control:** Tillage can help speed up residue breakdown, destroying places where the pathogen can overwinter, but increases the risk of erosion. Infected debris should be removed from the field if tillage is not used. Only certified, disease free seed should be used and proper rotations should be followed. If disease is present, planting should be avoided in the area of the infected field, in the subsequent year. A service that regularly updates the presence of the disease in Saskatchewan has been developed by Agriculture and Agri-Food Canada and the University of Saskatchewan. The system is available to the public on the internet at the following site: ([http://paridss.usask.ca/specialcrop/pulse\\_diseases/index.html](http://paridss.usask.ca/specialcrop/pulse_diseases/index.html)). Monitoring should begin early and continue throughout the growing season. Monitoring 5-7 days after rainfall is particularly important.

**Resistant Cultivars:** There are no resistant varieties, but fern-leaf varieties do not develop as severe disease symptoms as other varieties. There is work underway on breeding for improved resistance.

**Chemical Control:** Apron Maxx RTA (fludioxinil) is used on over 60 percent of seed for general seed treatment but it is not as efficacious as Crown for ascochyta. Thiabendazole and carbathiin are registered for the control of seed-borne ascochyta blight in chickpea. In-crop fungicides, such as chlorothalonil, azoxystrobin, boscalid and pyraclostrobin, applied at early flower with a second application at podding, when required, can help minimize damage. Chlorothalonil is a protectant fungicide that remains active for 10-14 days, but will not stop infections that are already in progress. There are populations of strobiluron resistant ascochyta in chickpea in Saskatchewan.

### ***Issues for Ascochyta Blight***

1. There is concern that the over-use of the strobilurin fungicides will cause them to become ineffective over time – with the first populations of resistant *Ascochyta rabiei* appearing in 2007. Fungicide rotations and integrated disease management will be critical if this is to be managed. Common rotation is to use a strobiluron in sequence with Bravo (chlorothalonil) with the chlorothalonil used last.
2. New, resistant varieties need to be developed to help in an integrated approach to managing this disease.

3. A ‘sentinel’ program for disease forecasting appears to have promise.

\*Ascochyta blight has been selected as a key priority for chickpea and a risk reduction strategy has been developed for this disease under the Pesticide Risk Reduction program.

## Grey Mould (*Botrytis cinerea*)

### ***Pest Information***

**Damage:** Botrytis infection can cause seedling blight and blighting of flowers, foliage and pods. There is a potential for yield reductions up to 20% as well as a decrease in the quality of seed due to discoloration.

**Life Cycle:** The pathogen survives in seed, on crop residues and in the soil. Infection can occur at any stage of growth, but infected seed is the primary cause of disease problems. Infected plants produce masses of spores that become airborne and disperse rapidly. Established crops have canopies that produce ideal conditions for infection and spread of the disease. Poor weather conditions at flowering, podding or harvest, or any physical injury can facilitate infection and increase disease pressure in the field. Disease is most severe in seasons with high moisture late in the season.

### ***Pest Management***

**Cultural Controls:** Thinner canopies are less conducive to disease, but there is a delicate balance between disease and weed control. Using proper rotations, disease free seed, seed treatments and minimizing damage to the crop, can all help minimize disease. Cereals used in the rotation are of particular help in reducing the build-up of soil-borne inoculum.

**Resistant Cultivars:** None available.

**Chemical Controls:** Boscalid is registered for the control of the foliar form of the disease.

### ***Issues for Grey Mould***

None identified

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

### ***Pest Information***

**Damage:** Young seedlings infected with root rot normally die, while infected mature plants may be stunted. There is the potential for 90% yield loss with Kabuli and up to 30% yield loss with Desi chickpeas.

**Life Cycle:** The pathogens are soil-borne and can attack any part of the root system including the stem at the soil line. The disease is more severe when emergence is delayed and with cool, saturated soils.

### ***Pest Management***

**Cultural Controls:** Encouraging rapid emergence (seeding at proper depths into warm, slightly moist, well-drained seedbeds) will reduce damage caused by the disease. Rotations that include cereals will help reduce the build-up of inoculum in the soil.

**Resistant Cultivars:** None available.

**Chemical Controls:** Thiabendazole, fludioxonil and metalaxyl will help with the control of root rots.

### ***Issues for Root Rot***

None identified.

## ***Sclerotinia stem rot (*Sclerotinia sclerotiorum*)***

### ***Pest Information***

*Damage:* The disease normally occurs in patches, typically where the crop growth is dense.

