

AGRI-FACTS

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Diamondback Moth

Diamondback moth, *Plutella xylostella* (L.), was introduced to North America from Europe about 150 years ago. The insect now occurs throughout North America, wherever its host plants are grown.

Diamondback moth larvae feed on all plants in the Brassicaceae family, and in Alberta, canola and mustard are its primary targets.

Background

Diamondback moth adults may overwinter in the prairies, but most infestations occur when adult moths arrive on wind currents in the spring from the southern or western United States or northern Mexico.

Although the diamondback moth occurs each year throughout the Canadian prairies and north central United States, the severity of the infestation varies considerably from year to year depending on the arrival time and population size of spring migrants. In some years, the pest has caused many millions of dollars in lost revenue.

Life cycle

The diamondback moth takes about 32 days to develop from egg to adult, but this timing can vary from 21 to 51 days depending on the environment and available food sources. Diamondback moth can have up to four generations per year on the prairies. Generations usually overlap, and all four life stages (egg, larva, pupa and adult) may be present in the field at the same time.

Early arrival combined with favourable environmental conditions can produce a larger population buildup and result in greater crop damage.

Adults

The adult moth is approximately 8 to 9 mm long with a wing span of 12 to 15 mm. At rest, the moth folds its wings over the abdomen in a tent-like manner. The folded wings flare upwards and outward at the tips. The wing tips are fringed with long hairs. Moths will flutter up out of the canopy when the canopy is disturbed.

The forewing margins have a series of yellow wavy markings. When the wings are folded while the moth is at rest, these markings come together to form three yellow diamonds, hence the name "diamondback."

Adult females lay an average of 160 eggs during their life span of about 16 days. Egg-laying occurs at night. The greatest number of eggs are laid the first night after emergence, and egg-laying continues for about 10 days.

Most canola crops will not have emerged when the migrant diamondback moth adults arrive from the United States.

These adults will lay eggs on cruciferous weeds and volunteer canola.

Eggs

Eggs are oval, yellowish-white and tiny. They are glued to upper and lower leaf surfaces singly or in groups of two or three, usually along the veins or where the leaf surface is uneven. The eggs hatch in four to eight days.

Larvae

Immediately after hatching from the egg, first-instar larvae burrow into the leaf and begin mining the leaf tissue internally. The three subsequent larval instars feed on the surface of leaves, buds, flowers and pods. Each instar has a duration of approximately 4 days, but the larval stage can range from 10 to 21 days depending upon temperature and the availability of food.

This insect pest can cost many millions of dollars in lost revenue.

The larvae are pale yellowish-green to green caterpillars covered with fine, scattered, erect hairs. The posterior end of the caterpillar is forked. At maturity, the larvae are cigar-shaped and about 12 mm long.

The diamondback moth larva is easily identified by its peculiar reaction to being disturbed. It will wriggle backward violently and may drop from the plant, suspended by a silken thread. After several seconds, the larva will climb back onto the leaf and continue feeding.

Pupae

Larvae pupate in delicate, white, open-mesh cocoons attached to the leaves, stems or seed pods of the host plant. Initially, the pupae are light green, but as they mature, they become brown as the adult moth becomes visible through the cocoon. The pupal stage lasts from 5 to 15 days, depending on environmental conditions.

Host plants and damage

Host plants of diamondback moth include all plants in the Brassicacea family. This group includes canola, mustard and the vegetable cole crops such as broccoli, cabbage, cauliflower and kale.

Crop damage is caused by the larval stage. Diamondback moth larvae feed on any green tissue of canola and mustard plants but prefer leaves. The amount of damage varies greatly, depending on plant growth stage, larval density and larval size.

Diamondback moth larvae have caused crop damage as early as the first true-leaf stage of the crop. This situation was seen in some areas in the 2012 crop year when diamondback moth adults arrived early. However, most crop damage occurs later in the growing season.

An arrival time of moths in mid-May can enable the species to complete three or four generations by the time crops are in the pod development stages and most vulnerable to attack.

Larval feeding damage to canola leaves is usually considered to have a minor effect on yield, but larval feeding on buds and flowers can be more damaging, especially when plants are under abiotic stress (e.g., drought) and cannot compensate by producing new buds and flowers.

In the pod stages, when leaves dry up, larvae move to stems and pods, where they remove surface tissue. The seeds within a damaged pod will not fill completely, and pods may shatter, resulting in yield loss. Larvae may also chew into pods and eat the developing seeds. In prairie fields under severe attack by diamondback moth, yield losses can be extreme.

Monitoring

Overwintering diamondback moths were found in central Alberta in the early 1990s. Adults have also recently been found in spring emergence traps in Saskatchewan and have been collected very early in spring in Manitoba. However, the numbers of these early specimens is low, and it is likely that very few diamondback moths survive prairie winters.

