canola council OF CANADA

CANOLA PRODUCTION TIPS

Content

Canola Production Tips

Canola is a management-responsive crop. The Canadian average yield from 2002 through 2011 was 30 bushels per acre, up from 24 bushels per acre in the previous decade (1992 – 2001) based on Statistics Canada reports. Yet knowledgeable growers often average 35 bushels per acre or more over all of their canola acres and achieving yields above 45 bushels per acre on individual fields is not uncommon. Weather certainly plays a role in canola yields, but management makes the difference between an average and above average canola crop.

This booklet is designed to help you concentrate on some of the key agronomic factors that can affect the profitability of your canola crop. Agronomy is the science **and** economics of crop production. Focusing on one without the other will short-change your profitability. Your goal in canola production should be to maximize your contribution margin. The contribution margin is the amount of gross revenue remaining to pay fixed costs, your labour and return on investment, after deducting variable costs.

In order to maximize canola production, it can't be stressed too strongly that you must know what's happening in your canola fields at all times. Canola is not a crop that can be ignored between major field activities (e.g. herbicide applications and swathing); nor can it be effectively monitored from the roadside. **Effective canola management results from regular hands-on scouting to assess the health of plants throughout the field.**

The topics in this booklet are considerably condensed in order to provide you with fast facts when you're in the field.

For complete information on all areas of canola production, refer to the Crop Production section of the Canola Council of Canada website **www.canolacouncil.org/crop-production**.

Start the crop off right

Get the crop out of the ground quickly to reduce seedling exposure to soil-borne diseases and prevent weeds from getting a competitive edge on the crop.

Seed 1/2 to 1" (1.25 to 2.5 cm) deep to moisture. Seeding too deep depletes seed energy reserves and encourages the development of seedling diseases.

Seeding early, even prior to reaching ideal soil temperatures for rapid germination (≥10°C), typically benefits yield. However, delayed germination and slow emergence in soils below 5°C may increase seedling mortality, counteracting early planting benefits. Also consider the calendar, frost risk and long range weather forecast to determine your earliest seeding date with an acceptable level of risk.

- *Seedling disease complex includes a number of fungi that attack canola seeds, roots or hypocotyls causing symptoms ranging from rotting in the ground, to poor growth or death of seedlings after emergence.*

Know the re-cropping restrictions for herbicides used in previous years

Soil residual herbicides can affect germination and growth of canola.

- Follow label recommendations and consult manufacturer guidelines in years of abnormally dry conditions.

Recropping restrictions for residual herbicides

Herbicide	Clearfield Canola	Non-Clearfield Canola
2,4-D*	1	1
Absolute*	1	2
Adrenalin, Solo, Viper	1	1
Altitude FX	1	1
Amitrol	1 day	1 day
Authority	2	2
Avadex	0	0
Barricade, Fluroxypyr + 2,4-D, Retain, Trophy	1	1
Benchmark	1	1
Curtail M, FlaxMax DLX, Prestige XC	1	1
Dicamba*	1*	1*

Eclipse III, Lontrel 360	1	1
Express Pro	10 months	10 months
Flucarbazone, Everest GBX, PrePare (Brown soils)		
Flucarbazone, Everest GBX, PrePare (Dark brown, black and grey wooded)	1*	1*
Flumioxazin	1	1
Frontline XL, Frontline 2,4-D, Spectrum	1	1
Imazamethabenz (Black and grey wooded soils)	1	1
Imazamethabenz (Brown and dark brown)	1	2
Infinity	1	1
Kerb	1	1
Metusulfuron (pH less than 7, brown and dark brown)		2
Metusulfuron (pH less than 7, other soils)		1
Metusulfuron (pH 7–7.9), brown and dark brown)		3
Metusulfuron (pH 7–7.9, other soils)		2
Muster		2

Herbicide	Clearfield Canola	Non-Clearfield Canola
Odyssey*, Odyssey DLX*	1	2
Option	1	1
PrePass*	1*	1*
Pulsar	1	1
Sencor	2	2
Simplicity	1	1
Stellar	1	1
Tandem	1	1
Triton C*	1	1
Velocity m3	1	1

Source: Guide to Crop Protection 2012. Saskatchewan.

Figures listed are the number of cropping seasons before each crop can be grown ("1" means that the crop can be grown the year following application). Products with preseeding restriction in months or days are labeled as such. A blank space means that there are no recommendations given on the product label and a field bioassay is recommended by many product manufacturers to determine if these crops are safe to plant.

**The minimum re-cropping intervals are listed. Safe intervals may be longer than those listed depending on the use rates, region, province, soil types, environment, time of application and crop variety. Refer to product label for more information.*

Use clean, certified seed of a suitable registered variety

- Certified seed helps ensure a true-to-type crop with the performance characteristics growers expect from the variety they have chosen.
- Certified seed typically comes treated. Fungicide seed treatments reduce seed-borne blackleg and alternaria black spot, and protect against seedling diseases. Insecticide treatments can also provide protection against flea beetle damage.
- The analysis of certified seed lots can provide useful information about any pest issues that may not be indigenous to your farm (e.g. presence of disease, or specific weed seeds at low levels that could present a risk of introduction).
- Certified seed has high standards for germination. Under similar seeding conditions, seed with a higher germination percentage and larger seed size will tend to have better rates of seed survival and improved plant development, which can translate into higher yield (when compared to smaller, lower germ seed of the same variety). However, high thousand seed weight (TSW) means fewer seeds planted per unit area if seeding rate is not adjusted. Check the bag or ask your rep for the TSW in grams, and use this number to help calculate a proper seeding rate to meet your target plant populations (see section on Seeding Rate Considerations on page 16).

Varieties from each species will tend to exhibit some of the following key traits listed for that species:

***B. napus* canola:**
- higher yield potential;
- higher oil content (1–2%);
- more tolerance to some diseases (brown girdling root rot, alternaria black spot);
- specific herbicide tolerance; and
- specialty oil traits.

***B. rapa* canola:**
- earlier maturity; and
- better shattering tolerance that can mitigate some risk for straight cutting.

***B. juncea* canola:**
- improved drought tolerance;
- increased heat tolerance; and
- better shattering tolerance that can mitigate some risk for straight cutting.

- Review performance data from different sources before selecting a variety. Choose a variety for both its yield potential and agronomic characteristics. Information from Canola Performance Trials (CPT) (www.canolaperformancetrials.ca) can help with selection.

