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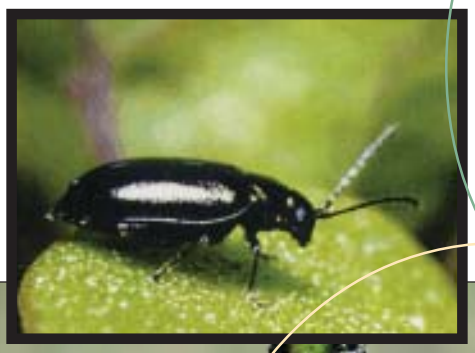
Crucifer Flea Beetle

Biology and Integrated Pest Management in Canola



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Canola is an important oilseed crop in the northern Great Plains of the United States and Canada. Canola adds crop diversity to the cropping rotation systems in the region. Production has increased in the United States and Canada in response to the pest problems and low commodity prices of small grains and increased market demand by health conscious consumers for its high quality edible oil.

The crucifer flea beetle, *Phyllotreta cruciferae* Goeze, and the striped flea beetle, *Phyllotreta striolata* (F.) (Coleoptera: Chrysomelidae), are the most serious insect pests of canola. Both species were introduced from Eurasia. *Phyllotreta cruciferae* has become the dominant flea beetle pest of oilseed *Brassica* (canola). Adult flea beetles emerge in the spring and feed on the cotyledons and true leaves. When they emerge in large numbers, they can quickly devastate a seedling canola field; therefore, timely detection and management of this pest is important. Flea beetle damage to oilseed *Brassica* crops exceeds $300 million annually in North America.

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Figure 1. Adult crucifer flea beetle, *Phyllotreta cruciferae Goeze.*

Figure 2. Adult striped flea beetle, *Phyllotreta striolata (F.).*

Figure 3. Flea beetle egg.

Figure 4. Flea beetle larva.

Figure 5. Flea beetle pupa.

Distribution

The crucifer flea beetle was introduced into North America in the 1920s and is now distributed across southern Canada and the northern Great Plains of the United States, including North Dakota, South Dakota, Montana, northwestern Minnesota, Manitoba, Saskatchewan, Alberta, British Columbia, Ontario, Quebec, and New Brunswick. The crucifer flea beetle is the most common and destructive flea beetle attacking canola.

In North America, the striped flea beetle was reported from "Carolina" in 1801 and is now widespread across Canada, United States, Mexico, and South America.

Identification

Adult

Crucifer flea beetle (Figure 1): The adult is a small, oval-shaped, blackish beetle with a bright blue sheen on the elytra, measuring about 1/32 to 1/8 in. (2-3 mm) in length. Flea beetles have enlarged hind femora (thighs) on their hind legs, which they use to jump quickly when disturbed. Their name, flea beetle, arose from this behavior.

Striped flea beetle (Figure 2): Adults are similar in size and shape to the crucifer flea beetle, but they are black with two yellow strips on their wing covers.

Eggs (Figure 3)

Eggs are yellow, oval, and about 0.38-0.46 mm long by 0.18-0.25 mm wide, and deposited singly or in groups of three or four adjacent to the host plant's roots.

Larvae (Figure 4)

Larvae are small approximately 1/8 in. or 3 mm, whitish, slender, cylindrical worms. They have tiny legs and a brown head and anal plate.

Pupae (Figure 5)

Pupae are similar in size to the adult and white in color except for the black eyes and the free body appendages, which are visible later in the pupal development.

Life Cycle (Figure 6)

