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Bertha Armyworm

Bertha armyworm (*Mamestra configurata*) is one of the most significant insect pests of canola in Canada. The pest occurs throughout Manitoba, Saskatchewan, Alberta and the interior of British Columbia.

Severe infestations can occur throughout most of this area, but are usually (but not always) limited to the Parkland area of the Prairies and the Peace River region of British Columbia and Alberta.

Background

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 true armyworm and variegated cutworm.

Bertha armyworm is one of the most significant canola pests

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

In extreme situations, infestations of more than 1,000 larvae per square metre have been reported while densities of 50 to 200 larvae per square metre may be common.

Infestations may be localized or spread over millions of acres. Widespread crop losses can be minimized with insecticides if the infestation is detected early. However, failure to detect infestations early may result in insufficient time to apply the chemicals before severe damage is done. Also, there may be temporary insecticide shortages if suppliers are not aware of the potential outbreak.

Monitoring programs are now in place to help forecast outbreaks and to act as an early warning signal for farmers, crop scouts and industry.

Life cycle

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

Pupae

Bertha armyworms survive the winter as pupae in the ground at depths of 5 to 16 cm. The pupa is a pod-like structure that protects the bertha armyworm while it transforms from the larval stage to the adult moth.

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 in size and tapered with flexible, terminal abdominal segments. Bertha armyworm pupae are indistinguishable from other cutworm pupae.

Adults

Adult moths begin emerging from the overwintering pupae in early to mid-June and continue until early August. Moths appear to be strongly attracted to canola fields that are in bloom and secreting nectar.

The moth has a wing span of about 4 cm and is active only at night. The forewing is predominantly grey 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-coloured, irregular transverse marking that is characteristic of the species.

Adult moths mate within five days of emergence, and the females 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.

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.

Larvae

Newly hatched bertha armyworm larvae are about 0.3 cm long. They are pale green with a pale yellowish stripe along each side. Because of their size and colour, 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 behaviour makes it difficult to distinguish small bertha armyworm larvae from those of the diamondback moth, which display a similar behaviour. Large larvae usually drop off the plants and curl up when disturbed, a defensive behaviour typical of cutworms and armyworms.

Larvae take approximately six weeks to complete their development, depending on temperature. During this period, they moult five times and pass through six growth stages. As they mature, their colour becomes variable. Some remain green, but many become brown or velvety black.

At maturity, the larvae are about 4 cm long, with a light brown head and a broad, yellowish-orange stripe along each side. The velvety black larvae have three narrow, broken white lines on their backs.

When mature in late summer or early fall, larvae burrow into the ground and form 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, alfalfa, lamb's quarters and related plants are preferred host plants. Bertha armyworm will also feed on a range of secondary hosts including flax, peas and potato.

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. Larvae in the last two larval stages eat about 80 to 90 percent 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 number of bertha armyworm larvae in a crop is not a reliable indicator of what to expect the following year. Bertha armyworm populations fluctuate widely from year to year. To assist producers with making crop protection decisions, a monitoring program has been implemented for the Canadian Prairies.

Alberta Insect Pest Monitoring Program

The emergence of adult moths from overwintering pupae is monitored using accumulated degree-days. After emergence, the flight of bertha armyworm moths is monitored using a network of pheromone-baited traps, which attract the male moths.

This network of approximately 200 pheromone traps is organized by Alberta Agriculture and Rural Development, and individual traps are managed throughout Alberta by a wide range of co-operators. The monitoring program has been conducted in Alberta since 1995.

The number of moths collected by these traps gives an indication of the risk of bertha armyworm larval infestations within a region, although not specifically for the field the trap is in (Table 1). Generally, higher numbers of moths during the flight period (around mid-June through July) indicate a greater risk of larval damage (in July and August).

Table 1. Moth catch as risk indicator of larval damage

Cumulative moth catch	Risk level	Interpretation
0 - 300	Low	Infestations are unlikely to be widespread, but fields should be inspected for signs of insects or damage.
300 - 900	Uncertain	Infestations may not be widespread, but fields that were particularly attractive to egg-laying females could be infested. Check fields.
900 - 1200	Moderate	Infestations likely, canola fields should be sampled regularly for larvae and for evidence of damage.
1200+	High	Infestations very likely, canola fields should be sampled frequently for larvae and for evidence of damage.

The Alberta Insect Pest Monitoring Network produces annual insect forecast maps available on Alberta Agriculture's website at: http://agriculture.alberta.ca/bugs-pest

The risk assessment provides an early warning signal for producers and agronomists to scout fields for larvae and determine if economic thresholds are surpassed.

Larval populations: field scouting

Regular monitoring of bertha armyworm larvae will allow early detection and minimize crop losses. Larval monitoring should begin about two weeks after peak trap catches and continue until either the mean number of larvae per square metre exceeds the economic threshold (at which point the crop is sprayed) or 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 fields may also have different-sized larvae, depending on when the eggs were laid.

For accurate larval estimates in a crop, monitor for larvae when plants are in the early pod stage. Count the number of larvae in a 0.25 square metre area in at least 5, but preferably in 10 to 15 different locations in the field with each area being a minimum of 50 metres apart. A three-sided frame can be used to define the area to be sampled.

Plants within each sampling unit should be shaken by hand, then the soil surface examined for larvae; earthen lumps and plant debris should be moved to expose hidden larvae. Do not rely on headland sampling alone (20 metres), and do not sample areas within the crop that are not representative of the field. Experience has shown that fields with highly variable topography need to be sampled more carefully and thoroughly.

Refer to Chapter 3 of the Canola Council of Canada's Canola Grower's Manual for descriptions of canola crop staging.

Multiply the average number of larvae per 0.25 square metre by 4 to get the average 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.

