

Adult striped
flea beetle and
crucifer flea beetle.
(P. Beauzay, NDSU)



Crucifer flea beetles on canola plant. (P. Beauzay, NDSU)

Integrated Pest Management of Flea Beetles in Canola

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Canola and other oilseed *Brassica* species are important oilseed crops in the northern Great Plains of the U.S. and Canada. As a cool season crop, canola adds diversity to cropping rotation systems.

The crucifer flea beetle, *Phyllotreta cruciferae* Goeze, and the striped flea beetle, *Phyllotreta striolata* (Fabricius) (Coleoptera: Chrysomelidae), are the most serious insect pests of canola. Both species were introduced from Eurasia.

Crucifer flea beetle is the dominant flea beetle pest of canola. Adult flea beetles emerge in the spring and feed on the cotyledons and true leaves. When they emerge in large numbers, they can devastate a seedling canola field quickly; therefore, timely monitoring and management of this pest is important. Control costs for flea beetles in oilseed *Brassica* crops often exceed \$300 million annually in North America.

Distribution

The crucifer flea beetle was introduced into North America in the 1920s and now is distributed across southern Canada and the northern Great Plains of the U.S., 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 first was reported in Québec, Canada, in a sample of sediment dating before 1668 and now is widespread across Canada and the U.S.

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Figure 1. Adult crucifer flea beetle. (P. Beauzay, NDSU)



Figure 2. Adult striped flea beetle. (P. Beauzay, NDSU)



Figure 3. Flea beetle egg.
(L. Harris, AgView International Inc., Saskatchewan, Canada)

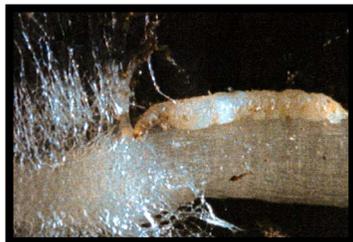


Figure 4. Flea beetle larva.
(L. Harris, AgView International Inc., Saskatchewan, Canada)



Figure 5. Flea beetle pupa.
(L. Harris, AgView International Inc., Saskatchewan, Canada)

Identification

Adult

Crucifer flea beetle (Figure 1): The adult is a small, oval-shaped, dark beetle with an iridescent blue sheen on the black elytra (wing covers), measuring about 1/32 to 1/8 inch (2 to 3 millimeters [mm]) in length. Flea beetles have enlarged 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 have two yellow strips on their black wing covers.

Eggs (Figure 3)

Eggs are yellow, oval and about 0.38 to 0.46 mm long by 0.18 to 0.25 mm wide, and are 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 inch 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 except for the black eyes and the free body appendages, which are visible later in the pupal development.

Life Cycle (Figure 6)

Phyllotreta 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 rarely overwinter in canola stubble. Beetles emerge when temperatures warm to 57 to 59 F (14 to 15 C) in early spring.

Flea beetles feed on volunteer canola and weeds, such as wild mustard, before moving to spring-planted canola fields. Depending on the temperature, adults may take up to three weeks to leave their overwintering sites. Striped flea beetle adults usually emerge before the crucifer flea beetle adults.

Warm, dry and calm weather promotes flea beetle flight and feeding activity throughout the field while simultaneously slowing canola growth. When weather conditions are cool, wet and windy, flea beetles may creep slowly into the field and concentrate feeding on the field edges.

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.

Larvae pass through three instars and complete their development in 25 to 34 days by forming a puparium (or resting stage). The pupal stage lasts for about seven to nine days, usually in early to mid-July.