- Evaluate the levels of disease resistance of any variety under consideration. Rotating varieties creates the opportunity to bring a mix of resistance genes to the field over time, which can reduce selection pressure and improve durability. Stewardship of disease resistance requires integration with other agronomic practices designed to control diseases.
- Don't put "all your eggs in one basket." To manage risk, try different varieties to compare them to the previous standard variety. Consider planting only a portion of the acreage to a new variety to allow time to assess how the variety performs on the farm before committing a large acreage.
- Do not depend on variety choice alone to improve yields, it will lead to disappointment. Current varieties have the genetic potential to produce a much higher than average yield. However, they will need timely management, adequate resources, frequent scouting and sufficient protection from pests to yield to their full economic potential.

Soil fertility and canola nutrition

- Profitable canola production relies heavily on adequate plant nutrition, which in turn is affected by management of soil fertility. In addition, the nutritional level of the plant will affect the crop response to stress factors such as disease and adverse weather. Balanced, effective fertilizer management not only contributes to profitable canola yield but also helps to maintain the productivity of the soil resource.

- Follow the 4R nutrient stewardship of using the right fertilizer source at the right rate at the right time and in the right place.
- Nitrogen (N), phosphorous (P), and sulphur (S) are the most limiting nutrients in most soils. Canola yields respond well to additional levels of these nutrients.
- A 35 bu/ac canola crop will take up the following amounts of the major nutrients (lb/ac):

N	P_2O_5	K_2O	S
100–123	46–57	73–89	17–21

- The above example shows the ratio of nutrients (5 : 2.4 : 4 : 1) to achieve from the combination of soil available nutrients and applied fertilizer.
- A high N:S ration can aggravate sulphur deficiencies. Achieving the above ratio of available N:S will help maximize yield.
- While canola requires the essential micronutrients, it is very rare that soils in western Canada are unable to supply sufficient quantities. Among the micronutrients, boron (B) would be the most likely deficiency to occur in canola, but very few economic responses to applied boron have been documented. Also, excessive boron can cause toxicity, so take care to apply only recommended rates if trying an application.

Target yields and fertilizer recommendations

Fertilizing to a target yield based on analysis of properly collected soil samples is important for maximizing your fertility dollar. Assess spring moisture conditions with a soil moisture probe to help establish a target yield. Using the depth of moist soil measured with the moisture probe, estimate the amount of stored water in the soil from the following table:

Water availability for different soil textures

Soil Texture	Inches of soil water per foot of moist soil	
	(inches)	(cm)
Sand	0.75	1.9
Loamy sand	1.0	2.5
Sandy loam	1.25	3.2
Loam	1.5	3.8
Clay loam	1.75	4.4
Clay	2.0	5.1

Reference: Saskatchewan Ministry of Agriculture (SMA)

Calculate target yield by using one of the formulas in the following table:

Formula for determining target yield on a soil test

Soil Zone	Yield Formula
Dry brown	Y = (WU - 2.5) X 2.0
Brown	Y = (WU - 2.25) X 2.5
Dark brown	Y = (WU - 2.0) X 3.0
Thin black	Y = (WU - 1.75) X 3.3
Black	Y = (WU - 1.5) X 3.6
Gray	Y = (WU - 1.25) X 4.0

Reference: SMA *Y = Yield (bu/ac)*
WU = Water use (inches of stored soil moisture + estimated in season precipitation)

Example: A grower has loam textured soil in the thin black soil zone. Soil moisture probe readings average 2.5' (0.8m) on 15 probes, giving 3.75" of available water. (See page 13.) Estimated in-season precipitation is 7", so total WU is 10.75". Using the formula above for thin black, the target yield is 29.7 bu/ac.

- Submit your target yield and your average depth of moist soil with your soil sample to assist the lab in making more accurate fertilizer recommendations.

Fertilizer placement

- Canola is sensitive to too much fertilizer (especially N) in the seed row. Canola can tolerate some fertilizer in the seed row, but the amount of fertilizer that can be safely seed-placed will decline with drier conditions and wider row spacing.
- Be aware of the seedbed utilization of the seeding opener and consult provincial guidelines for safe seed-placed fertilizer rates.

Nutrient deficiencies

- Canola can exhibit a number of nutrient deficiencies but N and S are the most common.
- Deficiencies can be corrected with minimal yield loss if detected early and timely rescue treatments are applied. This is most common with N, S and sometimes B. N can be added until bolting, S can be added into flowering, and B can be added up to early flowering.

▶ *Canola seedlings with N deficiency (right) vs. healthy seedlings (left).*

▶ *Classic symptoms of a severe sulphur deficiency. This crop will have a dramatic yield reduction.*

Plant into a firm seedbed for better seeding depth control

- The seedbed is firm enough when a work-boot sinks no deeper than the thickness of its sole.
- Base packing decisions on soil conditions each year. Generally, fine-textured soils are easily overpacked. These soils can become so compacted that the supply of oxygen to seedling roots is limited.
- Under loose soil conditions, pre-seeding packing is recommended for moisture conservation or improved seeding depth control.
- Post-seeding packing for good seed to soil contact may be required behind seeding equipment lacking on-row packing.

Seeding rate considerations

- Growing conditions at time of seeding, including the potential for diseases and insect damage, will affect the plant density. Under above average conditions, 60 to 80% of canola seed will produce viable plants. Under average conditions, 40 to 60% of the seed will produce viable plants.
- The recommended seeding rate range is five to 10 pounds per acre (5.6 to 11.2 kg/ha), with the ultimate goal of establishing a minimum of 7 plants/ft^2 (70 plants/m^2) to achieve optimum yields.
- Seed size affects seeding rate. The higher the thousand seed weight (TSW), the fewer seeds per pound.

- Seeding rate calculation (lb/ac) =

$$\frac{\textbf{9.6 X plants/ft}^2\ \textbf{X thousand seed weight in grams}}{\textbf{\% survival}}$$

- Lower seeding rates often mean fewer plants per square foot, which take longer to cover the ground. This helps weeds compete and concentrates insect populations on fewer plants.
- Low plant densities lead to increased branching, complicating staging for applications and swathing, and extending the development period causing delayed maturity and potential green seed problems.

IPM – What is it?

Integrated Pest Management (IPM) uses ALL the tools available for controlling weeds, diseases and insects. The goal of IPM is to achieve the best pest management by using all the tools in a method that is (1) safe, (2) environmentally sound and (3) economically viable.

The IPM toolkit includes

- Prevention (practices that reduce the severity of the pest problem or prevent build-up of the pest on the farm).
- Monitoring/forecasting (keeping track of the pests that are present and the actual size of the problem).
- Intervention (actions that reduce the economic impact of the problem).
- Record keeping (maintaining a field record of what happened and effectiveness of the intervention).

