Flea Beetles on Canola and Mustard

Flea beetles are a group (tribe) of leaf beetles. There are 188 species of flea beetles in Canada and 86 species in Manitoba. Some species feed on crops, others on wild vegetation, and there are some species that only feed on weeds and have been introduced as biological control of weeds. The name flea beetles refers to their jumping habits.

Ten species of crucifer feeding flea beetles occur in Manitoba. Of these, only the crucifer flea beetle, *Phyllotreta cruciferae* (Goeze), and the striped flea beetle, *Phyllotreta striolata* (F.), which were both introduced from Eurasia, are significant pests of canola, mustard and cruciferous vegetable crops. The ability of these flea beetles to maintain large overwintering populations has made them persistent spring pests of mustard, Argentine canola *(Brassica napus L.)*, Polish canola *(Brassica rapa L.)* and rapeseed.

Figure 1. Flea beetles and feeding pits

The economic impact of flea beetles on crop production varies with population densities of flea beetles, and growing conditions for the crop. Yield losses of about 10 percent are common where flea beetles are abundant even when the crop is protected with insecticides.

Feeding Damage

Crucifer and striped flea beetles feed on the cotyledons, leaves, apical bud tissue, petioles, stems, roots and seed pods of crucifers (e.g., canola, mustard, and rapeseed). The effect of the feeding activity on crop development varies with the part of the plant fed on, crop development, growing conditions and the intensity of the attack.

Adult beetles feed on the surface of leaves, stems and seed pods and produce small pits. When feeding is extensive, the small feeding pits merge and form larger holes in the leaves. The tissue underneath the injury eventually withers and dies. On leaves and cotyledons, the damaged tissue breaks up and falls out producing a shot hole appearance. Heavy infestations may severely damage cotyledons, the first leaves, petioles, and stems. The crop can usually compensate for the destruction of individual plants, provided large portions of the crop are not totally destroyed. Feeding damage may be enhanced when flea beetles feed on the growing point (meristem) because this can limit the ability of the plant to compensate.

During seedling emergence, severe stand loss can occur if flea beetle populations and feeding on seedlings is high. Early damage to seedlings produces plant stands with uneven height and maturity,

reduces seed yield, and contributes to seeds with elevated chlorophyll content.

Light to moderate infestations delay plant development and cause uneven maturity. Delayed maturity may expose the crop to adverse temperatures during flowering or to frost before the plants have matured. Uneven maturity at harvest reduces seed quality or yield. Delaying harvest to allow immature pods to ripen can contribute to yield loss when over-ripe seed pods shatter during harvest. Harvesting too early produces a crop with many immature seeds containing high chlorophyll levels, affecting seed quality and yield. Most of this damage can be prevented if canola is protected from flea beetle injury until plants have at least 3 or 4 true leaves.

During summer months the larval stages feed on plant roots and root hairs. Root damage is estimated to reduce yield by about five percent.

Late-summer populations feeding on mature plants

Adult crucifer and striped flea beetles which emerge after mid-July will also be attracted to canola and mustard. These late-summer flea beetle populations generally peak at the end of August-beginning of September. Their feeding during pod development and filling of late-seeded crops can result in reduced seed yield and increase chlorophyll content. Injury to the seed pods is usually concentrated on the youngest pods and on late-seeded crops. Flea beetle feeding on canola in late-summer is rarely an economic concern. Once canola is past the 5.2 growth stage, when seeds in the lower pods are green, it becomes resistant to injury from flea beetles. Even at the 5.1 - 5.2 growth stages, when seeds in lower pods are still green, numbers higher than 100 flea beetles per plant, and for some cultivars higher than 350 per plant, may be necessary to cause significant yield reductions.

Life cycle and Identification

The life cycle of the crucifer flea beetle is summarized in Figure 2.

Identification:

Adults: Flea beetles attacking canola, mustard, and rapeseed are small, elliptical or oval shaped beetles less than 2.5 mm long. When disturbed, they use their powerful hind legs to jump away, hence the name flea beetles. The crucifer and striped flea beetle are the dominant species feeding on these plants.