Crucifer flea beetles have a single generation in the northern Great Plains. They overwinter as adults in the leaf litter of shelterbelts or grassy areas and are rarely found in canola stubble. Beetles emerge when temperatures warm up to 57°F (14°C) in early spring. They feed on volunteer canola and weeds, such as wild mustard, and move to newly planted canola as it emerges. Depending on the temperature, it may take up to three weeks for the adults to leave their overwintering sites. The striped flea beetle adults usually emerge before the crucifer flea beetle. Warm, dry, and calm weather promotes flea beetle flight and feeding throughout the field, while simultaneously slowing canola growth. In contrast, cool, rainy, and windy conditions reduce flight activity, and flea beetles walk or hop leading to concentrations in the field margins. Females oviposit up to 25 eggs in the soil in June. The overwintered adults continue to remain active until late June and begin to die off in early July. Larvae hatch from the eggs in about 12 days and feed on the secondary roots of the plant. No major effects on plant vigor from larval root feeding have been noted in North Dakota. However, a yield loss of 5% from larval densities of 1/sq. in. (0.16/sq. cm) has been recorded in Manitoba. Larvae pass through three instars and complete their development in 25 to 34 days by forming small earthen puparium. The pupal stage lasts for about seven to nine days, usually in early to mid-July. The new generation of adults emerge from the puparium beginning in late July until early September and feed on the epidermis of green foliage and pods of canola, mustard, and cruciferous weeds (Figure 7). The crop is usually mature enough that feeding damage is minimal. In early fall beetles move to overwintering sites.

Figure 6. Life cycle of the Crucifer flea beetle.