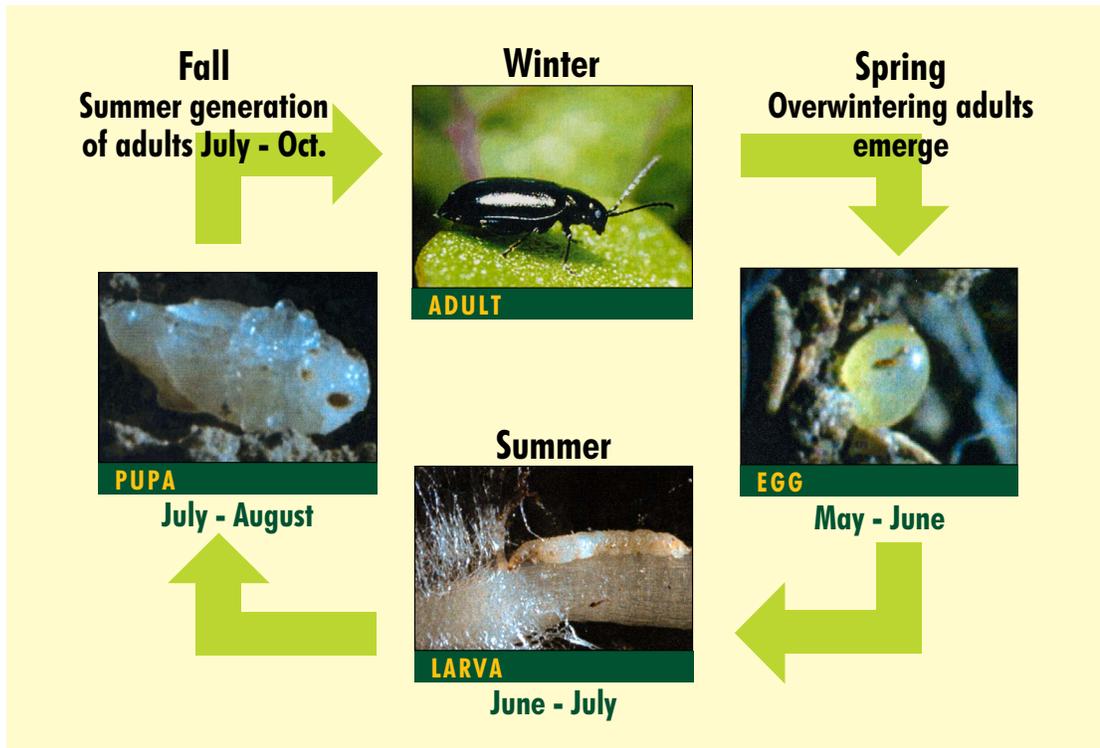


Figure 6. Life cycle of the crucifer flea beetle. (L. Harris, AgView International Inc., Saskatchewan, Canada)

The new generation of adults emerges from the puparium beginning in late July until early September and feeds 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 back to overwintering sites.

Hosts

Phyllotreta flea beetles have a narrow host range restricted to plants primarily in the family Brassicaceae. The preferred hosts are in the genus *Brassica* (Brassicaceae) and include the major agricultural hosts attacked by flea beetle: oil rapeseed or Argentine canola (*B. napus*) and Polish canola (*B. rapa/campestris*).

Phyllotreta flea beetles prefer plant families that produce mustard oil (or allyl isothiocyanate), which is a known aggregation pheromone of the crucifer flea beetle. Mustard (*Brassica* spp.) and crambe (*Crambe abyssinica*) also are susceptible to flea beetle attack but not preferred over canola.

Other hosts that flea beetles will attack in the garden setting are broccoli, Brussels sprouts, cabbage, cauliflower, horseradish, kale, radish and turnip. Some weeds attacked in the brassica group are flixweed, field pennycress, peppergrass and wild mustard.

Crop Damage

The major crop injury occurs during the spring when flea beetles feed on cotyledons and first true leaves, usually the first two weeks after crop emergence. The cotyledon leaf tissue is devoured by adult flea beetles, producing shallow

Figure 7. The new generation of flea beetles feeding on the green foliage and pods of canola in late July through fall.

(J. Knodel, NDSU)



divots or shot-holes with necrosis (Figure 8). Under severe pressure in North Dakota, flea beetles have been recorded as attacking the growing point (meristem tissue), killing the plant.

When flea beetle populations are large, and warm, sunny, dry, calm conditions favor feeding, fields can be infested quickly with a high risk of canola seedling death. 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.

Spring feeding activity occurs from May through June. During the summer months, the larvae feed on the secondary root hairs with negligible impact on yield loss or vigor. However, a yield loss of 5 percent from larval densities of one larva per square inch (0.16/square centimeter [cm]) has been recorded in Manitoba.