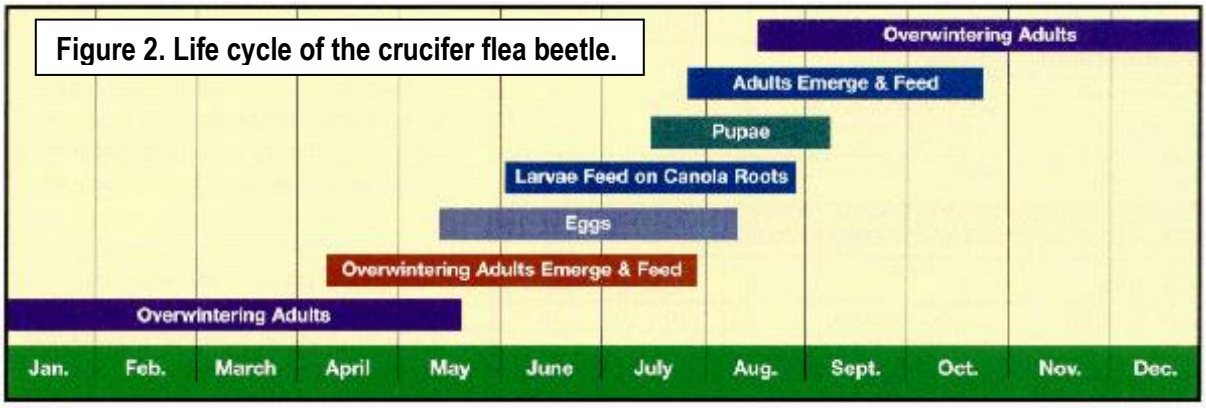

Figure 2. Life cycle of the crucifer flea beetle.

The crucifer flea beetle and striped flea beetle are the most widely distributed and destructive flea beetles attacking canola, mustard, and rapeseed. Adult crucifer flea beetles are uniformly black with a metallic bluish sheen (Figure 3). The wing covers (elytra) are randomly punctuated and they have enlarged femurs on their hind legs.

Striped flea beetle adults are black with distinctive yellow stripes on their elytra (Figure 4).

Figure 3. Crucifer flea beetle

Figure 4. Striped flea beetle

Each species has a single generation per year, although adults appear twice during the growing season. In the spring, overwintered adults emerge and feed on canola seedlings. Striped flea beetles emerge 1 to 4 weeks earlier than crucifer flea beetles. In the fall, it is the offspring of the overwintering adults that are observed feeding on canola leaves, stems and seed pods.

Flea beetles overwinter as adults near the surface of the leaf litter, grass, and debris beneath hedges, shelterbelts, poplar groves, and in association with canola stubble and volunteer cruciferous plants. Within the leaf litter in these locations flea beetle densities may be as high as 168 to 300 beetles/yd^2 (140 to 250 beetles/m^2).

Under cool conditions, flea beetles walk or hop into the adjacent cruciferous crops or weeds. When temperatures exceed 14 degrees C (early to mid-May) and wind is calm, the adult beetles may take flight and invade other fields, attacking seedlings as they emerge.

After selecting a host plant and feeding has commenced, beetles mate repeatedly. Egg-laying begins in late May and continues until the end of June or for about 30 days. A very small proportion of the population may continue to lay eggs until early August.

Eggs: Females deposit about 100 smooth, yellow, elongate, oval eggs (0.38 to 0.46 mm by 0.18 to 0.25 mm wide) either singly or in groups of three or four in the soil adjacent to the

Figure 5. Eggs of striped flea

host plant's roots. Unless the eggs are in contact with moist soil, they desiccate within a few hours. The eggs take about twelve days to hatch.

Larvae: Flea beetle larvae (Figure 6) are grub-like with off-white bodies and a brown head and anal plate. Larvae moult twice during the 25 to 34 days it takes them to complete three larval stages. Larvae feed on the root hairs and taproots of seedlings. In a few cases, larvae have been observed burrowing into the plant near the juncture of the root and stem. When larval development is complete, larvae pupate in small earthen cells.

Figure 6. Larvae of striped flea beetle.

Pupae: Flea beetle pupae are usually present in the field by early to mid-July. They are entirely white except for the eyes which darken as the pupal stage progresses to completion. The body appendages are free and distinguishable. The pupal stage lasts for about seven to nine days.

Adult: Adult emergence from the pupal stage begins after mid-July and continues until early September. The beetles feed on the leaves, stems and pods of cruciferous plants. Development from egg to adult takes about seven weeks. In late August and September adults move into leaf litter and debris to overwinter.

Monitoring

In the spring, producers and agronomists should monitor levels of flea beetles and assess damage to cotyledons, the first true leaves and stems on canola, rapeseed and mustard seedling. Assess plants every few days from the time plants emerge until the plants have at least three or four true leaves, especially on sunny, calm days when temperatures exceed 14 degrees C. Visually estimate the percent of cotyledon and leaf tissue that has been injured by flea beetles. Also assess the effect that severe defoliation or stem feeding may have on plant stand. Feeding on stems or petioles may at times cause the whole cotyledon, leaf or seedling to be killed.

In the fall, flea beetle densities should be noted. This will be the first signal of potential problems next spring.

Economic Thresholds

Economic thresholds are needed to decide whether a foliar spray for flea beetle control will be an economical investment or not. Since decisions regarding seed treatments are made prior to seeding, the use of economic thresholds for flea beetle control in canola only applies when foliar sprays are used as a flea beetle control strategy.