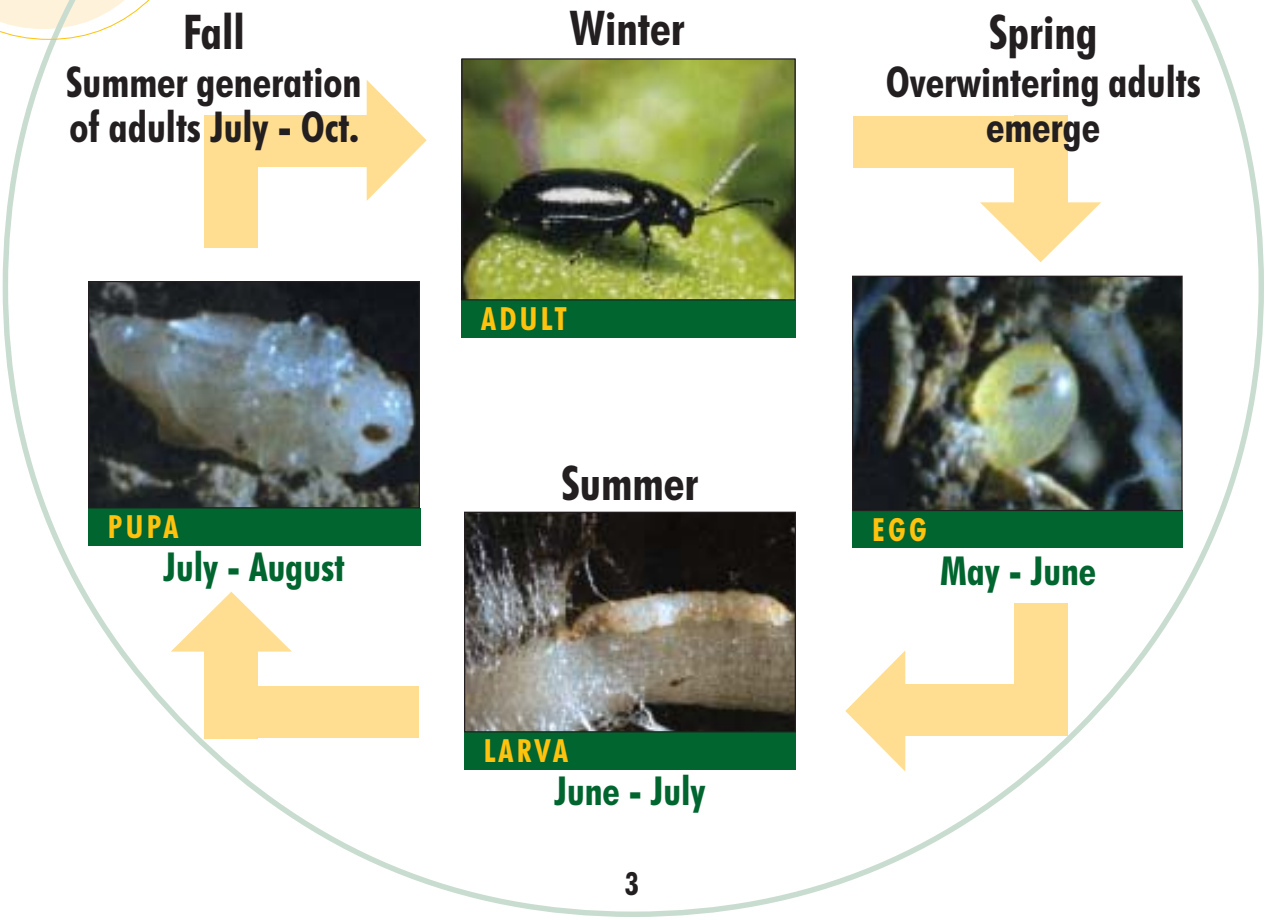

Figure 7. The new generation of flea beetles feeding on the green foliage and pods of canola in mid-July until early September.

Hosts

The crucifer flea beetle has a narrow host range restricted to plants primarily in the mustard family (Cruciferae). Other plant families attacked are the caper family (Capparidaceae), the nasturtium family (Tropaeolaceae), and the marshflower family (Limnanthaceae). Interestingly, all of the flea beetles prefer plant families that produce mustard oil (or allyl isothiocyanate), which is a known aggregation pheromone of the crucifer flea beetle. The most-preferred hosts are in the genus *Brassica* (Cruciferae), which include the major agricultural host attacked by flea beetle, oil rapeseed or Argentine canola *(B. napus)* and Polish canola *(B. rapa/campestris)*. Mustard (*Brassica* spp.) and crambe *(Crambe abyssinica)* are also susceptible to flea beetle attack but not preferred over canola. Other hosts that flea beetles will attack in the garden setting are cabbage, turnip, cauliflower, kale, Brussel sprouts, horseradish, and radish. Some weeds attacked in the cruciferous group are flixweed, field pennycress, peppergrass, and wild mustard.

Crop Damage

The greatest crop loss occurs during the spring when flea beetle feed on cotyledons and first true leaves during the first two weeks after emergence. Leaf tissue of the cotyledons die around adult flea beetle feeding sites producing a shot-hole appearance and necrosis (Figure 8). Under severe pressure in North Dakota, flea beetles have been recorded attacking the growing point (meristem tissue), killing the plant.

Adult feeding on young seedlings results in reduced crop stands and plant growth, delayed maturity, and lower seed yield. When flea beetle populations are large and warm, sunny, dry, calm conditions favor feeding, fields can be infested quickly and canola seedlings die.

Figure 8. Canola seedling damage, pitting caused by flea beetle feeding (top) and undamaged seedling (bottom).

Stand losses may result in having to reseed the field. Less severe infestations may result in stunted plants, uneven stands and maturation, and harvest problems. When weather conditions are cool, wet, and windy, flea beetles may creep slowly into the field and concentrate feeding on the field edges. Spring feeding activity occurs from May through June.

During the summer months, the larvae feed on the secondary root hairs, but only a negligible effect on yield loss or vigor has been observed. The summer generation of adult flea beetles emerge after mid-July and feed on developing pods (Figure 7). Usually the upper or younger pods and later seeded crops are most impacted. This feeding damage results in poor seed fill, premature pod drying, shriveled seeds, or pod shattering, and provides an entry point for fungal growth within pods in damp weather.

Integrated Pest Management

In the spring, overwintering flea beetle adults emerge, locate, feed on, and damage emerging canola plants. To effectively manage flea beetles and other pests of canola, producers should use an Integrated Pest Management (IPM) program. An IPM approach uses multiple strategies to control flea beetles, minimizes inputs, conserves the natural enemies of pests, and reduces the negative impacts of pesticides on the environment. This type of approach is also the most economical. Canola fields should be monitored on a regular basis to determine the level of infestation and damage.

Monitoring and Field Sampling

Flea beetles overwinter as adults and become active during early spring. Field monitoring for flea beetle activity should begin in newly emerged canola fields during May and June when air temperatures reach 57°F (14°C). Commercial, 4x6 in. yellow sticky traps (Figure 10) can be used for monitoring population levels, but they do not indicate the need for control actions. Assess the canola field for presence of flea beetles and their feeding damage during the first 14 days after crop emergence, or until plants have reached the 4-leaf stage. Fields should be checked daily to identify damage as it develops and to make timely management decision. Beetles are most active during sunny, warm, calm and dry weather conditions, so avoid monitoring for flea beetles when conditions are cool, windy, and damp.