Steps followed in an IPM program

- Identifying the pests;
- Understanding the life cycle of each pest;
- Monitoring/scouting for pests;
- Economic thresholds;
- Prediction/forecasting: tools and techniques;
- Preventive practices;
- Interventions – cultural, biological, genetic, chemical; and
- Evaluating the effectiveness/results of the strategy used.

Growers typically use a multitude of IPM techniques. The challenge in the future will be to pull together the techniques being used and create better "packages." Generally speaking, IPM only works to its fullest potential if a multi-year approach is taken, where plans for a canola field's pest program begin at least one year ahead of seeding the crop.

Plan a weed control strategy

- A good weed control program is essential because canola is a poor competitor in the seedling stage.
- Use pre-seed burn-off treatment to control early emerging weeds. To help manage herbicide resistance, use a herbicide treatment that includes more than just glyphosate, but does not leave a soil residue.

Herbicides for use in canola before seeding or after seeding but prior to crop emergence

Herbicide	Herbicide Group	Pre-seeding	Pre-emergent
Amitrol	11	✓	
CleanStart	9 & 14	✓	
Glyphosate	9	✓	✓

- In-crop weed control in the early stages of crop development (before the 4-leaf stage) will have greater yield benefits than later in the season.

Herbicides for use in canola

Herbicide	Herbicide Group	Roundup Ready	Liberty Link	Clearfield	Non-herbicide Tolerant Canola
Absolute	2 & 4			✓	
Ares	2			✓	
Avadex	8	✓	✓	✓	✓
Clethodim	1	✓	✓	✓	✓
Eclipse	4 & 9	✓			
Edge Granular	3	✓	✓	✓	✓
Equinox	1	✓	✓	✓	✓
Fortress	3 & 8	✓	✓	✓	✓
Glyphosate	9	✓			
Liberty	10		✓		
Lontrel 360	4	✓	✓	✓	✓
Muster Toss-N-Go	2	✓	✓	✓	✓
Odyssey	2			✓	
Poast Ultra	1	✓	✓	✓	✓
Quizalofop	1	✓	✓	✓	✓
Solo	2			✓	
Trifluralin	3	✓	✓	✓	✓

The tables above are adapted from provincial guides to crop protection for 2012. Always consult your current guide or product labels for registered uses, recommendations and restrictions.

- Weed control is equally important in the non-canola years. A number of weeds, particularly cruciferous weeds (e.g. stinkweed, shepherd's purse) can act as hosts for canola diseases and insects in the non-canola years.
- Regularly rotate among herbicide groups, not just herbicides. Herbicide group rotation is important for both canola and non-canola years.
- Herbicide-resistant weed populations are becoming widespread, so keeping accurate records of all herbicides used and any weed escapes is important.
- Walk your fields to identify what weed species are present. Field monitoring will also alert you to the development of resistant weeds.
- Have on hand a copy of your provincial government's weed control publication and a weed identification guide.

Beneficial Insects

Beneficial insects provide valuable contributions to canola production, both in terms of pollination of crops and predation of insect pests. Most of the insects found in canola fields are either beneficial or benign.

Lady Beetle

- There are over 450 species of lady beetles (also commonly called ladybugs or ladybird beetles) in North America.
- Most lady beetles are beneficial as both adults and larvae, primarily feeding on aphids, mites, small insects and insect eggs.
- Adult ladybugs have the familiar red or orange back with black markings or spots.
- The adults are small, round to oval, and dome-shaped.

▶ *Lady beetle larva*

- Lady beetle larvae are dark and alligator-like with three pairs of prominent legs.

Potential for consuming pests

- Lady beetles eat voraciously, and some species may eat their weight in aphids each day as a larva, and can consume upwards of 200 to 300 aphids per day.
- Once aphid populations fall, the lady beetle will fly in search of additional food.
- Lady beetle adults and larvae may feed on the eggs of moths and beetles, and mites, thrips, and other small insects, as well as pollen and nectar when aphids are scarce.
- This ability to survive on a wide range of prey makes them a valuable beneficial insect.

▶ *Adult lady beetle*

Other Beneficial Insects

Natural enemies of pest insects that provide an important service to farmers in the form of biological control – a key component of an Integrated Pest Management system.

▶ *Lacewing larva*

▶ *Hover fly*

▶ *Adult lacewing*

Managing for beneficial insects

- Use insecticides judiciously. This means spraying registered products at the proper timing only when pests have clearly surpassed their economic thresholds.
- Use trap crops or strips to lure pests to a localized area where targeted insecticide application can be made.
- Reduced tillage, leaving tall standing stubble and intercropping are management strategies that can reduce mortality and/or increase populations of some beneficial insects and parasitoids.
- Perennial crops like alfalfa offer a stable environment and may increase the overall populations of beneficials in the area.
- Manage insecticidal applications to minimize negative impacts on pollinators.
  - Choose insecticides with low hazard potential to bees.
  - Work with beekeepers and spray applicators to avoid beehives if possible or minimize impact on bees.
  - Do not spray a crop in flower unless absolutely necessary.
  - If spraying a crop in flower is necessary, do the spraying when there will be minimal bee activity in the fields.

▶ *Parasitic wasp*

▶ *Honey bee*

Insect Pest Management

Flea Beetles

Description

- Beetles emerge from over-wintering sites in April and early May, and begin feeding on volunteer canola and weeds. They move into the canola crop as it emerges. The heaviest feeding can last from May to late June.

Critical time for action

- Most injury occurs at the cotyledon and early true leaf stages, after the fourth leaf stage there will be minimal impact on yield.

Action required

- Seed into a warm, moist seedbed to promote good stand establishment and rapid seedling growth.
- Use an insecticidal seed treatment.
- Scout fields in the spring. Assess damage to cotyledons and the first true leaves of seedlings daily. Continue to scout until the seedlings are past susceptibility, especially when temperatures exceed 14°C.