Canola seedlings can withstand 50% leaf loss. Flea beetles can damage plants very quickly, however, so a suggested economic threshold for flea beetle feeding on canola is when there is 25% defoliation and flea beetles are present. Applying controls at 25% defoliation will reduce the risk of flea beetle damage getting to the level where yield loss and plant development has been substantially reduced.

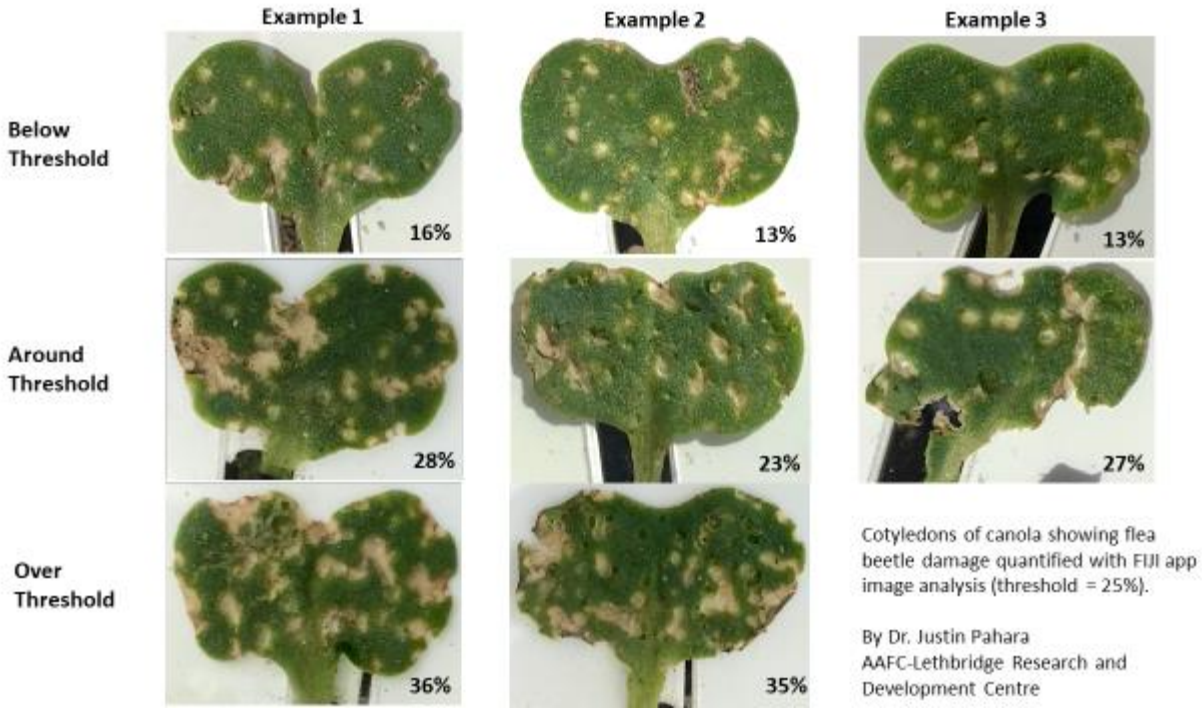

Figure 7. Examples of flea beetle damage below, around, and over the economic threshold.

When scouting fields for flea beetle damage, realize that flea beetles generally invade canola fields from the field edges. Flea beetle damage and numbers of flea beetles may be higher at the field edge than farther into the field. If this appears to be the situation, a foliar spray around the field edge may provide sufficient protection. On hot and calm days, flea beetles are capable of moving farther distances and may populate the field more uniformly. When assessing economic thresholds it is often important to also consider growing conditions. When flea beetle feeding is combined with poor plant growth during hot, dry weather, canola can tolerate less flea beetle feeding than if plants are growing under more ideal growing conditions.

Pest Management

Flea beetles can locate, attack, and quickly injure or destroy seedlings shortly after emergence, making them extremely difficult to control. To manage flea beetles, producers use a combination of cultural and chemical control strategies.

Biological Control

Predators, parasites and diseases can be important in regulating insect populations. To date the effect of biological control agents seems to be limited on flea beetles but several insects have been observed attacking adult flea beetles.

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*) are a few of the insects observed feeding on flea beetles.

A native braconid wasp, *Microctonus vittatae*, parasitizes flea beetle adults. However, its overall effect on flea beetle populations is unknown.

Unfortunately, flea beetle populations emerge in large numbers during a relatively short period of time and tend to overwhelm the parasites and predators.

Cultural Controls

Rapid germination and early growth: The larger the seedling, the more it can withstand injury from flea beetle feeding. To obtain large plants early, producers should use good quality seed, where practical seed into soil that is warm enough for quick germination and early growth, and plant as shallow as available moisture will allow. This produces seedlings that germinate and emerge quickly and grow vigorously. Seedlings of vigorously growing varieties are able to tolerate flea beetle feeding more than seedlings of less vigorous varieties.