Infections cause bleaching, drying and shredding of infected tissues. Yield losses can be up to 20%, but damage also includes decreased seed quality due to seed discoloration.

*Life Cycle:* The fungus overwinters as sclerotia in crop debris and in the soil. Warm, wet weather occurring 1-2 weeks before flowering in combination with a thick canopy favours disease. The sclerotia germinate, producing apothecia that then release ascospores into the air. Each apothecium can release up to 2 million spores over a 5-10 day period. Spores infect dead blossoms. Infections can spread to adjacent flowers, stems, leaves and pods within 2-3 days. New sclerotia are formed in rotting tissue and can persist in crop residue and soil for years.

### ***Pest Management***

*Cultural Controls:* Encouraging good plant health can help reduce infections. Rotations should include cereals which are non-host crops, to help reduce the build-up of soil-borne inoculum.

*Resistant Cultivars:* None available.

*Chemical Controls:* Boscalid is registered for the control of sclerotinia in chickpea. However this disease is a minor issue in the crop and thus control is gained incidentally when boscalid is used for control of ascochyta blight.

### ***Issues for Sclerotinia Stem Rot***

None identified

## Insects and Mites

### Key Issues

- Reduced risk insecticides are needed that are able to be used as part of an integrated approach to insect control.

**Table 8. Degree of occurrence of insect pests in Canadian chickpea production**

Pests	Degree of occurrence	
	Alberta	Saskatchewan
<b>Alfalfa looper</b>	E	E
<b>Cutworm</b>	E	E
<b>Grasshopper</b>	E	E
<b>Wireworm</b>	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		
DNR - Data not reported		
Source: <i>Canadian Expert Poll on Crop Protection</i> focus group for Saskatchewan (2007).		

**Table 9. Availability and use of insect pest management approaches for chickpea production in Canada\*\*.**

	Practice \ Pest	Alfalfa looper	Pale western cutworm	Redbacked cutworm	Grass - hoppers
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				
Prevention	tillage				
	residue removal / management				
	water management				
	equipment sanitation				
	row spacing				
	seeding depth				
	removal of alternative hosts (weeds/volunteers)				
	mowing / mulching / flaming				
Monitoring	scouting - trapping				
	records to track pests				
	field mapping of weeds				
	soil analysis				
	weather monitoring for forecasting diseases				
	grading out infected produce				
Decision making tools	economic threshold				
	forecasting/ degree day modelling				
	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				
no information regarding the practice is available					
available/used					
available/not used					
not available					
Source: Canadian Expert Poll on Crop Protection focus group for Saskatchewan (2007).					

\*\*Insect problems are very rare in chickpea and thus IPM decisions are not driven by insect issues.

**Table 10. Registered insect control products, classification and resistance groups for chickpea production in Canada.**

Regulatory status as of February 22, 2008 <sup>5</sup>				
Control product (active ingredient / organism) <sup>1</sup>	Classification <sup>2</sup>	Mode of action – resistance group <sup>2</sup>	PMRA status of active ingredient <sup>3</sup>	Pests or group of pests targeted <sup>4</sup>
lambda-cyhalothrin (Matador 120EC, Warrior Insecticide)	pyrethroid	sodium channel modulators / 3	R	Bean leaf beetle
				Cutworms
				Grasshoppers
				Potato leafhopper

<sup>1</sup>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.

<sup>2</sup>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](http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm) ; Insecticides: [www.irac-online.org/Crop\\_Protection/MoA.asp#area223](http://www.irac-online.org/Crop_Protection/MoA.asp#area223) ; Fungicides: [www.frac.info/frac/index.htm](http://www.frac.info/frac/index.htm)

<sup>3</sup>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](http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php)

<sup>4</sup>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](http://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.

<sup>5</sup>Source: Pest Management Regulatory Agency

**Table 11. Performance and use of insecticides for the control of insect pests of chickpea in Canada.**

Pests or Group of Pests targeted	Active ingredient <sup>1</sup>	Resistance group <sup>2</sup>	Stakeholder comments <sup>3,4</sup>	
			Performance <sup>3</sup>	Notes
Bean leaf beetle	lambda-cyhalothrin	3		
Cutworms	lambda-cyhalothrin	3	A	Rarely used; cutworms (pale western and red backed) are only a problem on a small number of acres.
Grasshoppers	lambda-cyhalothrin	3	A	Product is not effective at high temperatures.
Potato leafhopper	lambda-cyhalothrin	3		

<sup>1</sup>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](http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php)) for further information on pesticide use.

