Crop Profile for Chickpea in Canada

Prepared by:

Pesticide Risk Reduction Program

Pest Management Centre

Agriculture and Agri-Food Canada

March 2005

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada | Canada

Crop Profile for Chickpea in Canada

Pest Management Centre
Pesticide Risk Reduction Program
Agriculture and Agri-Food Canada
960 Carling Avenue, Building 57
Ottawa, Ontario
K1A 0C6
CANADA

This profile is based on a report prepared on contract (01B68-3-0046) by:

Mark Goodwin
Mark Goodwin Consulting Ltd.
524 Clifton St.
Winnipeg, Manitoba
R3G 2X2
CANADA

The authors recognize the efforts of the Pest Management Regulatory Agency, 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.

Table of Contents

List of Tables

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 (*Cicer arietinum* L.) 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. The growth habit is erect, with most of the pods formed in the top part of the plant. It is grown in over 45 countries and on all continents of the world. The crop provides is 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. 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. Around 96% of the Canadian chickpea production is centered in these two soils zones in Saskatchewan, with the other 4% in Alberta.

General Production Information

Canadian Production	68,000 metric tonnes 63,000 hectares
Farm gate value	$22 million
Domestic consumption	36,000 metric tonnes
Export (excludes products)	74,000 tonnes
Import (excludes products)	2,000 tonnes
Source (2003): Market Analysis Division, Agriculture and Agri-Food Canada http://www.agr.gc.ca/mad-dam/e/sd2e/hsd2ez.htm	

Production Regions

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

Cultural Practices

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 degrees Celsius, but, with Desi chickpeas, germination will begin at soil temperatures as low as 5 degrees Celsius. Kabuli chickpeas are more sensitive to cold and should not be seeded into soil colder than 10 degrees Celsius 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^2. 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 5ºC. 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 the 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. Kabuli chickpea is best adapted to the brown soil zone, and Desi chickpea is best adapted to the brown and dark brown soil zones of Saskatchewan. Chickpea is not well adapted to saline soils, or to high moisture areas.

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.

Production Issues

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.

Chickpea must be handled carefully, since the growing point of the seed is exposed. Typically the seed is beaked and wrinkled or ribbed. The beak is the protruding seedling root tip. 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.

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 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.

Table 1. Canadian chickpea production and pest management schedule

Time of year	Activity	Action
October - March	-	Nothing done
April	Soil care	Soil test
	Weed management	Burn down herbicide treatments are used
May	Plant care	Seeding
	Soil care	Fertilize
	Disease management	Seed treatments
	Insect & mite management	Monitoring
	Weed management	Identify and scout for weeds
June	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.
July	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
August	Plant care	Prepare for harvest
	Disease management	Monitor
	Insect & mite management	Monitor
	Weed management	Monitor
September	Plant care	Harvest
	Weed management	Check for winter annual germination and treat or till if necessary

Abiotic Factors Limiting Production

Key Issues

1. Many of the production problems centre around the fact that the crop has increased in acreage quickly and the development of crop protection tools and techniques has not been able to keep pace with the occurrence of abiotic factors and pest issues that come up.
2. There is concern over the fact that over the past two years, disease has stricken the crop in areas where there is more moisture in Saskatchewan.

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

Another 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, or crack the seed coat, both of which can downgrade the quality of the sample. 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.

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 nature 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.

Diseases

Key Issues

- Diseases are the most critical production problem for chickpea in Canada.
- There is concern over the reliance on strobilurins chemistry, as it may prove to be an issue in the future. To prevent 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 control management tools and practices for ascochyta.
- 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 2. Degree of occurrence of disease pests in Canadian chickpea production

	Degree of occurrence	
Major diseases	**AB**	**SK**
Ascochyta Blight	**E**	**E**
Botrytis Grey Mould	**E**	**E**
Root Rot	**E**	**E**
Lesser diseases	**AB**	**SK**
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: Pulse Canada		

Major diseases

Ascochyta blight (*Ascochyta rabiei*)

Pest Information

Damage: The pathogen causes lesions on leaves, stems and pods. Inside the lesions, pycnidia form spores that ooze out when conditions are moist and spread by rain splashing to neighbouring plants. 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 losses can occur in Kabuli and up to 50% yield loss in Desi.

Life Cycle: The pathogen is seed and residue-borne. 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

Chemical Control: 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 preventative fungicide that remains active for 10-14 days and will not stop infections that are already in progress.

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.

Alternative Control: 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). 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.

***Issues for** Ascochyta Blight*

1. There is concern that the over use of the recently registered strobilurins fungicides will cause them to be ineffective over time. Fungicide rotations and integrated disease management will be critical if this is to be avoided.
2. New resistant varieties need to be developed to help in an integrated approach to managing this disease.

