Bertha Armyworm

Bertha armyworm (*Mamestra configurata*) can be one of the most significant insect pests of canola in western Canada when populations are high. It occurs throughout Manitoba, Saskatchewan, Alberta and the interior of British Columbia. It has not been recorded east of Manitoba in Canada.

Bertha armyworm is native to North America and belongs to a group of insects referred to as "climbing cutworms." Also included in this group are the armyworm (*Mythimna unipuncta*) and variegated cutworm (*Peridroma saucia*).

In most years, populations are kept low by unfavourable weather conditions such as cold winters and cool wet weather, and by parasites, predators and diseases. But when these natural regulators fail, populations can increase dramatically, creating the potential for widespread damage to a variety of broad-leaved crops.

Infestations may be localized or spread over large areas. Crop losses can be minimized if high populations are detected early.

Figure 1. Bertha armyworm larva

Life Cycle

Bertha armyworms develop through four distinct stages: adult, egg, larva and pupa. In Canada, there is one complete generation per year.

Adults

The adult stage is a moth. Moths begin emerging from the over-wintering pupae in early to mid-June and continue until early August.

It is suspected that moths are strongly attracted to canola fields that are in bloom and secreting nectar. Adult moths mate within five days of emergence and lay their eggs on the host plants. Each female moth will lay about 2,150 eggs but numbers as high as 3,500 eggs per female have been recorded.

Figure 2. Adult moth of bertha armyworm

The moth has a wing span of about 4 cm (1.5 in.) and is active only at night. The forewing is predominantly gray, and flecked with patches of black, brown, olive and white scales. Near the middle of the forewing, towards the leading wing margin (front), there is a prominent, white, kidney-shaped marking defined with a ring of whitish scales. Near the tip of the forewing, there is a conspicuous white and olive-colored, irregular transverse marking that is characteristic of the species.

Eggs

Bertha armyworm eggs are laid in single-layered clusters of about 50 to 500 eggs on the lower surface of the host plant leaves. The eggs are sculptured, ridged and pinhead in size. When first laid, they are white but become darker as they develop. At average temperatures, the eggs hatch within a week.

Figure 3. Cluster of eggs of bertha armyworm

Larvae

Newly hatched bertha armyworm larvae are about 0.3 cm (1/10 inch) long. They are pale green with a pale yellowish stripe along each side. Because of their size and color, they are difficult to see on the underside of leaves.

When disturbed, small larvae may drop off the leaves by a fine silken thread. This behavior makes it difficult to distinguish small bertha armyworm larvae from those of the diamondback moth, which display a similar behavior. Large larvae may drop off the plants and curl up when disturbed, a defensive behavior typical of cutworms and armyworms. Larvae feed at night and often hide underneath leaf litter and clumps of soil during the day, which makes them difficult to see.

Larvae take approximately six weeks to complete their development, depending upon temperature. During this period, they moult five times and pass through six growth stages. As they mature, their color becomes variable. Some remain green, but many become brown or velvety black. At maturity, the larvae are about 4 cm (1.5 inch) long, with a light brown head and a broad, yellowish-orange stripe along each side. The velvety black colour form of the larvae has three narrow, broken white lines on its back.

Figure 4. Mature larvae of bertha armyworm can vary in colour

At maturity in late summer or early fall, larvae burrow into the ground and form pupae.

Pupae

Bertha armyworms survive the winter as pupae in the ground at depths of 5 to 16 cm (2 to 6 inches).

Pupation usually begins in mid to late August. All larvae will have pupated by early to mid September. If the autumn is unusually warm, some pupae may continue their development and emerge as moths in late August or September, only to perish when winter arrives.

Pupae are reddish brown, about 0.5 to 1.8 cm (0.2 to 0.7 inches) and tapered with flexible, terminal abdominal segments. Bertha armyworm pupae are indistinguishable from other cutworm pupae.

Figure 5. Bertha armyworm pupae

Host Plants and Damage

Larvae are the only development stage of the bertha armyworm to cause crop damage. They feed on a variety of crops and weeds. Canola, rapeseed, mustard, lamb's quarters and related plants are preferred host plants. They can also cause significant damage to quinoa and hemp. Bertha may also feed on a range of other plants including flax, potatoes, alfalfa, and peas.

The degree of crop damage varies with the crop, the plant's growth stage, the growth stage of the larvae, and the number of larvae present. Significant crop damage usually occurs within a three-week period between late July and late August, depending on the season and crop location.