<sup>2</sup>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](http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm) ; Insecticides: [www.irac-online.org/Crop\\_Protection/MoA.asp#area223](http://www.irac-online.org/Crop_Protection/MoA.asp#area223) ; Fungicides: [www.frac.info/frac/index.htm](http://www.frac.info/frac/index.htm)

<sup>3</sup>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<sup>p</sup> – 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)

<sup>4</sup>Source(s) - *Canadian Expert Poll on Crop Protection* Focus Group for Saskatchewan (2007).

## Alfalfa Looper (*Autographa californica*)

### ***Pest Information***

*Damage:* Damage is sporadic, but may become more of a problem with more years of chickpea cropping and as acreage increases. When significant, yield losses can be up to 20%.

*Life Cycle:* The pest overwinters as pupae in the soil or in trash near the base of the host plant.

There are two generations per year, with larvae from the second generation causing the most severe damage.

### ***Pest Management***

*Cultural Controls:* Crops should be seeded as early as possible, as older plants with vigorous growth can withstand more damage than younger, less established plants.

*Resistant Cultivars:* None available.

*Chemical Controls:* None available.

### ***Issues for Alfalfa Looper***

1. There is a need for a control agent for alfalfa loopers.

## Cutworms: Pale western (*Agrostis orthogonia*) and Redbacked (*Euxoa ochrogaster*)

### ***Pest Information***

*Damage:* Larvae can kill plants by feeding. Damage is sporadic, being patchy and normally affecting no more than 5% of the total acreage.

*Life Cycle:* Larvae molt several times while feeding, before tunnelling into the soil to pupate.

Some species overwinter as eggs, others as larvae or pupae. Other species do not overwinter, arriving annually from the United States on winds. Most species found in Canada have 1 or 2 generations per year.

### ***Pest Management***

*Cultural Controls:* Seeding should be done as early as possible using treated, certified seed.

*Resistant Cultivars:* None available.

*Chemical Controls:* Patch treatments of lambda-cyhalothrin are used if necessary.

### ***Issues for Cutworms***

1. None identified.

## Grasshopper (*Melanoplus sanguinipes*)

### ***Pest Information***

*Damage:* Grasshoppers feed on chickpea plants, killing them. Yield loss can be as high as 50% if plants are attacked at the early seedling stage.

*Life Cycle:* Grasshoppers prefer to lay their eggs in uncultivated ground, usually at field margins, on pasture land and on roadsides. Eggs, which are the overwintering stage, are laid in August and September and hatch the following May and June. A late spring or a cool summer can

delay the development of the pests, resulting in nymphs being present throughout the fall. Adult feeding can continue until the first heavy frost.

#### ***Pest Management***

*Cultural Controls:* Early seeding of crops, crop rotation, tillage and trap strips are all used to help control the pest.

*Resistant Cultivars:* None available.

*Chemical Controls:* Lambda-cyhalothrin is available for grasshopper control in chickpea.

#### ***Issues for Grasshopper***

1. There is a need for the development of a reduced risk approach, including the use of biologicals for the management of grasshoppers in chickpea.

### **Wireworm (Family: Elateridae)**

#### ***Pest Information***

*Damage:* Wireworms burrow into shoots, causing plants to become stunted, wilt and die.

Damage is sporadic and patchy, resulting in up to 5% yield loss.

*Life Cycle:* Wireworms are the larval stage of click beetles. There are nearly 400 species of wireworms found in Canada, with most being harmless. The larval stage requires 2-6 years to complete.

#### ***Pest Management***

*Cultural Controls:* Early seeding, crop rotations and tillage are methods used to control the pest.

*Resistant Cultivars:* None available

*Chemical Controls:* None available

#### ***Issues for Wireworm***

1. There is a need for the registration of a control agent for the pest in chickpea.

### ***Key Issues***

- There is a need for broadleaf weed control tools to augment the control based on the newly registered sulfentrazone.
- There is a need for the development and communication of integrated pest management strategies.
- There is concern over the sensitivity of chickpea to residual herbicides in the soil. Education is required to inform growers of the hazards posed by certain herbicides to this crop. This is also the case for other crops in the rotation with the newly registered use of sulfentrazone in chickpea.
- There is a need for formally established integrated pest management programs for chickpeas.
- There is a need for education on crop rotations and cultural pest management strategies.