The amount of defoliation should be used as a guide to determine the need for management action. Injury occurs first at the field edges, particularly where a shelterbelt/grassy area borders a field. The beetles readily fly when temperatures exceed 64°F (17.8°C) and will move quickly into the field's interior. To determine the extent and distribution of damage, start at the field margins and walk into the field, selecting plants at various random intervals. Estimate percent defoliation for each plant selected. **The economic threshold for a foliar application is when an average of 25% of the surface area of cotyledons and first true leaves has been injured (Figure 9) and beetles are present.** If leaf damage is less than 25% and the crop is actively growing, the crop can usually recover. **Watch fields closely in hot, dry weather, when flea populations can rapidly increase.**

Foliar treatments must be made quickly if damage exceeds 25% defoliation. Under high beetle pressure and feeding damage, a delay of one to two days can result in loss of entire fields. If damage is limited to only the edge, spraying only part of the field may

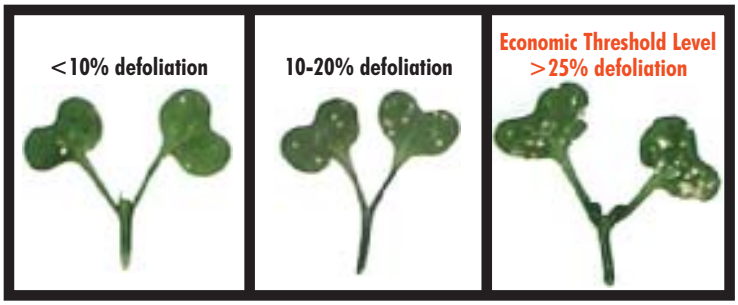

Figure 9. Examples of defoliation with 25% defoliation on canola cotyledons being an economic threshold level.