The new generation of adult flea beetles emerges after mid-July and feeds on developing pods (Figure 7). Usually the upper or younger pods on top 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 manage flea beetles and other pests of canola effectively, producers should use an integrated pest management (IPM) program.



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

Monitoring and Action Threshold

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). Yellow sticky traps (Figure 10) can be used for monitoring beetle emergence and population levels, but they do not indicate the need for control actions.

Monitor canola fields for the presence of flea beetles and their feeding injury (defoliation) during the first 14 days after crop emergence, or until plants have reached the four- to six-leaf stages. Fields should be checked daily to identify damage early and make timely management decisions.

The amount of defoliation is used as an action threshold. Injury occurs first at the field edges, particularly where a shelterbelt or 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 the percent of defoliation for each plant selected.

For foliar insecticide applications, the **action threshold is when an average of 20 to 25 percent defoliation has occurred on the cotyledons and/or first true leaves (Figure 9), and beetles are feeding actively in the field. Watch fields closely in hot, dry weather, when flea populations can increase rapidly.**

Foliar treatments must be made quickly if defoliation exceeds 20 to 25 percent. Under high beetle densities, a delay of one to two days can result in the loss of entire fields.

Apply insecticides during the sunny, warm part of the day when beetles are feeding actively on the plants. Canola plants that have reached the four- to six-leaf vegetative growth stage or beyond can tolerate more feeding injury unless flea beetles are feeding on the growing point.

During years when flea beetle populations are high through June, a yield loss of 10 percent is common even when the crop is protected with insecticidal seed treatments. Under these conditions, a later foliar treatment (21 days after planting) often is 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 they usually do 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. No accurate forecasting model is available for predicting the risk of flea beetle outbreaks in the following growing season.

Cultural Control

Planting Date

Planting canola 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. However, early seeded canola coincides with peak flea beetle emergence and often severe feeding activity. In contrast, late-seeded canola typically has less feeding injury but lower yields.

Increased seeding rates also may help reduce flea beetle impact by reducing overall injury per plant with more plants per unit area. In Canada, canola planted in wider row spacing of 7.8 to 11.8 inches (20 to 30 cm) also resulted in decreased feeding injury per plant, compared with narrower row spacing of 4 inches (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

The use of different cropping systems, such as no-till, minimum till or fall dormant seeding, may help lower the overall populations of flea beetles and reduce the need for insecticide use for management of flea beetles in canola. Because flea beetles are more active during sunny and warm days, different cropping systems may provide a less desirable, cooler micro-environment.