Direct seeding: If early seeding is used in conjunction with direct seeding into standing stubble, plants are afforded a micro-climate that offers moist soil conditions (favouring rapid germination). Flea beetles have a preference for environments that are exposed to bright sunlight and are relatively warm. Direct seeding provides a micro-climate which is less ideal for flea beetles. This seeding method produces large plants early and may reduce the producer's dependence on insecticides, except under conditions of intense flea beetle pressure.

Increased seeding rate: Increasing seeding rates can help reduce the impact of flea beetle attack. For a given population of flea beetles, having more plants per unit area means that feeding damage per plant is reduced and seedlings can then recover more readily from flea beetle injury. The Canola Council of Canada recommends targeting five to eight plants per square foot. A canola plant population at the high end of the recommend range will mean more plants for a fixed number of flea beetles.

Wider row spacing: At a given seeding rate, wider row spacing of 20 - 30 cm, rather than 10 cm, can also result in less flea beetle damage per plant. Although the reasons are not yet clear, it appears that flea beetles are more attracted to the reduced visual contrast between vegetation and soil that occurs at narrow row spacing.

Larger seeds: Seedlings from large canola seeds are more tolerant to damage from flea beetles than seedlings from medium or small seeds for both Argentine and Polish canola. This is because of a higher initial shoot biomass and higher growth rate when flea beetle damage is severe.

Crop rotation, although of value in many ways for maximizing canola yields, is not on its own an effective flea beetle management strategy. Adults are capable of long range movement.

Research is currently being performed to try to develop flea beetle resistant varieties of canola. If successful, this may be another option available to canola growers in the future for flea beetle control.

Chemical Control

The insecticides used for flea beetles on canola, mustard and rapeseed can be applied as a seed treatment, or post emergence foliar sprays.

Seed Treatments: Coating seeds with an insecticide in combination with one or more fungicides prior to planting is a common practice. With the seed treatments currently available, canola seedlings are protected from flea beetles for about three to four weeks from the date of seeding. There is higher mortality of crucifer flea beetles from Helix and Prosper than for striped flea beetles.

Table 1. Seed Treatments that Control Flea Beetles in Canola and Mustard

Seed Treatment	Insects Controlled	Crop
Lumiderm[1,2]	Flea beetles, cutworms	canola, mustard
Fortenza Advanced[1,3]	Flea beetles, cutworms	canola, mustard
Buteo start[1]	Flea beetles	canola
Helix Vibrance	Flea beetles	canola, mustard
Prosper EverGol	Flea beetles	canola, mustard
Nipsit Inside	Flea beetles	canola
Sombrero	Flea beetles	canola, mustard

[1]Applied combined with a neonicotinoid-based seed treatment.
[2]Do not apply any subsequent application of a group 28 insecticide (such as Coragen) for a minimum of 60 days after planting seed treated with Lumiderm.
[3]Do not apply any subsequent application of a group 28 insecticide (such as Coragen) after planting seed treated with Fortenza.

Foliar Insecticides: High levels of flea beetles may result in a post-emergent insecticide application being required to protect seedlings where conditions prevent canola from insecticide treated seed from germinating and advancing to the 3 to 4 leaf stage within three to four weeks after seeding. Field scouting for flea beetles is important, particularly on hot, calm days. If heavy flea beetle damage and high numbers of flea beetles are noticed in the field, foliar sprays should be applied as soon as possible, since flea beetles can cause substantial damage quickly.

Additional foliar sprays may sometimes be needed since flea beetles may continue to move into fields of canola at the susceptible stage after the residual from the first foliar spray has become ineffective. If more than one foliar spray is needed to manage flea beetles, note that insecticides have restrictions on the number of applications per field per year. If control of other insects is also anticipated, have a product plan so you can manage insects at economic levels and stay within label restrictions.

Table 2. Foliar Insecticide Treatments for Flea Beetles in Canola and Mustard

Insecticide	Crop	Rate (ml of product per acre)	Preharvest Intervals (days)
Decis 100 EC	Canola, mustard	20 - 30	7
Decis 5 EC, Advantage Deltamethrin	canola,mustard	40 - 60	7
Poleci	canola, mustard	81 - 121	7
Silencer/ Labamba/ Zivata*	canola, mustard	34	7
UP-Cyde/ Ship	canola, mustard	57	30
Pounce/ Perm-Up	canola	36 - 73	Treat up to 5-leaf stage
Ambush	canola	28 - 57	Treat up to 5-leaf stage
Malathion 500	canola	440	7
Malathion 85E	canola, mustard	217 - 346	7
Sevin XLR	canola	202	Seedling application only

*Canola treated with lambda-cyhalothrin (Silencer, Labamba, Zivata) can't be used as animal feed.

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