Grey Mould (*Botrytis cinerea*)

Pest Information

Damage: Infected plants produce masses of spores that become airborne and disperse rapidly. 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. 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

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

Cultural Controls: Thinner canopies mean less 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 reduce help minimize disease. Cereals used in the rotation are of particular help in reducing the build-up of soil-borne inoculum.
Alternative Controls: None identified.
Resistant Cultivars: None

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.
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

Chemical Controls: Thiabendazole, fludioxonil and metalaxyl will help with the control of root rots.
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.
Alternative Controls: None identified.
Resistant Cultivars: None available.

Issues for Root Rot

None identified.

Lesser Diseases

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 include decreased seed quality due to seed discoloration.
Pest 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 in 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.

Pest Management

Chemical Controls: Boscalid is registered for the control of sclerotinia in chickpea.

Cultural Controls: Encouraging good plant health can help reduce infections. Rotations should include cereals to help reduce the build-up of soil-borne inoculum.

Alternative Controls: None identified.

Resistant Cultivars: None

Issues for Sclerotinia Stem Rot

None identified

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

Control product (active ingredient / organism)[1]	Classification[2]	Mode of action – resistance group[3]	PMRA status of active ingredient[4]	Pests or group of pests targeted	Performance of product according to recommended use[5]	Notes
Azoxystrobin	Strobiluron	11	RR	Anthracnose	A	
				Ascochyta	A	
Boscalid	Anilide and Pyridine	7	RR	Botrytis	A	
				Sclerotinia	A	
				Ascochyta	A	
Chlorothalonil	Aromatic	M²	R	Ascochyta	A	
				Anthracnose	A	
Mancozeb	Sy			Anthracnose	A	
				Ascochyta	A	
Pyraclostrobin	Strobiluron	11	R	Anthracnose	A	
				Ascochyta	A	
Thiabendazole	Sy Benzimidazole And Thiazole	1	R	Ascochyta	A	Seed borne ascochyta, botrytis, fusarium, and rhizoctonia

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

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

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

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

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

Sources: Pulse Canada, Labels as per ELSE database on PMRA website

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

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

no information regarding the practice is available
available/used
available/not used
not available
Source(s): Information in the crop profile for individual pests

Insects and Mites

Key Issues

- Reduced risk insecticides are needed that are able to be used as part of an integrated approach to insect control.
- There is a need for the development of integrated control strategies for insects in chickpea.

Table 5. Degree of occurrence of insect pests in Canadian chickpea production

	Degree of occurrence	
Major pests	**AB**	**SK**
Alfalfa Looper	E	E
Cutworm	E	E
Grasshopper	E	E
Minor pests	**AB**	**SK**
Wireworm	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(s): Pulse Canada

Major Insects and Mites

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%.

Pest 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

Chemical Controls: None

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.

Alternative Controls: None identified.

Resistant Cultivars: None

Issues for Alfalfa Looper

1. There is a need for a control agent for the pest.

Cutworms or Pale western (*Agrostis orthogonia*) and Red backed (*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 tunneling 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 only 1 or 2 generations per year.

Pest Management

Chemical Controls: None

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

Alternative Controls: None identified.

Resistant Cultivars: None

Issues for Cutworms

1. There is a need for a control agent for cutworm in chickpea.

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. The eggs are laid in August and September and overwinter to hatch in May and June. A late spring or a cool summer can delay the development of the pests, making nymphs present throughout the fall. Adult feeding can continue until the first heavy frost.

Pest Management

Chemical Controls: None

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

Alternative Controls: None identified.

Resistant Cultivars: None

Issues for Grasshopper

1. There is a need for a control agent for grasshopper in chickpea.

Minor Insect and Mite Pests

Wireworm

Pest Information

Damage: The pest burrows into shoots, causing plants to become stunted, wilt and die. Damage is sporadic and patchy, causing up to 5% yield loss.

Life Cycle: Wireworms are the larval stage of the 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

Chemical Controls: None

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

Alternative Controls: None identified.

Resistant Cultivars: None

Issues for Wireworm

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

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

There are no products currently registered for the control of insects in chickpea in Canada.

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

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

no information regarding the practice is available
available/used
available/not used
not available
Source(s): Information in the crop profile for individual pests

Weeds

Key Issues

- There is a need for broadleaf weed control tools, as there are currently no registered herbicides for the control of the most important ones, such as kochia and Russian thistle.
- There is a need for improved harvest management tools (desiccants, growth regulators, defoliants).
- 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.
- 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.
- There is a need for harmonization between the registration process in the United States and that of Canada. This includes compressing trial zones, increasing the acceptance of U.S. data in Canada and expediting the set up of a Canadian IR-4 like program.
- The pulse industry needs to work with PMRA on regulatory flexibility to maintain pulse crops in the minor use system and obtain more registration for pulse crop pest control.
- Industry needs to explore the potential for coordinating and developing the registration packages for minor use pesticides.