Economic thresholds

When to take action

Insecticide application is recommended when bertha armyworm larvae are sufficiently abundant so that the value of the crop they consume is greater than the cost of controlling them. This number is called an economic threshold. Twenty larvae per square metre in canola can reduce yields by 1.16 bushels per acre in the crop.

The economic threshold for bertha armyworm varies with the cost of the insecticide, the method of application and the crop's value. Using crop values and application costs,

Table 2 indicates the larval density (larvae per square metre) at which an insecticide treatment in canola would be warranted.

Table 2. Economic threshold for Bertha armyworm larvae											
	Expected seed value ($/bushel)										
Spraying cost ($/acre)	6	7	8	9	10	11	12	13	14	15	16
	Number of larvae per square metre										
7	20	17	15	13	12	11	10	9	9	8	8
8	23	20	17	15	14	13	11	11	10	9	9
9	26	22	19	17	16	14	13	12	11	10	10
10	29	25	22	19	17	16	14	13	12	11	11
11	32	27	24	21	19	17	16	15	14	13	12
12	34	30	26	23	21	19	17	16	15	14	13
13	37	32	28	25	22	20	19	17	16	15	14
14	40	35	31	27	24	22	20	19	17	16	15
15	43	37	32	29	26	23	22	20	19	17	16

Source: Originally developed by Bracken and Bucher. 1977. Journal of Economic Entomology. 70:701-705". Revised by Manitoba Agriculture, Food and Rural Initiatives to reflect current crop value and spraying costs.

For example, the economic threshold would be reached and spraying could provide an economic return if larval counts were more than 19 per square metre (as shown in a highlight in Table 2) given a crop price of $353 per tonne ($8.00/bu) and a spray cost of $22 per hectare ($9.00/ac).

Under drought conditions, where bertha armyworm feeding is concentrated on canola pods by early leaf drop, economic thresholds may be lower than indicated. Dividing the economic thresholds by 1.48 may give more appropriate economic thresholds under drought conditions.

Economic thresholds for bertha armyworm in flax have not been determined.

Control

In most years, bertha armyworm is controlled naturally by biological or environmental factors.

Environmental control

Environmental conditions have a significant effect on bertha armyworm populations, especially on the overwintering pupae. During harsh winters in snow-free fields, most bertha armyworm pupae die. Bertha armyworm outbreaks appear to be favoured by snow accumulation, which protects pupae from prolonged exposure to temperatures below minus 10 C.

The trend toward reduced tillage and stubble conservation results in more snow accumulation on infested fields and could favour bertha armyworm survival, especially in years with early snowfall.

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

Biological control

In Canada, two parasitoids are effective native parasites of bertha armyworm:

- an ichneumonid wasp (*Banchus flavescens*)
- a tachinid fly (*Athrycia cinerea*)

Banchus flavescens lays its eggs in the first to third larval instars and kills mature larvae after they enter the soil to pupate. *Athrycia cinerea* lays eggs on the third to sixth instar larvae, and the emerging parasitoid larvae immediately burrow into the bertha armyworm larvae. The parasitoids presence in a crop does not indicate, however, that control measures are unwarranted.

A nuclear polyhedrosis virus also attacks bertha armyworm.

These natural enemies often do not destroy larvae until after considerable crop damage has occurred. The greatest effect on bertha armyworm is found a year or two after the peak of an outbreak, which is probably why severe infestations only last two or three years.

Because natural enemies help control outbreaks, insecticide application to control bertha armyworm should only be conducted when the economic threshold is reached. This practice helps preserve natural enemies by eliminating unnecessary insecticide applications that will kill beneficial insects.

Chemical control

Chemical control is the producer's last line of defense against the bertha armyworm. For best results, apply an insecticide as soon as economic thresholds are reached. A single, well-timed application of any registered insecticide applied with aerial or high clearance ground equipment is usually effective.

Ensure that pre-harvest intervals are observed so that Maximum Residue Limits (MRLs) remain below export requirements. Check labels for registered crops.

Please refer to Alberta Agriculture and Rural Development's current *Crop Protection* guide (Blue Book), Agdex 606-1, for products registered for bertha armyworm control. See Alberta Agriculture's website at: http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/All/agdex32

For best chemical control:

- The larvae should be at least 1.3 cm long.
- Apply the insecticide early in the morning or late in the evening when the larvae are actively feeding. 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.
- Use the higher label rates of application when a range is indicated.

To avoid killing foraging honeybees, delay insecticide applications until after the crop has finished blooming. If this timing is not possible, use the least harmful (to bees) insecticide to control the bertha armyworm larvae, and apply during the evening.

Cultural control

Bertha armyworm populations can be manipulated to reduce crop loss. Methods include planting alternative crops, effective weed control, early swathing and fall cultivation.

Fall cultivation can kill many bertha armyworm pupae by mechanical damage. 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.

Effective control of weeds such as lamb's quarters and wild mustard can reduce bertha armyworm infestations in flax, peas, lentils and sugar beets. Larvae will feed first upon these weeds and then move onto these crops after the weeds have been destroyed.

Best management practices

- Use risk assessment maps as a regional early warning sign to scout fields for larvae. These maps are available on the Alberta Insect Pest Monitoring Network website at: http://agriculture.alberta.ca/bugs-pest.
- Monitor larval numbers in the early pod stage (stages 5.1-5.2) in each field as adjacent fields may have very different larval densities laid.
- Twenty larvae per square metre in canola can reduce yields by 1.16 bushels per acre. Use economic threshold levels to determine if spraying is warranted.
- Under drought conditions, dividing the economic thresholds by 1.48 may give more appropriate economic thresholds under drought conditions.
- Allow beneficial insects to prey on bertha armyworm by only spraying when economic thresholds are reached.
- Observe pre-harvest intervals.

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