▶ *Crucifer flea beetle. Adult flea beetles are 1/10" (2.5 mm) long.*

▶ *Striped flea beetle. Adult flea beetles are 1/10" (2.5 mm) long.*

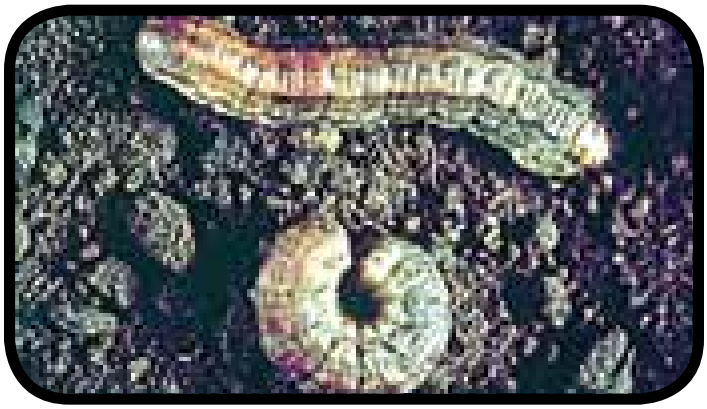
▶ *Flea beetle "shot hole" damage illustrating 25% defoliation.*

- Flea beetles overwinter as adults and emerge to chew holes in the cotyledons, stems or leaves creating a "shot hole" appearance. This can cause delayed plant development and thinner, weaker plant stands. High beetle populations last fall may mean elevated risk, making frequent scouting essential. In heavy infestations, entire plants may be eaten.
- The action threshold for applying foliar insecticide is typically at 25% defoliation to reduce yield loss, if flea beetles are still present and actively feeding. For crops with lower plant populations this threshold will be lower.

Cutworms (Red-backed and Pale Western)

Description

- These two species are the most common canola pests and overwinter as eggs, laid in the fall by moths that are night fliers. In April or early May, the eggs hatch and the young larvae feed mainly at night on weeds and volunteer plants.
- At maturity, the pale western cutworm larvae are greenish or slate-grey with a brown head, while red-backed cutworm larvae are dark grey with two broad, dull, brick red stripes along the back. They vary in size from 1.2 to 1.5" (30–38 mm).



▶ *Red-backed cutworm larvae.*

▶ *Cutworm larvae eat into stems and usually sever them at or just above the soil surface. The plants will then wilt and die.*

Action required

- The key to minimizing damage is early detection. Scout the fields and inspect seedlings every three to four days during the first few weeks of crop development, looking for bare areas, holes or notches in foliage, and cut off plants. Dig in the top 5 cm of soil around damaged plants to find the larvae.
- Small larvae (12–18 mm; 0.5–0.7") pose the greatest potential for damage as they will still feed and grow.
- A nominal economic threshold for foliar insecticide application may be reached at 25 to 30% stand reduction.
- Foliar insecticide control may only be necessary in small areas of the field, when bare patches appear and large numbers of cutworms are still actively feeding, as evidenced by green plant material in the gut of the larvae. Some other species like army, darksided or dingy cutworm occasionally feed on canola, so if the larvae differ from descriptions above confirm the type but don’t discount them as pests.
- After the second or third year of infestation, beneficial organism populations such as parasitic insects, viral diseases and bacterial infections build enough to begin bringing cutworm numbers down.

Root Maggots

Infestations are more severe after a cool, wet spring. Larvae feed on the root tunnelling into the taproot, producing brown streaks on the root. The lower leaves of infested plants often turn yellow with severe damage resulting in arrested plant growth. Feeding damage may also promote disease, causing further plant stress. Heavy infestations can delay blooming and cause severe lodging and yield losses.

Description

- Small white maggots hatch from eggs laid in June. They begin to pupate in late July to mid-August.

Critical time for action

- There is no registered chemical control, so cultural control practices must be used before or at time of seeding.

▶ *Root maggots are found in the roots and are white, 1/4" (6 mm) in length.*

Action required

- Where climatic conditions permit, plant *B.napus* canola. It is less susceptible to root maggots than *B.rapa* canola.
- A moderate increase in seeding rates may reduce damage and yield loss caused by maggot feeding. Heavier canola plant densities result in smaller basal stems that are less attractive to egg laying females.
- Higher frequency of canola in crop rotation may lead to buildup in root maggot population over time. Scout regularly to assess damage on canola roots, especially in tight rotations.

▶ *Root maggots on canola roots.*

▶ *The adult form of the root maggot is a 1/5" (5 mm) fly.*

Lygus Bugs

Description

- Adult lygus bugs range in colour from pale green to reddish brown to black, and from fairly uniform colour to mottled. They have a distinct triangular or V-shaped marking on their backs. Young nymphs resemble the adults without wings. See photos below.
- Adults and the oldest (fourth and fifth instar) nymphs are responsible for most of the feeding injury.

- Monitor fields adjacent to alfalfa fields, where overwintering lygus bug populations may be high.
- Adults and nymphs pierce and suck juices from the pods, stems and blossoms. This feeding causes blossoms to abort and young pods to drop from the plants. Feeding on the older pods causes the seed to become shrivelled. The pods may also become deformed.
- Yield losses have been estimated as high as 15 to 20%.

Action required

- Scout and assess economic thresholds at the end of flowering and pod ripening stages.
- Sweep-net monitoring should be done under fair weather conditions (e.g., sunny, low wind, above 15°C and typically aiming between 10 a.m. to 4 p.m.).
- Consult the economic threshold charts available through **www.canolacouncil.org/crop-production** or provincial government agriculture websites, which consider application costs, canola prices, and plant development stage. Proper threshold can range from 4 to over 30 per 10 sweeps depending on the combination of these factors.
- Scout and manage cabbage seedpod weevil and lygus bug separately, as ideal control timing does not overlap.

Cabbage Seedpod Weevil

Description

- Adult cabbage seedpod weevils are typically 1/10 to 1/6" (3–4 mm) long with an oval, ash grey to black body and a strongly curved snout.
- Larvae are white and grub-like without legs or eyes and are about 1/12" (2 mm) long.
- Adults feed on flower buds causing bud blasting while larvae eat developing seeds, causing yield loss. Small larval exit holes make pods susceptible to disease and shattering.

▶ *Adult cabbage seedpod weevils can feed on developing canola buds causing bud blasting. They also deposit eggs into small developing pods.*

Life cycle

- One generation per year.
- Adults overwinter under litter and in light soils. They become active in spring, flying at temperatures above 15°C and feeding on early crucifer crops or weeds in spring before laying eggs.
- Each female lays 60 to 70 eggs that hatch within five to 30 days, depending on temperature. The most crop damage occurs during the three to four weeks the larvae spend in the pods, each consuming five to seven canola seeds.
- When feeding is completed, the larva chews a round exit hole at the base of the pod and drops to the ground to pupate. New adults emerge within two to four weeks and feed on green stem and pod material but do little damage.
- Adult populations the preceding fall can be used to predict the risk of infestation.