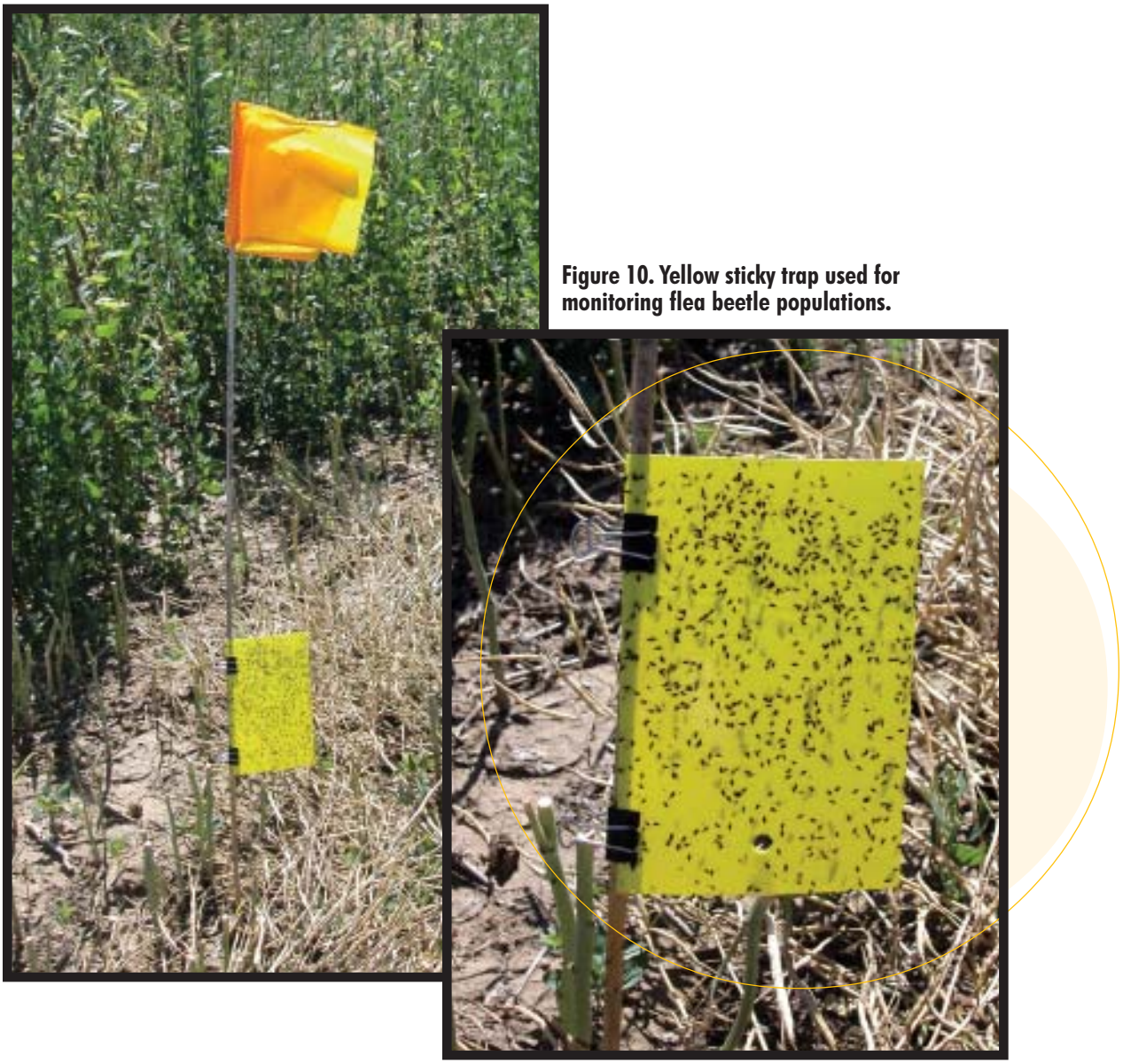

Figure 10. Yellow sticky trap used for monitoring flea beetle populations.

reduce flea beetle numbers. Apply insecticides during the sunny, warm part of the day when beetles are actively feeding on the plants. Canola plants that have reached the 4-leaf vegetative growth stage or beyond can tolerate more feeding damage, unless flea beetles are damaging the growing point. During years when flea beetles are abundant through June, a yield loss of about 10% can be common even when the crop is protected with insecticidal seed treatments. Under these conditions a later foliar treatment (21 days after planting) may be necessary to protect the crop from re-infestation.

The summer generation of adults emerging in late July and August will feed on the leaves, stems, and pods of the maturing crop, but usually does not cause economic damage. Control may be necessary in late maturing fields where large and increasing numbers of adults may congregate and feed on green pods.

Monitor the summer adult populations in late July and August to determine the need for protecting next year's canola crop. If the flea beetle population is abundant in canola swaths, consider a seed treatment for the following production season.

Economic Threshold

Seedling: 25% defoliation of cotyledons and first true leaves

Cultural Control

Planting Date

Canola planted early from April to mid-May reduces the risk of heat and drought stress during flowering and produces higher seed yields than canola planted from late May to early June. Early seeding with good quality seed into a shallow, firm seed bed also reduces the risk of feeding injury by flea beetles to canola seedlings. Planting early and shallow helps seedlings emerge earlier, so plants are larger and can tolerate more feeding by the time flea beetle populations are large. Increased seeding rates may also help reduce flea beetle impact by reducing overall damage per plant with more plants per unit area. In Canada, canola planted in wider row spacings of 7.8-11.8 in. (20-30 cm) resulted in decreased feeding damage per plant than narrower row spacings of 4 in. (10 cm). Later planted canola may not always avoid invasion of the flea beetle because of repeated migrations into the crop. Flea beetles continue to fly actively throughout May and June. Trap data of flea beetles in the north central region of North Dakota indicate that flight activity fluctuates throughout May and June, perhaps caused by favorable or unfavorable weather conditions.

Planting Systems

Use of different cropping systems such as no-till, minimum till, or fall dormant seeding, may offer an alternative to the traditional chemical control of flea beetles on canola. Since flea beetles are more active during sunny and warm days, it has been suggested that the different cropping systems may provide a less desirable, cooler micro-environment for flea beetle activity. Often, flea beetle populations are lower in no-till fields compared to conventional tillage fields. Dormant seeded canola may germinate, emerge, and reach the 4-leaf stage before significant numbers of flea beetles emerge from overwintering sites. Only 4% of the dormant-seeded fields in the north central region of North Dakota during 1999-2000 were sprayed with a foliar insecticide for flea beetle control, compared to 25% of the spring-seeded fields, according to a canola grower survey.