Table 8. Degree of occurrence of weed pests in Canadian chickpea production

	Weed Occurrence	
Major Weeds	**AB**	**SK**
wild buckwheat	E	E
kochia	E	E
Russian thistle	E	E
green foxtail	E	E
wild oats	E	E
Minor Weeds	**AB**	**SK**
yellow foxtail	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
Pest not present
E – established
D – invasion expected or dispersing
DNR - Data not reported
Source(s): Saskatchewan Agriculture and Food

Major Weeds

Annual Grasses

Commonly found weed species: Wild oats (*Avena fatua*), wild millet, green foxtail, 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

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 become a larger 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. There are a very limited number of chemicals available for weed control in chickpeas.

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.

Alternative Controls: None identified.

Resistant Cultivars: None available.

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.

Annual Broadleaves

Pest Information

Commonly Found Weed Species in Chickpea Producing Areas: – 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.

Pest Life Cycle:

Pest Management

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 in soils with less than four per cent organic matter. This product controls weeds like 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.

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

Alternative Controls: 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 so that they do not spread/roll through the field.

Resistant Cultivars:

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 crops ability to compete with weeds.

Minor Weeds

Perennial Grasses

Pest Information

Damage: The predominant perennial grass is quack grass (*Agropyron repens*).

Life Cycle: Perennial weeds tend to have extensive creeping rootstocks, 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 of the 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

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.

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. 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. The use of clean, certified seed reduces the introduction of new weed seed. Deploying harvesting techniques that minimize seed loss in the cereal crop the year prior to growing chickpea 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.

Alternative Controls: None identified.
Resistant Cultivars: None available.

Key Issues for Perennial Grasses

None identified

Perennial Broadleaves

Pest Information

Damage: Weeds compete for resources, reducing yields.

Life Cycle: Canada thistle (*Cerium ardencies*) and sow thistle (*Conches ardencies L.*) have been reported as becoming increasingly problematic. Both of these weeds 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 in wind than Canada thistle.

Pest Management

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.

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.

Alternative Controls: 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.

Key Issues for Perennial Broadleaves

None identified

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

Control product (active ingredient / organism)[1]	Classification[2]	Mode of action – resistance group[3]	PMRA status of active ingredient[4]	Pests or group of pests targeted	Performance of product according to recommended use[5]	Notes
Clethodim	cyclohexene oxime	1	R	Annual grasses	A	Resistance is a growing problem with the Group 1 chemistries.
Poast (sethoxydim)	cyclohexene oxime	1	R	Annual grasses	A	Resistance is a growing problem with the Group 1 chemistries
Sencor (metribuzin)	Triazinone	5	R	Limited Annual broadleafs	I	Controls wild mustard but is ill-suited for control of key dry region weeds such as kochia and Russian thistle

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

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

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

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

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

Source(s): Pulse Canada and AFRR

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

	Practice / Pest	Annual broadleaf	Annual grass
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		
Avoidance	resistant varieties		
	planting / harvest date adjustment		
	crop rotation		
	trap crops - perimeter spraying		
	use of disease-free seed		
	optimizing fertilization		
	reducing mechanical damage / insect damage		
	thinning / pruning		
Monitoring	scouting - trapping		
	records to track pests		
	field mapping of weeds		
	soil analysis		
	weather monitoring for disease forecasting		
	Patch treatments		
Suppression	use of thresholds for application decisions		
	biological pesticides		
	pheromones		
	sterile mating technique		
	beneficial organisms & habitat management		
	pesticide rotation for resistance management		
	ground cover / physical barriers		
	controlled atmosphere storage		
	forecasting for applications		

no information regarding the practice is available
available/used
available/not used
not available
Source(s): Information in the crop profile for individual pests

Vertebrate Pests

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

References used in this document

Alberta Pulse Growers www.pulse.ab.ca

Agriculture and Agrifood, Pulse Crop Diseases website paridss.usask.ca/specialcrop/pulse_diseases/index.html

Canadian Agri-Food Research Council website of ongoing research by commodity
www.carc-crac.ca/english/index.htm

Canadian Grain Commission publication, Grading Standards for Canadian Crops

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

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

Government of Saskatchewan, Saskatchewan Agriculture, Food and Rural Revitalization 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:
www.gov.mb.ca/agriculture/crops/insects/forecast/grasshopper_map.html
www.agr.gov.sk.ca/DOCS/crops/integrated_pest_management/insects/images/hoppermap2003.gif
www.agric.gov.ab.ca/pests/forecast/2003hopper_forecast.html

Pulse Canada www.pulsecanada.com, Chickpeas Market Information

Ray McVicar, Pulse Specialist, Saskatchewan Agriculture and Food

Saskatchewan Pulse Growers, www.saskpulse.com

Statistics Canada, www.statcan.ca

United Nations Food and Agricultural Organization website accessed February 12, 2002, apps.fao.org

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

Name	Organization	Pest type	Specific pests	Type of research
Scott Research Station, Scott, SK	Agriculture Canada	Weeds	Various	Agronomy
University of Saskatchewan		Weeds/Pathology	Various	Agronomy/Breeding
Swift Current Research Station	Agriculture Canada		Various	Agronomy
Indian Head Research Station, Indian Head, SK	Agriculture Canada	Weeds	Various	Agronomy