Small larvae feed on the underside of the leaves, chewing irregularly-shaped holes in the leaves. They usually cause little damage at this stage, even when population levels are high. Crop damage occurs rapidly once the larvae moult to the second-last stage. These larvae are about 1.3 cm (1/2 inch) in length. Larvae in the last two larval stages eat about 80% to 90% of the plant material consumed during the life of the larvae.

If the plants, especially canola, drop their leaves before the larvae are mature, the developing larvae will feed directly on the seed pods. Seed pods may be "debarked," but more commonly, the larvae chew holes in the pods and eat the seeds. At high numbers, the entire seed pod may be consumed. Even if the pods are only stripped of their outer green layer and not eaten entirely, crop losses may still occur because of premature shattering.

In flax, the larvae eat the flowers and developing bolls. Once the flax bolls are full-size and start to ripen, larvae usually feed on the calyx below the boll. Occasionally, larvae will feed on the green stems of ripening bolls, causing them to drop off.

Monitoring

The presence of bertha armyworm larvae in a crop one year is not a reliable indicator of what to expect the following year. Bertha armyworm populations fluctuate widely from year to year.

Adult Populations

To help forecast potential levels of larvae, moths of bertha armyworm can be monitored in June and July using traps baited with sex pheromone lures, which attracts the male moths. The number of moths collected by these traps gives an indication of what the bertha armyworm larval populations may be like regionally, although they may not be an accurate predictor of larval numbers for the field the trap is in. These traps are best used in a coordinated regional forecasting program rather than a field-specific predictor.

Figure 6. Trap for monitoring adults of bertha armyworm

Larval Populations

Early detection and regular monitoring of bertha armyworm larvae are critical to minimize crop losses. Larval monitoring should begin about early-July and be done at least weekly until the crop is swathed.

It is important to monitor larval numbers in each field. Adjacent fields may have very different larval densities, depending upon how attractive the crop was when the moths were laying their eggs. Adjacent crops may also have different-sized larvae, depending on when the eggs were laid.

For accurate larval estimates in a crop, sample at least five locations a minimum of 50 metres apart, although sampling more locations will result in more accurate estimates. Do not sample headlands (20 metres wide) and areas within the crop that are not representative of the field.

At each location:

- Mark out an area of one quarter of a metre square (50cm X 50cm). A 3-sided frame can be used to define the area to be sampled.
- Shake the plants growing within that area to dislodge any larvae remaining on the plants.

- Then count the number of larvae in the 1/4 square metre area. It is important to take your time while counting larvae. Carefully search the soil and leaf litter. The larvae are difficult to see and may be hidden underneath clumps of soil, in cracks in the soil, or within curled leaves.

Multiply the number counted by 4 to get the number per square metre. Use the average number of larvae at the sites surveyed within each field to determine if the economic threshold has been exceeded and an insecticide is necessary.

Economic Thresholds - When to Take Action

Insecticide application is economical when bertha armyworm larvae are abundant enough that the yield loss that will likely result from their feeding if they are not controlled approaches the cost of controlling them.

The economic threshold for bertha armyworm varies with the cost of the insecticide, the method of application and the crop's value. Using current crop value ($/bushel) and application costs ($/acre), Table 1 indicates the larval density (larva per square metre) at which an insecticide treatment in canola would be warranted. This table is based on research that found an average loss in yield of 0.058 Bu/acre for each larvae/m^2 can be expected.

Table 1. Economic thresholds for bertha armyworm on Argentine canola.

	Expected Seed Value - $/bushel										
	6	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**
Spraying Cost - $/acre	Number of Larvae/metre^2										
8	23	17	14	11	10	9	8	7	6	6	5
10	29	22	17	14	12	11	10	9	8	7	7
12	34	26	21	17	15	13	12	10	9	9	8
14	40	31	24	20	17	15	14	12	11	10	9
16	46	34	27	23	19	17	15	14	13	12	11
18	52	39	31	26	22	19	17	16	14	13	12
20	57	43	34	28	24	21	19	17	16	15	13
22	63	47	38	31	27	23	21	19	17	16	15
24	69	51	41	34	29	25	23	21	19	17	16

For example, assuming a crop price of $14.00 per bushel and a spraying cost of $16.00 per acre, the table indicates an economic threshold of 19 bertha armyworm larvae per square metre. Spraying would not be economical if larvae counts are less than 19 per square metre.