**Table 12. Degree of occurrence of weed pests in Canadian chickpea production**

Annual weeds	Weed Occurrence	
	Alberta	Saskatchewan
wild buckwheat ( <i>Polygonum convolvulus</i> )	E	E
kochia ( <i>Kochia scoparia</i> )	E	E
Russian thistle ( <i>Salsola pestifer</i> )	E	E
green foxtail ( <i>Setaria viridis</i> )	E	E
wild oats ( <i>Avena fatua</i> )	E	E
yellow foxtail ( <i>Setaria glauca</i> )	E	E
stinkweed ( <i>Thlaspi arvense</i> )	E	E
lady's thumb ( <i>Polygonum persicaria</i> )	E	E
volunteer crops	E	E
<b>Perennial weeds</b>		
Canada thistle ( <i>Cirsium arvense</i> )	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		
DNR - Data not reported		
Source: <i>Canadian Expert Poll on Crop Protection</i> focus group for Saskatchewan (2007).		

**Table 13 Availability and use of weed pest management practices approaches for chickpea production in Canada.**

	Practice \ Pest	Annual broadleaf weeds	Annual grass	Perennial broadleaf weeds (Canada thistle)
Avoidance	resistant varieties			
	planting / harvest date adjustment			
	crop rotation			
	trap crops - perimeter spraying			
	use of weed-free seed			
	optimizing fertilization			
	reducing mechanical damage / insect damage			
	thinning / pruning			
	choice of planting site			
Prevention	tillage			
	residue removal / proper harvesting of cereal crops			
	water management			
	equipment sanitation			
	row spacing / seeding depth			
	removal of alternative hosts (weeds/volunteers)			
	mowing / mulching / flaming			
	weed management in non-crop lands			
	weed management in non-crop years			
Monitoring	scouting - trapping			
	records to track pests			
	field mapping of weeds			
	soil analysis			
	weather monitoring			
	grading of grain/ produce for weed contamination			
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	mechanical weed control			
	biological pesticides			
	patch treatments			
	pesticide rotation for resistance management			
	ground cover / physical barriers			
no information regarding the practice is available				
available/used				
available/not used				
not available				
Source: Canadian Expert Poll on Crop Protection focus group for Saskatchewan (2007).				

**Table 14. Registered weed control products, classification and resistance groups for chickpea production in Canada.**

<b>Regulatory Status as of February 22, 2008<sup>5</sup></b>				
<b>Control product (active ingredient / organism)<sup>1</sup></b>	<b>Classification<sup>2</sup></b>	<b>Mode of action / resistance group<sup>2</sup></b>	<b>PMRA status of active ingredient<sup>3</sup></b>	<b>Pests or group of pests targeted<sup>4</sup></b>
<b>carfentrazone-ethyl (Aim EC)</b>	triazolinone	inhibition of protoporphyrinogen oxidase / 14	R	broadleaf weeds and defoliate/desiccate crop as a harvest aid
<b>clethodim (Select EC, Centurion EC)</b>	cyclohexanedione	inhibition of acetyl CoA carboxylase (ACCase) / 1	R	grassy weeds
<b>diquat (Reglone Desiccant)</b>	bipyridylum	photosystem I electron diverters / 22	RE	desiccate crop and weeds
<b>glyphosate (Roundup Original 360 Liquid Herbicide)</b>	glyphosate	inhibition of EPSP synthesis / 9	RR	annual weed control prior to seeding
<b>metribuzin (Sencor 500 Flowable Herbicide, Sencor 75DF Sprayule 75% Water Dispersable Granular Herbicide)</b>	triazinone	inhibition of photosynthesis at photosystem II site A / 5	R	annual broadleaf weeds
<b>quizalofop p-ethyl (Assure II Herbicide)</b>	cyclohexanedione	inhibition of acetyl CoA carboxylase (ACCase) / 1	R	grassy weeds
<b>sethoxydim (Poast Ultra Liquid Emulsifiable Herbicide)</b>	cyclohexanedione	inhibition of acetyl CoA carboxylase (ACCase) / 1	RE	grassy weeds

<sup>1</sup>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.

<sup>2</sup>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](http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm) ; Insecticides: [www.irac-online.org/Crop\\_Protection/MoA.asp#area223](http://www.irac-online.org/Crop_Protection/MoA.asp#area223) ; Fungicides: [www.frac.info/frac/index.htm](http://www.frac.info/frac/index.htm)

<sup>3</sup>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](http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php)

<sup>4</sup> 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](http://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.