▶ *The larvae that hatch from these eggs can consume about five canola seeds before chewing an exit hole and dropping to the ground to pupate.*

Action required

- Control brassicaceous weeds including volunteer canola.
- Scout in the spring when the crop first enters the bud stage and continue through the flowering period.
- Select 10 locations within each field, and at each location count the number of weevils from ten 180° sweeps with a sweep net.
- Sweep between 11 a.m. and 5 p.m. (when temps are above 20°C) when the insects will be most active making sweep counts more accurate.
- The action threshold for applying insecticides is at least 20 weevils in 10 sweeps during canola flowering.
- Insecticide application targets adults when crops are at 10 to 20% flower to avoid egg laying in newly formed pods. This is the stage when 70% of plants in the field have at least 10 open flowers.
- Spray when temperatures are 15 to 24°C.
- Consider trap cropping on large fields to reduce insecticide costs.
- While early seeding may benefit yield for other reasons, early seeded fields are at higher risk from this pest and should be closely monitored.

Diamondback Moth

Description

- Eggs are pale green or yellow, laid singly or in twos or threes on both sides of leaves. Tiny, green larvae hatch about mid-June and "mine" the leaves by entering the leaf and feeding on internal tissue. They emerge from the leaf in about a week and feed for 10 to 21 days on the outer leaf tissue. When disturbed, larvae will wiggle vigorously or hang from slender threads.
- It takes about 32 days to develop from egg to adult, so scout continuously during July and early August. There can be up to three generations per growing season, with the second typically causing the most damage.

▶ *Moths can arrive from the United States in early May.*

▶ *Larvae are up to 1/3" (8 mm) long, smooth spindle-shaped pale yellow-green worms.*

▶ *The larvae pupate in white lacework cocoons anywhere on the plant.*

Action required

- Control brassicaceous weeds including volunteer canola.
- Monitor provincial agricultural websites for early warning notices.
- Early arrival = multiple generations = higher risk of economic damage.
- Scout fields in July and August. Monitor crops at least twice per week from bud stage through pod set.
- Remove plants in an area measuring 0.1 m^2 (about 12" square), beat them onto a clean surface, and count the number of larvae dislodged from the plants.
- Consider insecticide application when larval counts exceed 20 to 30 larvae/0.1 m^2 at the advanced pod stage. No economic threshold is available for early flowering stages, but it is generally agreed to be lower than at advanced pod stage (probably between 10 and 15 larvae/0.1 m^2).

Bertha Armyworm

Description

- Adults emerge from overwintering pupae in mid-June to mid-July. Eggs are laid soon after moths emerge.
- Larvae or worms emerge in about one week and pass through six growth stages or instars. There is only one generation of bertha armyworms per year.

The night-flying bertha armyworm moths are black and olive with whitish markings and a silvery fringe on each wing.

Newly hatched larvae are 1/10" (2.5 mm) long, pale green with a pale yellowish stripe on each side. Mature worms are 1 1/2 to 2" (4.4–5.1 cm), velvety black to brown with a broad orange stripe along each side and a light brown head.

Action required

- Early maturing crops (through variety choice and early seeding) can help avoid a significant bertha armyworm infestation unless the moth flight is exceptionally early.

- Use provincial monitoring programs starting in June to help identify regions at greatest risk for potential outbreaks, based on numbers of moths trapped.
- Start scouting to assess if larval counts are exceeding economic thresholds after peak flowering or about two weeks after peak trap catches of adult moths.
- Consult an economic threshold table available at **www.canolacouncil.org/crop-production** or your provincial agriculture department website to determine the appropriate threshold to use, considering application costs and canola prices. Thresholds can range from 8 to over 30 larvae per m^2.
- Under drought stress, dividing the economic thresholds above by 1.48 may give more appropriate economic thresholds.
- Distinguish between small bertha armyworm larvae and diamondback moth larvae.
- The worms are easily dislodged from canola plants, so do the counts in the field. The most effective method is to pace off a square metre, then vigorously shake the plants within the boundary and count fallen larvae on the soil surface and within leaf litter. Sprinkling baby powder or flour on the ground beforehand will make the larvae easier to see.
- Bertha armyworm should be controlled before the insect reaches its most destructive fifth and sixth instar in August.
- Control larvae when they are at least 1.3 cm (0.5") long, by applying an insecticide early in the morning or late evening when the larvae are actively feeding.

Disease Management

Blackleg

Before planting

- Determine the potential for blackleg based on the amount of disease in the area and records of disease levels in fields. Airborne blackleg ascospores produced from infected crop residue are mainly responsible for disease spread because they can travel relatively long distances (at least 10 km).
- Walk fields to see how well previous years' infected canola stubble has decomposed. Stubble is a host for the disease organism.
- Choose an acceptable rotation length, keeping in mind that in areas of high blackleg risk, rotations less than one in four years increase the potential for disease incidence. Tight rotations with resistant varieties also increase selection pressure for resistant strains.
- Select R-rated resistant varieties. However, utilizing the same resistance genes repeatedly in the field over time can select for races of the fungus that are virulent against that resistance. The higher the frequency of growing the same variety, the greater the risk. Rotating varieties may help.

At seeding

- Plant only seed treated with a recommended fungicide. Seed treatment will control seed-borne blackleg but will not prevent seedling infection caused by spores released from diseased stubble.

- In areas where blackleg is not a problem, have the seed tested prior to planting and plant only clean seed.

In crop

- In conjunction with varieties that have some resistance, a registered foliar fungicide can be applied as a preventative measure.
- Foliar fungicide should be applied at the rosette stage, prior to bolting. **Generally at this stage there is no evidence of the disease, but occasionally leaf lesions may be found.** The fungicide delays the onset of damaging cankers, allowing the canola pods to fill more completely.
- The best time to assess the level of blackleg in a field (for future reference) is from after the crop is blooming until swathing. Stem lesions are white to pale grey with a distinctive dark border. Hard, black bodies slightly larger than a pinpoint may appear within these lesions. Pods may ripen and split prematurely in severe cases.
- Examine at least 50 plants for the presence of lesions. If lesions are found on more than 10% of plants, then there is a risk of significant disease development.

▶ *Blackleg leaf lesion.*

▶ *Example of blackleg stem lesion.*

At harvest

- Use a straw chopper and chaff spreader to evenly distribute infected crop residue and/or incorporate the trash. This will increase the rate of decomposition of infected stubble.