Crop Rotation

Since flea beetles are strong flyers and disperse over wide areas from overwintering sites, crop rotation is not an effective means of managing flea beetles. However, crop rotation is very important in reducing the level of canola diseases like blackleg and sclerotinia.

Plant Resistance

Although some of the larger-seeded varieties are more resistant to flea beetle damage due to their large seedling size, no canola varieties exhibit sufficient resistance to protect against flea beetle feeding damage.

Biological Control

Predators known to feed on flea beetles include lacewing larvae *(Chrysopa carnea),* big-eyed bugs *(Geocoris bullatus),* the two-lined collops *(Collops vittatus),* the western damsel bug *(Nabis alternatus)* and the northern field cricket *(Gryllus pennsylvanicus).* Parasitic wasps, like *Microtonus vittate,* are known to attack crucifer flea beetles, but the rate of parasitization is very low. Unfortunately, flea beetle populations emerge during a narrow window in the spring, and natural enemies usually do not have enough time to negatively impact flea beetle populations.

Insecticide Control

When flea beetle populations are large the previous fall, a seed treatment with a systemic insecticide should be applied as a preventive tactic. About 60-70% of canola seed in North Dakota is treated with an insecticide-fungicide. Treatments provide protection against flea beetles for about seven-14 days after seedling emergence. Flea beetles can still reduce yield of canola grown from treated seed by 8-10% when beetle populations are large and canola is past the protection period.

Foliar applied insecticides are effective when beetle populations have reached an economic threshold level and treatments are timed properly. Insecticides registered for flea beetle management in North Dakota as of 2002 are listed in the table below. Please check with the current *Field Crop Insect Management Guide* for updated insecticide registrations. Insecticide users must READ, UNDERSTAND, and FOLLOW ALL LABEL DIRECTIONS.

Registered Flea Beetle Insecticides

Insecticide	Dosage in Lb Ai/acre	Product Per Acre	Restrictions on Use
Capture 2 EC *RUP*	0.033 to 0.04	1.3 to 2.6 fl oz	Reduced rate is issued as a state 2 (ee) label. Apply in a minimum of 2 gals. of finished spray per acre by air or in a minimum of 10 gals. per acre by ground. When applying by air, 1 to 2 quarts of emulsified oil may be substituted for 1 to 2 qts of water in the finished spray. Do not apply within 35 days of harvest.
Ethyl-methyl parathion 6-3 *RUP*	0.5	0.66 pt	Aerial application only, using a minimum of 3 gallons of water per acre. Do not apply within 28 days of harvest. Do not enter treated fields for 3 days after application. Fields must be posted.
Gaucho		10.7 - 21.3 oz per hundred-weight of seed	For use in commercial seed treaters only. Not for use in hopper-box, slurry-box or other seed treatment applications at, or immediately before, planting.
thiamethoxam Helix (10.3% active) Helix Xtra (20.7% active)		23 fl oz per hundredweight of seed	For use in commercial seed treaters only. Contains 3 fungicides to protect against diseases. There is a 30 day plant back restriction.
Methyl parathion 8EC *RUP*	0.5	0.5 pt	Aerial application only, using a minimum of 3 gallons water per acre. Do not apply within 25 days of harvest. Do not enter treated fields within 48 hours after application. Fields must be posted.

RUP - Restricted use pesticide

Additional Sources

Canola Connection, Canola Council of Canada, http://www.canola_council.org/

Canola Production, NDSU Ext. Service Circular A-686, 1998, http://www.ext.nodak.edu/extpubs/plantsci/crops/a686w.htm

Northern Canola Growers Association, http://www.northerncanola.com/default.asp

2002 Field Crop Insect Management Recommendations, NDSU Ext. Service, Circular E-1143, http://www.ext.nodak.edu/extpubs/plantsci/pests/e1143w1.htm

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