<sup>5</sup>Source: Pest Management Regulatory Agency

**Table 15. Performance and use of herbicides for the control of weeds in chickpea in Canada.**

Pests or Group of Pests targeted	Active ingredient <sup>1</sup>	Resistance group <sup>2</sup>	Stakeholder comments <sup>3,4</sup>	
			Performance <sup>3</sup>	Notes
annual grasses	clethodim	1	A	Provides good control of setaria (foxtail) and wild oats. Herbicide rotation is important due to resistance issues. There are Group 1 resistant populations of foxtail and wild oats on the Prairies.
	quizalofop p-ethyl	1	A	Provides good control of foxtail and wild oats.
	sethoxydim	1	A	Provides good control of foxtail.
annual broadleaf weeds	metribuzin	5	A	Provides adequate control of wild mustard. Provides fair control of stinkweed and lady's thumb. Is ill-suited for control of key dry region weeds such as kochia and Russian thistle.
annual weed control prior to seeding	glyphosate	9		Must be applied as a pre-seeding burn. This is tricky with such a long season crop. Provides good control of foxtail. Controls first flushes of wild oats.
broadleaf weeds and defoliate/desiccate crop as a harvest aid	carfentrazone-ethyl	14		
desiccate crop and weeds	diquat	22		
limited broadleaf weeds	sulfentrazone	5	I	Good control of kochia. Has residual properties and re-cropping needs to be considered.

<sup>1</sup> 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](http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php)) for further information on pesticide use.

<sup>2</sup>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](http://www.plantprotection.org/HRAC/Bindex.cfm?doc=moa2002.htm) ; Insecticides: [www.irac-online.org/Crop\\_Protection/MoA.asp#area223](http://www.irac-online.org/Crop_Protection/MoA.asp#area223) ; Fungicides: [www.frac.info/frac/index.htm](http://www.frac.info/frac/index.htm)

<sup>3</sup>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<sup>p</sup> – 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)

<sup>4</sup>Source(s) - *Canadian Expert Poll on Crop Protection* Focus Group for Saskatchewan (2007).

## Annual Grasses

*Common species:* Wild oats (*Avena fatua*), wild millet (foxtail) (*Setaria* spp.), volunteer cereals and other annual grasses.

### ***Pest Information***

*Damage:* If left unmanaged, all can inflict yield losses of 25 to 40 percent, depending on density of the weed and the time of emergence of the weed relative to the crop.

*Life Cycle:* Wild oats occur in most years. Wild millet is worse in years where hot, dry conditions prevail. 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.

### ***Pest Management***

*Cultural Controls:* Minimizing tillage tends to lead to reduced 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. It also leads to reduced yields. Use of clean, certified seed reduces addition of new weed seed. Deploying harvesting techniques that minimize seed loss in the cereal crop the year prior to growing chickpeas can lead to reduced populations of volunteer cereals. A fall tillage prior to freeze-up can do the same but this practice can leave the soil prone to erosion.

*Resistant Cultivars:* None available.

*Chemical Controls:* As chickpea production has changed to reduced tillage/soil conservation techniques, there has been a shift and reduction in certain weed species such as green foxtail while perennial weeds have become a bigger problem. This has led to increasing reliance on Group 1 graminicides such as sethoxydim and clethodim. These products are effective in a wide range of application stages on all of the grassy weeds mentioned above.

### ***Key Issues for Annual Grasses***

1. There is concern with the overuse of group 1 graminicides during crop rotation. When the chemistry is used too often, resistance to the entire product group or to members of the group can occur.
2. There are a very limited number of chemicals available for weed control in chickpeas.

## Annual Broadleaf Weeds

### ***Pest Information***

*Common Species:* Wild buckwheat (*Polygonum convolvulus*), kochia (*Kochia scoparia*) and Russian thistle (*Salsola pestifer*)

*Damage:* There is potential for up to 50% crop loss due to weed pressure if weed populations are high.

*Life Cycle:* Annual weeds complete their life cycle from seed germination, through vegetative growth and flowering to seed production, in one year.

### ***Pest Management***

*Cultural Controls:* Mowing of field edges and areas surrounding saline spots will reduce the seed set of kochia and Russian thistle. Early seeding is important to allow the crop to better

compete with weeds. As with annual grasses, it is important to use clean, weed-free seed and to scout fields frequently to minimize the ingress of broadleaf weed problems. Patch treatment of weeds like kochia or Russian thistle may be practical if the weeds are located in patches in saline areas.