After harvest

- To assess the potential for blackleg in following years, walk fields at swathing time to check canola plants or stubble for evidence of blackleg lesions or cankers.
- The amount of infection present will help identify the level of risk and the best management practices for that field in following years.
- Checking fields the following spring may not give as accurate a picture of disease levels. A number of other organisms can produce blackleg-like symptoms on the stubble in the late fall and early spring and can give the impression that blackleg is more severe than in reality.

General tips

- In non-canola years, control volunteer canola, as it will act as a host for the disease.
- Increasing the number of years between canola crops in the rotation reduces incidence and severity of blackleg in fields. Maintain a minimum break of two or three years between canola crops to protect against the breakdown of current blackleg resistance in varieties and allow effective long-term blackleg disease management.

Sclerotinia

At seeding

- Use a seed source free of sclerotia.
- Varieties with some tolerance to sclerotinia are available, but may not negate the need for fungicide application if conditions are good for disease development.

In crop

- Sclerotinia requires moist, warm conditions for at least 10 days in order to germinate sclerotia and form apothecia.
- Spores produced by the apothecia cannot infect leaves or stems directly. They first need dead canola petals or other organic material as a food source to germinate, grow and penetrate the plant. Infecting the plant requires rainfall or heavy dews that keep stems and leaves wet for two to three days. Ascospores released and deposited on petals as the crop is coming into full bloom create the highest risk of infection, depending on weather and environmental factors.

▶ *Sclerotia are small, black, round or oval bodies up to 3/4" (2 cm) long that develop in infected stems. They can survive in the soil up to five years or more.*

- In the 10-day period before flowering, walk through the crop, checking for signs of apothecia.
- Use available risk assessment tools such as the sclerotinia stem rot checklist and testing to determine the percentage of petals infected with spores to indicate whether fungicide application should be considered.

▶ *Apothecia are mushroom-like bodies, which produce the infectious sclerotinia spores.*

- Optimum stage for fungicide application is generally between 20 and 50% bloom, depending on the specific fungicide used. Check the crop protection guide or product label for details. Depending on weather conditions, it takes three to six days to move from first flower to 20% bloom.

Identification of flowering stages of canola

Flowering Stage	*B. napus* Canola (Flowers – Main Stem)	*B. rapa* Canola (Flowers – Main Stem)
10%	10	6 to 7
20%	14 to 16	10 to 12
30%	20	14 to 16

At harvest

- Sclerotinia can progress rapidly in wet, compacted swaths. The heavier and more compact the swath, the greater the likelihood for sclerotinia to rot the swath before it can be combined. As much as one-third of the crop can be lost to sclerotinia in the swath.
- To reduce or avoid further disease development in the swath, in fields with sclerotinia infection:
  - avoid compacting the swaths;
  - leave tall stubble for better drying;
  - do not swath if rain is in the immediate forecast;
  - do not swath immature stands (less than 30% of the seed ripened); and
  - consider straight combining, recognizing the increased risk of shattering for prematurely ripened diseased plants.

▶ *Sclerotinia infected plants turn straw coloured as they prematurely ripen.*

General tips

- Crop rotation is not always effective because of the pathogen's large host range and its ability to survive for years in the soil as sclerotia. Aim for a minimum of one year, preferably three years, between susceptible crops to reduce the build up of sclerotia in the soil. Avoid seeding canola adjacent to a field that had a heavily infected crop the previous year. Crops may still be infected from airborne spores produced in nearby fields.
- There are some biological control products available targeted at either degrading sclerotia in the soil to reduce spore production or providing an alternative to chemical fungicide. Consult the suppliers for more details.
- Foliar fungicides remain the main control strategy. Several tools are available to help growers assess risk and plan for fungicide application.
- Don't follow or precede canola in a rotation with beans, sunflowers, mustard, pulse crops, alfalfa, clover or potatoes as they can act as hosts for the disease. Control Canada thistle as it is also a host for the disease.

Root Rot Complex

The root rot complex, which includes foot rot, late root rot, root rot and brown girdling root rot, is caused by soil-borne fungi that affect the roots of adult plants. Different strains of the pathogens can also cause seedling diseases early in the season. In most of western Canada, the disease manifests itself primarily at the seedling stage, while in the Peace River region both seedling loss and the much more serious brown girdling root rot occur.

Brown Girdling Root Rot

Brown girdling root rot is the most serious root rot disease. The soil-borne fungi that cause the disease occur in all soil types and textures, primarily in the Peace River region.

Before planting

- The disease appears to be more severe when canola follows canola, clover or fescue, than when canola follows summerfallow. However, brown girdling root rot can also occur in new breaking and in fields not previously planted to canola.

At seeding

- Use *B. napus* varieties where possible, as they are relatively less susceptible.
- Use recommended seed treatments for control of the root rot complex, however, these fungicides do not provide season long control.
- Optimum, balanced crop fertility can reduce the impact of the disease.

▶ *Early stages of brown girdling root rot.*

In crop

- Light brown lesions usually appear on the taproot 3" (7.6 cm) or more below the soil surface after flowering. The lesions eventually girdle the root. The amount of yield loss depends on how much root is lost to girdling. The disease is more prevalent under moist conditions.
- Allow at least three years between canola crops. Consider including field peas in the rotation (to improve the nitrogen level) to reduce disease severity.
- No economical chemical controls are available for brown girdling root rot.

▶ *Advanced stage of brown girdling root rot; taproot is completely severed. Swathed plants tend to pull out of the ground increasing pod shattering problems and slowing harvest.*

Fusarium Wilt

Fusarium wilt, a soil-borne fungal disease of canola, has been observed throughout western Canada. It is caused by *Fusarium oxysporum,* which is different from the species that cause fusarium head blight in cereal crops.

Before planting

- Select varieties with good tolerance to fusarium wilt, especially in areas where the disease has been previously identified.

In crop

- Scout fields for the following symptoms:
  - Yellow or reddish-brown streaks, often occurring only on one side of the stem or on the branches. Some plants may have an orange discoloration at the base of the stem. Plants with minor infection may also ripen prematurely and tend to shatter.
  - Chlorosis and necrosis of stems, vascular discoloration, poor seed set and premature desiccation.
  - Premature death in severely infected plants. Stems and/or branches turn brown, but plants remain upright with roots intact. No lesions are visible on stems or roots. Plants are often stunted and have small pods with no seeds, resulting in significantly reduced yield.

Alternaria Black Spot

At seeding

- Plant seed treated with a recommended fungicide. This will help control infection transmitted from the seed to seedlings and reduces seed rot.
- *B. rapa* varieties are more susceptible to alternaria than *B. napus* varieties.
- Early planting of *B. napus* canola may help to reduce the risk of alternaria.

