

Caterpillar Pests in Cole Crops

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A variety of caterpillars cause damage in Michigan cole crops. The three most significant species are the imported cabbageworm (*Pieris rapae*, Lepidoptera: Pieridae), the diamondback moth (*Plutella xylostella*, Lepidoptera: Plutellidae) and the cabbage looper (*Trichoplusia ni*, Lepidoptera: Noctuidae). These three species are commonly found on cole crops such as cabbage, cauliflower, broccoli, collards, turnips, radishes, kale, mustards and other leafy greens.

Identification

Imported cabbageworm. Eggs are yellow and conical, laid individually on the leaf surface and occasionally on the stem. An adult butterfly can lay 300 to 400 eggs in her lifetime. The imported cabbageworm caterpillar is dark green with fine hairs covering the body, which create a velvety appearance (Figure 1). Large larvae begin to develop a yellow stripe on the upper surface of the body, which is clearly visible on the final larval developmental stage. Maximum length for the imported cabbageworm is approximately 1 inch. This caterpillar is commonly found along the veins of leaves and easily blends into the foliage. As an adult, the imported cabbageworm is a white butterfly with black markings on the wing tips. The adult is commonly referred to as the cabbage white butterfly (Figure 2).



FIG. 1. The body of the imported cabbageworm caterpillar is covered with fine hairs, which give it a velvety look. The color of the caterpillar matches that of the leaf; when scouting, look for signs of fresh damage and frass on the plants. A closer look will reveal the caterpillar feeding on the leaf.



FIG. 2. Adults of the imported cabbageworm are commonly seen flying above plants throughout the summer. These white butterflies can be recognized by the black markings on the wing tips. Female butterflies lay eggs during the course of their life on cole crops and feed on pollen and nectar.

Diamondback moth. Eggs are tiny, flat, circular and cream-colored. They are laid in small clusters on the leaves. A single diamondback moth can lay as many as 188 eggs over 4 days. The diamondback moth larva is pale green or yellow-green, and by the time it's ready to pupate, it is approximately 1/2 inch long. The body of the caterpillar appears segmented and tapered at the ends (Figure 3). The head capsule is black during the early developmental stages. As the caterpillar develops, the head capsule turns yellow-green but remains distinguishable from the rest of the body. The diamondback moth caterpillar is commonly found on the leaf surface. The adult diamondback moth is a 1/2-inch-long tan moth with brown, diamond-shaped markings on the wings, visible when the wings are folded over the back at rest (Figure 4).

Cabbage looper. Eggs are round and white and typically laid on the leaf surface. The cabbage looper is a pale green caterpillar with a white stripe down each side of the body (Figure 5). The cabbage looper reaches 1 to 1 1/2 inches in length and has a distinctive pale green head capsule. It gets its name from its inchworm motion as it moves along the surface of the leaf. Cabbage looper adults are about 1 inch long, with wings folded over the back at rest. Adults are dark brown and gray moths, with a distinct figure "8" white pattern in the middle of the wings (Figure 6).

Behavioral differences between the caterpillars can help with identification. When disturbed, the imported cabbageworm will usually remain motionless. On the other hand, the diamondback moth will wiggle its body around. The cabbage looper will either inch away or will try to defend itself by whipping its head toward the source of the disturbance.

Life Cycle

Cabbageworm. This insect overwinters in the pupal stage, and adults emerge in the spring. Eggs of the imported cabbageworm hatch in about five days. The caterpillar feeds and develops for approximately 11 to 20 days before forming a pupa from which the adult butterfly emerges after 6 to 11 days. In Michigan, an estimated 4 to 5 generations can occur.

Diamondback moth. In Michigan, the pupae overwinter in field debris, and adults emerge in the spring or early summer. Diamondback moth adults can also arrive in Michigan on wind currents; eggs and larvae can be transported with seedling transplants. The eggs of the diamondback moth hatch in 5 to 6 days. The larvae feed for about 18 days, and then they pupate in a loosely woven net. Finally, the adult moth emerges after 4 to 15 days. In Michigan, an estimated 4 to 5 generations can occur.

Cabbage loopers. Cabbage loopers migrate northward on wind currents from southern states, so they often arrive in Michigan later in the growing season. Larvae emerge from eggs within a few days and develop for 16 to 19 days before pupating. The pupa turns from initially green to dark brown, and the adult emerges 9 to 10 days later. The entire life cycle lasts 32 to 37 days, allowing for one to two generations to develop in a typical Michigan season.



FIG. 3. The larva of the diamondback moth is light green and segmented with tapering ends. The caterpillar spends its life feeding on the leaf.



FIG. 4. The adult diamondback moth is a small (1/2 inch) brown insect, with characteristic diamond-shaped markings on the wings, visible when they are folded over the back at rest.



FIG. 5. The cabbage looper caterpillar is a pale green insect with a white stripe down each side of the body. The cabbage looper reaches 1 to 1 1/2 inches in length and has a distinctive pale green head capsule. It gets its name from its inchworm motion as it moves along the surface of the leaf.

Damage

All of the caterpillars cause damage by chewing holes in the leaves (Figure 7). The imported cabbageworm feeds along the edges of leaves, leaving only thick veins behind. It feeds on all ages of leaves but prefers the younger leaves.