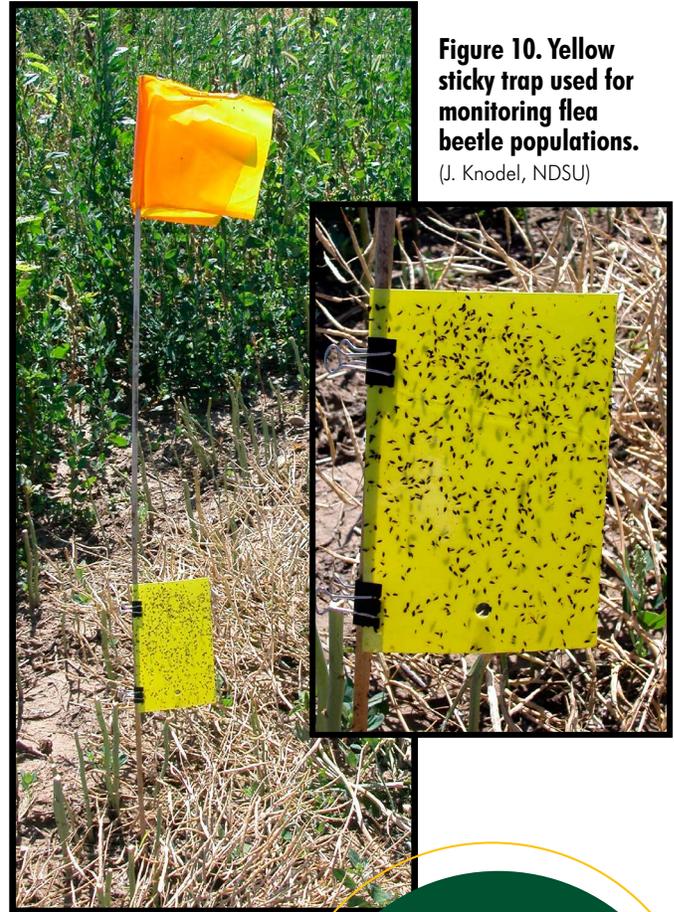


Figure 10. Yellow sticky trap used for monitoring flea beetle populations. (J. Knodel, NDSU)

Action Threshold
 Seedling:
 20-25% defoliation of cotyledons and first true leaves



10 percent defoliation



10 to 15 percent defoliation



action threshold,
20 to 25 percent defoliation



50 percent defoliation



75 to 80 percent defoliation



dead plant

Figure 9. Examples of defoliation ratings with action threshold of 25 percent defoliation on canola cotyledons. (L. Lubenow, NDSU)

Often, flea beetle populations are lower in no-till fields, compared with conventional-tillage fields. Dormant-seeded canola may germinate, emerge and reach the four-leaf stage before significant numbers of flea beetles emerge from overwintering sites. In the north-central region of North Dakota, only 4 percent of the dormant-seeded fields were sprayed with a foliar insecticide for flea beetle control, compared with 25 percent of the spring-seeded fields.

Crop Rotation

Because 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, such as blackleg and sclerotinia.

Plant Resistance

Some of the larger-seeded varieties of Brassicaceae are more vigorous against flea beetle feeding injury due to the larger size of their cotyledon leaf area, which resulted in decreased injury to seedlings. Researchers have found that trichomes on plant leaves, stems and pods reduce flea beetle feeding injury by interfering with their feeding behavior.

A deterrent compound in yellow mustard also provided some tolerance against flea beetle feeding injury. These traits could be used as a host plant resistance trait in future canola breeding efforts.

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, such as *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 impact flea beetle populations negatively. Entomopathogenic nematodes, such as *Steinernema carpocapsae*, have shown some success in the canola field in reducing feeding injury of flea beetles.

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Chemical Control

Systemic insecticides, such as neonicotinoid insecticides applied as a seed treatment, are the primary insecticide strategy for management of flea beetles in canola. About 95 percent of canola seed in North Dakota is treated with an insecticide and fungicide. Systemic seed treatments provide protection against flea beetles for about 21 days after planting.

The prophylactic use of insecticide seed treatment may be unnecessary when flea beetle populations are low. However, producers must decide about using seed treatments before planting and before populations densities of flea beetles are known.

In cool, wet springs, canola may be at increased risk for feeding injury from flea beetles because seedling growth is delayed and the uptake of systemic insecticide toxins in seed treatments is slowed.

Concerns have been raised about the development of insecticide resistance in *Phyllotreta* flea beetles in canola because neonicotinoid insecticide seed treatments have been the primary insecticide used to control flea beetles for more than a decade. In Canada, the striped flea beetles are more tolerant (less mortality) of neonicotinoid seed treatments, compared with the crucifer flea beetles.

Research is underway in North Dakota to determine if neonicotinoid seed treatments remain effective against the two *Phyllotreta* species and if striped flea beetles are becoming more common than crucifer flea beetles in canola.

Foliar-applied insecticides are used when beetle populations have reached an action threshold level. Treatments must be applied quickly to prevent significant feeding injury when the crop is susceptible.

Insecticides registered for flea beetle management in canola are listed in the current “North Dakota Field Crop Insect Management Guide” (E1143). Pesticide applicators must **read, understand and follow all label directions**.

Additional Sources

“North Dakota Field Crop Insect Management Guide,” E1143, NDSU Extension Service www.ag.ndsu.edu/pubs/plantsci/pests/e1143.pdf

“Canola Production Field Guide,” A1280, NDSU Extension Service www.ag.ndsu.edu/publications/landing-pages/crops/canola-production-field-guide-a-1280

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