In crop

- Application of a registered foliar fungicide with an acceptable pre-harvest interval at late bloom can provide economical control of this disease.
- Monitoring fields will give an indication of disease levels for future field management.

▶ *Under moist conditions, leaves will develop grey spots with yellow halos. Under dry conditions, spots may be grey with purplish or black borders or entirely black. Severely infected leaves wither and drop.*

▶ *Pods may show sunken, dark brown to black circular lesions.*

At harvest

- Alternaria acts as a desiccant, drying the pods and causing them to split open. Where alternaria lesions cover a large proportion of pod surfaces, early swathing can help reduce yield losses to shattering.
- If alternaria is visible in *B. rapa* canola, do not straight combine the crop.

After harvest

- The fungus survives on infected crop residue and produces spores that infect the new crop, so growers may consider incorporating diseased stubble on soils with low risk of erosion.

General tips

- In non-canola years, control weeds such as mustard, flixweed, stinkweed and volunteer canola as they act as hosts for the disease.
- Alternaria is present in most canola fields but only causes significant yield loss when high humidity and warm temperature combine to encourage its rapid development at pod set.

Clubroot

Clubroot is a serious soil-borne fungal disease in cabbage, cauliflower and rutabaga crops, chiefly in eastern Canada and the coastal regions of British Columbia. It was identified in canola fields near Edmonton, Alberta in 2003 and since then, the numbers of infested fields identified in central Alberta have increased sharply each year. Currently, there are no economical control measures that can remove the disease from a canola field once it has been infected.

Before planting

- Preventing the spread of clubroot spores by restricting soil movement is critical to managing this disease. Minimize all equipment traffic into infested fields. Whenever possible limit tillage. Reduced tillage or direct seeding also may help combat a clubroot infestation by reducing the movement of contaminated soil.

- Resting spores of the fungus can survive in soil for many years. In the presence of susceptible roots, the spores germinate and release tiny organisms that swim in free water to the surface of the rootlets, penetrate and form a fungal colony inside the root cells that produces galls.

- Four years is considered a minimum rotation between canola in fields known to have the disease. It may not prevent the introduction of the disease, but it will restrict disease development and severity within the field.

- Do not move cultivating or any other equipment from infested to non-infested areas without thoroughly cleaning the equipment before entering the field. To clean equipment, knock off soil lumps, loose soil and crop debris, and follow with pressure washing. A final rinse with a weak disinfectant (1 to 2% household bleach), left on the machinery for at least 10 to 15 minutes, should virtually eliminate any viable spores.

At seeding

- Use clubroot-resistant hybrid varieties in high risk areas. Rotate between clubroot-resistant hybrid varieties. Because resistance likely comes from a single gene, that resistance can fail if used frequently on the same field.
- Avoid common, untreated seed (all crops) because earth-tag (soil particles) on seed can be a source for introducing the disease to new areas.

In crop

- Scout canola fields regularly for wilting, stunting, yellowing or premature ripening, and identify the cause.
- Galls appear on the roots of infected plants, ranging from tiny nodules to large, club-shaped outgrowths. They are easiest to find at swathing.
- Warm soil (20–24°C), high soil moisture and acid soil (pH less than 6.5) all favour infection and the severity of disease development.

▶ *Early infection.*

▶ *Very severe clubroot on canola.*

After harvest

- Control volunteer canola and susceptible weeds in rotational crops as they can serve as hosts for clubroot.
- Avoid the use of bales and manure from infected areas, as the spores can survive through the digestive systems of livestock.

Aster Yellows

Aster yellows disease is caused by a phytoplasma infection and is spread by the aster leafhopper (Macrosteles quadrilinetus), which comes up each year on south winds from the U.S. This phytoplasma has an extremely wide host range, and can infect about 300 species of plants. Infected canola plants will often form bladder-like structures in place of healthy pods.

At seeding

- Canola varieties are not known to have any genetic resistance. If aster yellows is found in one variety, it will be found in all varieties, although incidence may vary. This is likely due to differences in attractiveness of the crop to the insect vector (aster leafhopper) rather than actual resistance.
- Seed crops as early as possible in the spring.

In crop

- Plants infected at an early growth stage fail to produce flowers and set pods. In western Canada, most plants are infected when leafhopper populations are at a maximum in mid-June to the end of June. Leafhoppers can move from field to field and can also produce several generations.
- Normally, there is little need to control aster yellows in annual field crops since incidence of the disease is usually low and does not result in significant economic loss. Insecticides are registered for control of leafhoppers in canola, but a reliable economic threshold is lacking due to poor correlation between leafhopper numbers

and aster yellows incidence. The difficulty in timing a single application to prevent transmission of the phytoplasma to plants prior to control and avoid potential re-invasion also makes the economics questionable.

- Control of biennial and perennial host weeds in the field and surrounding area may reduce the incidence of this disease.

▶ *Aster yellows infection on canola with bladder-like distorted pods.*

At harvest

- Plants infected with aster yellows can have misshapen seeds and yield loss without showing any of the obvious signs of infection – such as the puffed bladder-like pods. The plant looks normal but some pods are empty or contain misshapen seeds.
- Although in most years infection rates don't go above 1%, infection rates of 5 to 20% or higher in individual fields have been reported. A 10% infection rate results in 3% to 7% misshapen or missing seeds.

Maximize Harvest Returns

Swathing versus direct combining

- Assess each canola crop carefully before choosing straight cutting, based on four factors: crop canopy, disease, hail risk, frost risk.
- *B. rapa* varieties may be direct combined because they mature earlier and resist shattering.
- For straight combining, the crop canopy should be well knitted and slightly lodged to reduce the chance of pod shattering and pod drop.

Assessing seed colour change

- In hot, dry weather, canola can go from 10 to 50% seed colour change in just days.
- Examine only pods on the main stem. Seed in pods on the bottom third of the main stem mature first and will turn colour much sooner than seed in pods on the top third of the main stem.
- Consult the Canola Council of Canada Canola Swathing Guide for a complete guide on assessing seed colour change.

▶ *Eleven of the 20 seeds in this pod have colour change.*

Timing swathing

- Optimum stage to swath for both yield and quality: Up to 60% seed colour change. This enables growers with large acreages to start swathing at 30 to 40% seed colour change without sacrificing significant yield or quality.
- Time of swathing usually has little effect on green seed levels, except under abnormal situations.
- To minimize high green seed:
  - Swath as early as 10 to 15% seed colour change on the main stem to reduce the risk of damage if there is a high probability of killing frost.
  - Avoid swathing too early in hot, dry weather (30 to 35°C). The heat can rapidly dry down the crop in the swath, leading to yield loss from excessive seed shrinkage or elevated green seed from reduced activity of chlorophyll clearing enzymes.
  - Desiccation dries the crop quickly; glyphosate provides pre-harvest weed control; neither speed maturity.
  - Assess crop after frost using Canola Council of Canada recommendations to determine whether to swath.