*Resistant Cultivars:* None available.

*Chemical Controls:* Metribuzin can be applied early post-emergence. Best performance is achieved when chickpea plants are 3 cm or less. This early treatment is safer to the chickpea and ensures weeds are small. Metribuzin should not be used in soils with less than four per cent organic matter. This product controls weeds such as wild mustard (*Sinapsis arvensis*) but is not effective against kochia and Russian thistle. 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 chickpea production. Sulfentrazone provides good control of kochia in chickpea.

#### **Key Issues for Annual Broadleaves**

1. There is a lack of tools for broadleaf weed control in chickpea, particularly for post-emergence broadleaf weed control. The crop is a poor competitor. Post-emergence strategies that rely on metribuzin must cope with the fact that the product can cause crop injury, thus further reducing the crop's ability to compete with weeds. Sulfentrazone controls a limited spectrum of broadleaf weeds.

### **Perennial Grasses**

#### **Pest Information**

*Common species:* The predominant perennial grass weed is quack grass (*Elytrigia repens*).

*Life Cycle:* Perennial weeds tend to have extensive creeping root systems, which frequently produce shoots that will then produce a new plant. They also tend to readily regenerate through either seed germination or root fragments. Normally they can regenerate from as little as an inch of root fragment. Most perennial weed seeds will germinate within a year, but some may remain viable in the soil for up to twenty years or more.

#### **Pest Management**

*Cultural Controls:* Minimizing tillage tends to lead to reduced populations of quackgrass as tillage cuts up the rhizome which triggers the development of more shoots.

*Resistant Cultivars:* None available.

*Chemical Controls:* There are a very limited number of chemicals available for weed control in chickpeas. Group 1 graminicides, such as sethoxydim and clethodim, can provide good suppression of quackgrass.

#### **Key Issues for Perennial Grasses**

None identified.

### **Perennial Broadleaf Weeds**

#### **Pest Information**

*Common species:* Canada thistle (*Cirsium arvense*) and perennial sow thistle (*Sonchus arvensis*) have been reported as becoming increasingly problematic.

*Damage:* Weeds compete for resources, reducing yields.

*Life Cycle:* Both Canada thistle and perennial sow thistle are noxious and both 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 system and can survive by generating shoots from this underground root system. Both spread by seed as well, with sow thistle seeds travelling somewhat further by wind than Canada thistle.

### ***Pest Management***

*Cultural Controls:* Monitoring uncultivated field edges and roadsides and mowing when thistles are ready to flower, will minimize spread into fields. Tillage is generally more effective against perennial sow thistle than Canada thistle. However, since perennial sow thistle has a deep, penetrating root system, frequent, deep tillage is required. The high cost and risk of soil erosion make such tillage undesirable. The management of field-scale infestations requires a combination of control measures during all periods of application and over several years, along with good fertility to improve crop competition. Careful record keeping on herbicide treatments is essential to base decisions on what to do next, to minimize potential weed resistance problems and to prevent crop injury from herbicide carryover.

*Resistant Cultivars:* None available.

*Chemical Controls:* Spraying in-crop herbicides too early can often reduce perennial sow thistle control. Perennial sow thistle often emerges over a longer time than Canada thistle. Performance of in-crop herbicides can be improved by delaying application until near the end of the application period specified on the label. The delay allows the maximum number of perennial sow thistle shoots to emerge. There are no effective post-emergent broadcast herbicides available. Perennial sow thistle response is as good or better than Canada thistle response to post harvest herbicide applications, provided plant growth and weather conditions are favourable.

### ***Key Issues for Perennial Broadleaf Weeds***

None identified.

## **Vertebrate Pests**

There are no major vertebrate pests in chickpea production although rabbits and deer can cause localized crop damage.