Drought Stress - potential effect on economic threshold

Drought stress on canola may result in early dropping of leaves. Lack of leaves may cause more pod feeding by the larvae and affect yield more directly. Also, canola may not compensate as well for tissue loss under stressed conditions. Thus, under moisture stress, economic thresholds for bertha armyworm may be lower than indicated in the above table. Under severe drought stress, dividing the economic thresholds above by 1.48 may give more appropriate economic thresholds.

Control

In most years, bertha armyworms are controlled naturally by natural enemies or adverse weather.

Effects of Weather

Cold temperatures can increase mortality of the over-wintering pupae. During harsh winters in snow-free fields, many bertha armyworm pupae may die. Bertha armyworm outbreaks appear to be favored by snow accumulation, which protects pupae from prolonged exposure to temperatures below -10°C.

Newly hatched larvae are especially vulnerable to inclement weather and diseases.

Cultural Control

Crop and field management may be used to reduce crop loss from bertha armyworm. Methods include planting alternative crops, early swathing and fall cultivation.

Fall cultivation can kill many bertha armyworm pupae by mechanical damage and exposing them to predators. Tillage can also reduce the amount of snow trapped on a field by removing or flattening stubble and exposing pupae to sub-zero temperatures over the winter. This practice may be effective for individual fields but is not likely to be effective unless it is adopted by all producers in an area. Adult moths are strong flyers and can easily move to adjacent fields. Fall cultivation should not be used on light-textured soils susceptible to erosion.

Early seeding with early maturing varieties may help minimize yield loss where this is practical and does not increase the risk of other potential pests.

Biological Control

Parasitic insects that can kill bertha armyworm include an ichneumonid wasp (*Banchus flavescens*), and a tachinid fly (*Athrycia cinerea*). When levels of these parasitoids are numerous, parasitism by *Banchus flavescens* can exceed 40%, and *Athrycia cineria* may kill over 20% of bertha armyworms. *Banchus flavescens* attacks the early larval stages (1 to 3) of bertha armyworm, while *Athrycia cineria* attacks later stages (3-6).

Figure 7. *Banchus flavescens*

Figure 8. *Athrycia cineria*

Predators of bertha armyworms have not been well studied. Vertebrate predators, particularly birds, may be important during periods of high populations of larvae.

Pathogens known to infect and kill bertha armyworms include a nuclear polyhedrosis virus, and the fungus *Entomophthora* sp.

Chemical Control

Chemical control is the producer's last line of defence against the bertha armyworm.

Application Timing: For best results, watch crops closely for evidence of pod feeding, and if economic thresholds are exceeded apply insecticides just as pod feeding is beginning.

A single, well-timed application of any registered insecticide applied with aerial or high clearance ground equipment is usually effective.

Table 2. Summary of the insecticides registered for bertha armyworm in canola, mustard and flax in Canada*

Product	Rate / acre	Preharvest Intervals (days)		
		Canola	Mustard	Flax
Coragen MaX Coragen	17 - 50.5 ml 51 - 152 ml	1	1	1
Decis 100 EC	20 - 30 ml	7	7	7
Decis 5 EC, Advantage Deltamethrin	40 - 60 ml	7	7	NR
Poleci	81 - 121 ml	7	7	NR
Silencer, Labamba, Zivata**	34 ml	7	7	NR
Up-cyde, Ship	81 - 113 ml	30	NR	NR
Chlorpyrifos	304 - 405 ml	21	NR	21

* NR in the preharvest interval column indicates the insecticide in not registered in that crop.

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

No insecticides are registered for bertha armyworm on quinoa or hemp in Canada.

For Best Control:

- Because larvae hide during the day and feed at night, applying insecticides late in the day or in the evening when the larvae are actively feeding is preferred. Do not apply during warm afternoons.
- Use enough water to ensure adequate coverage.
- Use high water volumes in crops with dense canopies such as canola.

Protection of Pollinators

Pollinators such as honey bees can increase the yield of canola. To avoid killing foraging honey bees, delay insecticide applications until after the crop has finished blooming. If this is not possible, apply during the evening to avoid direct contact with bees with the exception of chlorpyrifos, which should not be applied to flowering canola. Application of insecticides to flowering canola when yield-reducing insects are below economic threshold levels can decrease potential yields of canola if pollination is impacted. Additional information on the benefits of bees to canola can be found at:
http://www.gov.mb.ca/agriculture/crops/insects/pdf/beesoncanolafactsheet.pdf

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