When to combine

- Green seed is the major downgrade that results from frost.
- Before combining, use a crush strip to determine the amount of seed that is green inside – No. 1 Canada allows 2.0% distinctly green.

- Check both seed moisture content and green seed before combining.
- Canola requires at least 20% moisture in the seed for curing to take place. Under hot, dry or windy conditions, the crop may dry down to acceptable moisture content before the seed has cured and cleared the chlorophyll.
- Letting swaths sit through several heavy dews or showers will help clear the chlorophyll. This process may take up to 14 days or longer.

Storage

- Storing the crop in a dry and cool condition reduces the risk of sweating.
- 10% moisture content does not equal safe storage.
- For storage longer than 5 months, canola should be binned at a maximum of 8% moisture and cooled to 15°C or lower throughout the bin.
- Monitor bins closely during the first six weeks and then continue to check stored canola regularly until delivery.
- If stored canola temperatures plateau or start to rise while outside air cools through the winter, it can signal the start of spoilage.

Aeration

- Aeration means cooling/conditioning.
- Aeration fans should be started as soon as the canola covers the floor of the bin, so that immediate cooling can take place. Fans must be operated continuously until the temperature of the canola is near the average outside temperature.
- When the outside temperature has dropped below the temperature of the stored canola by 5 to 10°C, the canola should be cooled again.
- No conditioning operation is complete until the temperature of the entire bulk has reached the desired level.
- After the bulk has reached the desired storage temperature, the bin should be checked periodically for evidence of heating or moisture migration.
- Airflow rates for aeration range from 0.1 to 0.2 cfm/bushel (1–2 L/s per m^3).

Natural air drying

- Natural air drying (near ambient drying) means reducing the moisture in the grain.
- Natural air drying using aeration alone can remove one or two percentage points of moisture, but only if outside air has "capacity to dry." Air's capacity to dry depends on its temperature and relative humidity (RH).

- The fans should be started as soon as the canola covers the perforated areas of the bin floor and should be operated continuously in the fall until either the crop temperature is reduced to 0°C or the crop is dry.
- Airflow rates for natural air drying range from 1 to 2 cfm/bushel (10–20 L/s per m^3).

Heated air drying

- Heated air drying means reducing the moisture in the grain with an additional heat source.
- Canola destined for seeding purposes should be dried at less than 45°C; however, for oil extraction, seeds can be dried at up to 82°C.
- Wetter seed requires a longer drying process at a lower drying temperature.
- Grain must be cooled after heated air drying.

Grain bag storage

- Store only dry seed for short duration (3–6 months).
- Monitor with temperature probes at least twice per week until temperatures stabilize.
- Watch for rodent activity.
- Clear snow to help prevent deer from walking on bags.
- Place in well-drained area.

- Unload before frost goes out of ground in spring.
- Place on grass to prevent stubble from poking holes in the bag.

Marketing Considerations

The ultimate speculation is holding unpriced canola in the bin and then failing to monitor its condition.

There are a number of marketing and pricing options available. These include:

- production contacts;
- deferred delivery contracts;
- basis contracts;
- deferred pricing contracts;
- hedging through a futures or options contract; and
- price averaging through selling a portion of the crop every few weeks or every month.

There is a cost and risk to holding unpriced canola in the bin, waiting for higher prices: risk of seed quality deterioration, lost opportunity costs, interest costs associated with holding the canola, and the risk of price declines.

Calculation of Seeds/Pound

$$\text{Seeds/pound} = \frac{454}{\text{Thousand Seed Weight in Grams}} \times 1000$$

Metric/Imperial Conversions

Symbols	
Length	**Weight**
10 mm = 1 cm	1000 mg = 1 g
100 cm = 1 m	1000 g = 1 kg
1000 m = 1 km	1000 kg = 1 t
Area	**Volume**
10,000 m^2 = 1 ha	1000 ml = 1 L
	1000 L = 1 m^3

Relationship between grade, per cent green seed and chlorophyll in parts per million*		
CGC Grade	**Percent Green Seed**	**Chlorophyll PPM**
No. 1 Canada	<2	≤25
No. 2 Canada	2 to 6	26 to 45
No. 3 Canada	6 to 20	46 to 100
Sample	>20	>100

**Reference: Daun, J.K. and Symons, S. (2000) How green is green? Sampling and perception in assessing green seeds and chlorophyll in canola. JAOCS, Vol 77, n.11*

Approximate Relationships	
Length	**Volume**
2.54 cm = 1 in	28.41 ml = 1 fluid oz
1 m = 39.40 in	29.57 ml = 1 fluid oz (U.S)
1 m = 3.28 ft	1 L = 1.76 pints
1 m = 1.09 yd	1 L = 0.88 quart
1 km = 0.62 mile	4.55 L = 1 gal (Imperial)
Canola Bulk Density	3.79 L = 1 gal (U.S.)
50 lb/bushel = 38.94 lb/ft^3	1 m^3 = 35.71 ft^3
Weight	1 m^3 = 1.30 yd^3
28.35 g = 1 oz	1 bushel = 1.284 ft^3 = 36.367 L
1 kg = 2.20 lb	**Area**
1 tonne = 2204 lb	1 ha = 2.47 acres
1 tonne = 1.10 ton	1 acre = 43,560 ft^2
Pressure	**Power**
1 psi (lb/in^2) = 6.90 kPa	1 hp = 0.746 kW

Crop	
Canola, Mustard	1 tonne = 44.1 bushels 1 bushel = 22.7 kilograms
Wheat, Peas, Beans, Clover	1 tonne = 36.7 bushels 1 bushel = 27.2 kilograms
Corn, Flax, Rye	1 tonne = 39.4 bushels 1 bushel = 25.4 kilograms
Buckwheat, Barley	1 tonne = 45.9 bushels 1 bushel = 21.8 kilograms
Oats	1 tonne = 64.8 bushels 1 bushel = 15.4 kilograms

For more information on canola production, contact your local Canola Council of Canada regional agronomist. Please check the Canola Council of Canada website at **www.canolacouncil.org** or phone **204-982-2100**.

Images for this project provided by:

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