## ***Provincial Pulse Crop Specialists and Provincial Minor Use Coordinators***

Province	Ministry	Crop Specialists	Minor Use Coordinators
<b>Alberta</b>	Alberta Agriculture, Food and Rural Development	<u>Mark Olson</u> ( <a href="mailto:mark.olson@gov.ab.ca">mark.olson@gov.ab.ca</a> )	Dan Cole ( <a href="mailto:dan.cole@gov.ab.ca">dan.cole@gov.ab.ca</a> )
<b>Saskatchewan</b>	Saskatchewan Agriculture	Ray McVicar ( <a href="mailto:rmcvicar@agr.gov.sk.ca">rmcvicar@agr.gov.sk.ca</a> ); Penny Pearse	Ray McVicar ( <a href="mailto:rmcvicar@agr.gov.sk.ca">rmcvicar@agr.gov.sk.ca</a> )
<b>Manitoba</b>	Manitoba Agriculture, Food and Rural Initiatives	John Gavloski ( <a href="mailto:jgavloski@gov.mb.ca">jgavloski@gov.mb.ca</a> )	David Kaminski ( <a href="mailto:david.kaminski@gov.mb.ca">david.kaminski@gov.mb.ca</a> )

## ***National and Provincial Pulse Crop Grower Organizations***

### **Pulse Canada**

1212-220 Portage Ave.  
Winnipeg, MB R3C 0A5  
[www.pulsecanada.com](http://www.pulsecanada.com)

### **Alberta Pulse Growers**

[www.pulse.ab.ca](http://www.pulse.ab.ca)

### **Saskatchewan Pulse Growers**

104-411 Downey Road  
Saskatoon, SK S7N 4L8  
[www.saskpulse.com](http://www.saskpulse.com)

### **Manitoba Pulse Growers Association**

P. O. Box 1760  
Carman, MB R0G 0J0  
[www.manitobapulse.ca](http://www.manitobapulse.ca)

## Research Contacts in Canada

Name	Organization	Pest type	Specific pests	Type of research
S. Banniza	Crop Development Centre, U. of Saskatchewan, Saskatoon, SK	diseases	all	integrated pest management
B. Gossen	AAFC Research Station, Saskatoon, SK	diseases	all	integrated pest management; breeding
R. Holm	University of Saskatchewan	weeds, diseases	agronomy	integrated pest management; general agronomy
D. Johnson	U. of Lethbridge, Lethbridge, AB.	insects	grasshoppers	forecasting, monitoring, modelling, biological control
R. McVicar	Saskatchewan Agriculture	weeds, diseases and insects	extension	integrated pest management
P. Pearse	Saskatchewan Agriculture	diseases	extension	integrated pest management
Y. Gan	AAFC Research Station, Swift Current, SK	weeds, diseases and insects	all	integrated pest management systems

## References

Alberta Pulse Growers [www.pulse.ab.ca](http://www.pulse.ab.ca)

Agriculture and Agrifood, Pulse Crop Diseases website  
[paridss.usask.ca/specialcrop/pulse\\_diseases/index.html](http://paridss.usask.ca/specialcrop/pulse_diseases/index.html)

Canadian Grain Commission publication, Grading Standards for Canadian Crops

Government of Alberta, Pulse crops  
[www.agric.gov.ab.ca/app21/infopage?cat1=Crops&cat2=Peas+%26+Pulses](http://www.agric.gov.ab.ca/app21/infopage?cat1=Crops&cat2=Peas+%26+Pulses)

Government of Manitoba, Pulse Crops  
[www.gov.mb.ca/agriculture/crops/pulsecrops/bhf01s01.html](http://www.gov.mb.ca/agriculture/crops/pulsecrops/bhf01s01.html)

Saskatchewan Agriculture, Food and Rural Revitalization [www.agr.gov.sk.ca](http://www.agr.gov.sk.ca), Ascochyta Blight in Pulse Crops, Chickpeas in Saskatchewan, Crop Planning Guide, Guide to Crop Protection 2003

Grasshopper forecasting sites can be found at the following websites:

[http://www.gov.mb.ca/agriculture/crops/insects/forecast/grasshopper\\_interp.html](http://www.gov.mb.ca/agriculture/crops/insects/forecast/grasshopper_interp.html)

<http://www.agriculture.gov.sk.ca/Default.aspx?DN=b07d649b-9449-42a9-b2ef-30489d2fbde3>

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/prm12509](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/prm12509)

Pulse Canada [www.pulsecanada.com](http://www.pulsecanada.com), Chickpeas Market Information

Ray McVicar, Pulse Specialist, Saskatchewan Agriculture and Food

Saskatchewan Pulse Growers, [www.saskpulse.com](http://www.saskpulse.com)

Statistics Canada, <http://www.statcan.gc.ca/>

United Nations Food and Agricultural Organization website accessed February 12, 2002,

<http://faostat.fao.org/site/291/default.aspx>