A wind trajectory modelling project is now implemented annually during the growing season and integrates a network of sentinel sites with pheromone traps. To assess the population, a network of 27 monitoring sites has been established across Alberta. This network is meant to act as part of an early warning system for diamondback moth and should be used in conjunction with crop scouting.

These traps can sometimes predict the potential for crop damage, and trap counts can provide an early warning of a possible infestation. Environmental conditions will determine how many eggs are laid and whether the larvae emerge and survive.

The diamondback moth forecast map can be found at Alberta Agriculture and Rural Development's Alberta Insect Pest Monitoring Network website at: <http://agriculture.alberta.ca/bugs-pest>

Larvae

Producers should sample diamondback moth larvae by removing the plants in an area measuring one-tenth of a square metre area (about 1 square foot), beating the plants on a clean surface and then counting the number of larvae dislodged from the plants. Repeat this procedure in at least five locations in the field to obtain an average count. Crops should be sampled at least twice a week during the growing season.

Economic thresholds

When to take action

A nominal threshold of 25 to 33 per cent defoliation, with larvae still present on plants, can be applied for canola at seedling stage.

The nominal threshold when control is required in canola is if larvae exceed 100 to 150 per square metre (1 - 2 larvae/plant) in immature to flowering plants and 200 to 300 per square metre (2 - 3 larvae/plant) in plants with flowers and pods.

Thresholds at all crop stages may be lower for Polish type canola than for Argentine type canola and higher for mustard.

Control

Environmental control

Cool, windy weather reduces adult activity, and females often die before they lay all their eggs. Heavy rainfall can drown small larvae and reduce numbers by more than half. Humid conditions within the crop following a rainfall can promote the spread of fatal fungal diseases throughout the diamondback moth population.

Biological control

Diseases, parasites and predators affect diamondback moths.

Entomophthorales fungi cause natural disease outbreaks in diamondback populations. These outbreaks usually occur late in the growing season when populations are high. The rate of infection of diamondback moth larvae can be high enough to limit the development of additional generations late in the season.

In western Canada, three species of parasitic wasps attack the diamondback moth. *Diadegma insulare* (Cresson) and *Microplitis plutellae* (Muesebeck) attack the larval stages while the third species, *Diadromus subtilicornis* (Gravenhorst), attacks the prepupal and pupal stages.

Diadegma insulare is considered the most important parasitoid. It does not survive prairie winters and migrates northward with the diamondback moth. In Alberta, *D. insulare* parasitized 45 per cent of diamondback moth individuals in 1992; by comparison, *M. plutellae* and *D. subtilicornis* were each responsible for approximately 15 per cent of the parasitism.

Microplitis plutellae has a widespread distribution in North America, overwinters in western Canada and can be present early in the season to parasitize hosts.

Flies, wasps, lacewings, plant bugs, pirate bugs, beetles, spiders and birds also prey on the diamondback moth larvae.

Chemical control

Despite the abundance of potential biological control agents, the only effective way of controlling a diamondback moth outbreak once the population exceeds the economic threshold is to apply an insecticide. After an infestation is controlled at the podding stage, a new infestation is not likely to become established because of the rapid advance of the crop toward maturity.

Insecticide selection will depend on cost, environmental conditions, days to harvest, availability of product, the presence of other pests and the presence of pollinating insects. Consult Alberta Agriculture and Rural

Development's *Crop Protection* (Blue Book), Agdex 606-1, for up-to-date references to pesticides. Check Alberta Agriculture's website at: [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex32](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex32)

Always consult the product label for appropriate rates and application guidelines.

Insecticides should always be applied with enough water to ensure adequate coverage. Use high water volumes and label rates when the crop canopy is dense.

Avoiding insecticide application to flowering crops can minimize injury to honeybees and other pollinating insects.

Cultural control

Pre-seed weed control and tillage reduce the availability of cruciferous weeds and volunteer canola host plants, preventing the successful establishment of first generation larvae when moths arrive before canola emergence.

Best management practices

- Early season control of Brassicaceous weeds including volunteer canola helps to eliminate host plants for early arriving diamondback moth.
- Use the Alberta Insect Pest Monitoring Network to guide crop scouting activities.
- Scout for early arriving diamondback moth and larvae damage on seedlings.
- In July and August, monitor crops at least twice per week, scouting for larvae.
- The nominal threshold when control is required in canola is if larvae exceed 100 to 150 per square metre (1 - 2 larvae/plant) in immature to flowering plants and 200 to 300 per square metre (2 - 3 larvae/plant) in plants with flowers and pods.
- Minimize the effect on beneficial insects by using economic thresholds to ensure insecticide application is made only when warranted. Anecdotal evidence shows that beneficial insects have kept most diamondback moth infestations below economically damaging levels.

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