The cabbage looper will often feed on the underside of leaves, feeding only on the first layers of leaf tissue. After the plant's immune system is weakened, the looper begins chewing into the leaf, forming holes. A good indicator of the presence of loopers and imported cabbageworms is fresh frass (droppings) on leaves.

Young diamondback larvae mine in the plant tissue and consume only the middle layer of the leaves. As larvae grow, they exit the leaves and consume all the tissues except the thin layer of transparent wax. This type of damage resembles windowpanes and is characteristic of this pest.

Control

Cultural

Heavy rainfall or overhead irrigation systems can remove and kill some caterpillars. Removing debris from the field eliminates overwintering habitat for pests. Rotating crops can also eliminate overwintering populations by removing their food source the next season.

Removal of weeds closely related to cole crops, including mustards such as field mustard (*Sinapsis arvensis*), removes an additional food source for these caterpillars. It also prevents them from establishing populations before the cultivated crops are transplanted into the field.

Caterpillar Pests in Cole Crops

Planting floral sources near cole crops provides pollen and nectar sources for beneficial insects and can increase biological control. Buckwheat around the edges of fields can provide a good nectar source.

Intercropping can also contribute to pest population reduction. Intercropping is planting two or more crops side by side in a field, such as potato and broccoli. Intercropping often reduces pest abundance because it decreases the concentration of the food source within a field, making the field less attractive to colonizing insects.

Natural enemies

Parasitoids: *Cotesia rubecula* is a small, dark parasitic wasp that attacks young imported cabbageworm caterpillars. This wasp lays an egg into a caterpillar, where it hatches into a larva and feeds on its host. The parasitoid kills the host caterpillar when it reaches its final developmental stage; then it emerges and forms a white pupa on the outside of the caterpillar (Figure 8). Although the parasitized caterpillar can feed on the plant until it reaches its final larval developmental stage, it dies before it can develop into a reproductive adult.

Diadegma insulare is another small parasitic wasp that attacks diamondback moths. They also develop inside their caterpillar hosts, and the adults emerge from the diamondback moth pupae. The caterpillar can feed and develop, but it cannot become an adult, and it cannot go on to reproduce.



FIG. 6. Cabbage looper adults are about an inch long, with wings folded over the back at rest. Adults are dark brown moths with a distinct figure “8” white pattern in the middle of the wings.



FIG. 7. Caterpillar damage on cabbage: holes chewed into the leaves and head.



FIG. 8. White parasitoid pupa attached to its imported cabbageworm caterpillar host.

Tachinid flies, such as *Voria ruralis* and *Compsilura concinnata*, are common parasitoids of the cabbage looper. As in the case of the *Diadegma insulare*, the caterpillar can feed and develop, but it cannot become an adult, and it cannot go on to reproduce.

Predators: In addition to parasitoids, predators also reduce caterpillar populations. Predators that consume caterpillar eggs and larvae include the spined soldier bug, minute pirate bug, spiders, harvestmen, ground beetles, lacewing larvae and lady beetles, such as the pink-spotted lady beetle (Figure 9).

Chemical

The beneficial insects described above can be conserved by avoiding the use of broad-spectrum insecticides, especially early in the season when pest pressure is low. Selective insecticides, such as products containing *Bacillus thuringiensis* (*Bt*), are safe to natural enemies and therefore recommended for use. *Bt* products are most effective when applied to small caterpillars. These insecticides have a one-day preharvest interval. There are *Bt*-resistant populations of diamondback moths, but at this time we have not confirmed any cases from Michigan. The other two caterpillar species are not known to develop resistance to *Bt*. Other insecticide options that allow natural enemies to survive include products that contain spinetoram, novaluron or methoxyfenozide. Spinetoram has a broad-spectrum knockdown action; it controls multiple growth stages and provides residual control.

Caterpillar Pests in Cole Crops

Novaluron and methoxyfenozide are both insect growth regulators: they stop insects from developing through their normal life stages. These insecticides are more effective on small caterpillars. Methoxyfenozide has a one-day and novaluron a seven-day preharvest interval. Broad-spectrum insecticides are also available for use in cole crops. Many of these are applied to control other pests but will also be effective against caterpillars.



FIG. 9. Pink-spotted lady beetle adult is a predator commonly found in Michigan cole crop fields. These insects feed on the eggs and small larvae of cabbage pests.

The development of insecticide resistance can be avoided by rotating insecticide classes between applications and by using appropriate application rates. One of the cornerstones of insecticide resistance management is to avoid using rates that allow some insects to survive and pass their ability to overcome toxic effects to the next generation. Regular scouting and the use of treatment thresholds can lower the number of chemical applications while maintaining clean and healthy plants.

Scouting thresholds for caterpillars in cole crops

Crop	Stage	Percent plants infested	
		Imported cabbage- worm, cabbage looper	Diamondback moth
CABBAGE	Transplant to cupping	50% with more than 5 larvae per plant	30%
	Cupping to early head	50% with more than 5 larvae per plant	20%
	Early head to harvest	10% with more than 1 larva per plant	
BROCCOLI, CAULIFLOWER	Seedbed	10%	10%
	Transplant to first curl	40%	20%
	First curl to harvest	10%	10%

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