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Tomato Hornworm
Tobacco Hornworm
(*Manduca quinquemaculata* and *Manduca sexta*)

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What You Should Know

- Tomato and tobacco hornworms are the larval stages of the five-spotted hawk moth and Carolina sphinx moth.
- Hornworms feed on leaves, stems, blossoms, and fruits of host plants.
- Hornworms are managed by careful monitoring, hand-picking, and insecticides.
- In Utah, hornworms reach peak population in mid-summer.

Tomato and tobacco hornworms are closely related species that cause similar damage to the same host plants. Both are equivalent in size and appearance. **Tomato hornworms** are the larval stage of the **five-spotted hawkmoth** (*Manduca quinquemaculata*) and **tobacco hornworms** are the larval stage of the **Carolina sphinx moth** (*Manduca sexta*). Tomato and tobacco hornworms can both be found throughout Utah attacking host plants.

HOSTS

Host plants of both species include members of the Solanaceae family such as tomato, pepper, potato, eggplant, along with various nightshade flowering plants. Additionally, tobacco is also targeted by tobacco hornworm.

IDENTIFICATION

Larvae of both species have five pairs of prolegs (fleshy abdominal limbs of a caterpillar), are a cylindrical shape, and are 4 inches long at maturity. The tomato hornworm is green with eight, white "V" markings along its back, pointing toward the head. At the end of its abdomen is a notable black tail spine (Fig. 1).

Fig. 1. Tomato hornworm (*Manduca quinquemaculata*)

Fig. 2. Tobacco hornworm (*Maduca sexta*)

The tobacco hornworm is also green, but has seven diagonal white stripes with black margins along its body, and a distinctive orange-red tail spine (Fig. 2).

At the adult stage, the five-spotted hawkmoth (tomato hornworm) has a wingspan of up to 5 inches (13 cm). The wings are gray and brown with large front wings and small hind wings marked with a zigzag pattern. The moth's abdomen is brown and white with a row of five yellow spots along each side (Fig. 4).

The Carolina sphinx moth (tobacco hornworm) has a wingspan up to 4 inches (10 cm). The wings are narrow with a gray, brown, and white pattern. On the abdomen are six yellow spots along each side (Fig. 5).

Both moths have long, coiled, tube-like mouthparts, which are used to extract nectar. They typically fly in the evening, hovering over flowers. In flight, they may be mistaken as hummingbirds.

Hornworm eggs are spherical in shape and 1.5 mm in diameter, ranging in color from white to a light green.

The pupa (chrysalis) is 2-3 inches long and dark brown. A noticeable feature is the "handle" structure in which the moth's mouthparts will develop.

Look-alike caterpillars are the larvae of the white-lined sphinx moth (*Hyles lineata*). This caterpillar is primarily found on fruit and ornamental plants and will rarely be seen attacking vegetable crops. Tomato Fruitworms (*Helicoverpa zea*) are found on the same host crops but are significantly smaller.

LIFE CYCLE

Both tomato and tobacco hornworms have the same life cycle (egg, larva, pupa, and adult) and both can have either one or two generations per year in Utah (Fig. 3).

The hornworms overwinter in the ground as pupae. In mid-spring, adults emerge and mate. This adult stage usually lasts 2 to 3 weeks.

In late spring and early summer, females of both species lay clusters of eggs on either the upper or underside of leaves. Females can lay up to 1,000 eggs. Eggs hatch within 4 to 8 days, depending on weather conditions.

The hornworm larva starts feeding immediately upon hatching, and grows throughout the summer as it undergoes 5-6 instars, reaching maturity within 3-4 weeks. The larva then drops to the soil near the base of the plant, burrows 4-6 inches down and pupates. A second generation of adults emerges about 2 weeks later.

SIGNS & SYMPTOMS

Hornworm larvae have chewing mouthparts, and primarily feed on the host plant's foliage. In their final instar and high populations, they can cause significant economic damage to crops. Hornworms will begin consuming the upper leaves first, and slowly move downward to lower leaves (Fig. 7). Loss of foliage may decrease fruit production and increase the risk of sunscalded fruit. Larvae also feed on fruits, blossoms, and stems when foliage runs out or populations are high (Fig. 6).

Fig. 3. Hornworm eggs (top left). First instar larvae hatching (top rght). Larvae burrowing into the soil to begin pupation (bottom left). Hornworm pupa (bottom right).

Fig. 4. Five-spotted hawkmoth (*Manduca quinquemaculata*), the adult stage of the tomato hornworm.

Fig. 5. Carolina sphinx moth (*Manduca sexta*), the adult stage of the tobacco hornworm.

Fig. 6. Hornworm feeding on skin and flesh of tomato fruit.

Fig. 8. Tomato plant defoliation caused by tomato hornworm.

Fig. 7. Substantial defoliation on tomato plant caused by a single tomato hornworm.

MONITORING

Monitoring is important because hornworm larvae can easily blend in with the foliage, so they may not be detectable until after damage has begun to occur.

Begin monitoring in early July before hornworm populations reach their peak in mid-summer. Larvae tend to hide during the day, so scout in early morning or evening.

Tomato plants are typically a good host plant to initially check in fields and gardens. Shake a portion of the plant over paper or cardboard to dislodge any larvae.

Inspect a selection of plants for feeding damage on the newer foliage. Look on the foliage and ground for dark green-black frass pellets (excrement), which will be plentiful even with a few larvae present.

MANAGEMENT

There are a variety of integrated pest management strategies for tomato and tobacco hornworms that can reduce, remove, and prevent pest populations. These options include mechanical, cultural, biological, and chemical practices.

For homeowners or gardeners with a small number of plants, handpicking caterpillars from the plant and submerging them in soapy water can quickly reduce damage. Another option is a light trap for the adult moths. Setting these up in the spring near the growing site can capture and kill moths when they emerge, this method may be more practical in commercial sites as a way to monitor population thresholds.

One method of cultural control is tilling soil in spring or fall to disrupt and destroy overwintering pupae and reduce their population for the following season.

There are many insects that contribute to natural biological control. Lady beetles (Coccinellidae) and green lacewings (Chrysopidae) prey on hornworm eggs. Paper wasps (Vespidae) will feed on many small caterpillars in gardens including early instar hornworm larvae.

Braconid wasps (Braconidae) are another important natural enemy, specifically *Cotesia congregatus* that parasitizes hornworms. This parasitoid lays its eggs inside hornworms. The eggs hatch and the wasp larvae then feed on the inside of the caterpillar. Mature wasp larvae then emerge from inside the caterpillar, and attach themselves to the hornworm's body, where they pupate as white cocoons (Fig. 9). This process ultimately kills the hornworm. If you find a parasitized hornworm, it is best to let it be. This will allow the wasp life cycle to continue.

Pesticides are typically not necessary in small gardens, but could be considered as an option for large field production. There are a variety of organic and conventional insecticides available for both home and commercial growers (see Table 1).

Fig. 9. Parasitized hornworm covered in pupae from the **braconid wasp,** Braconidae.

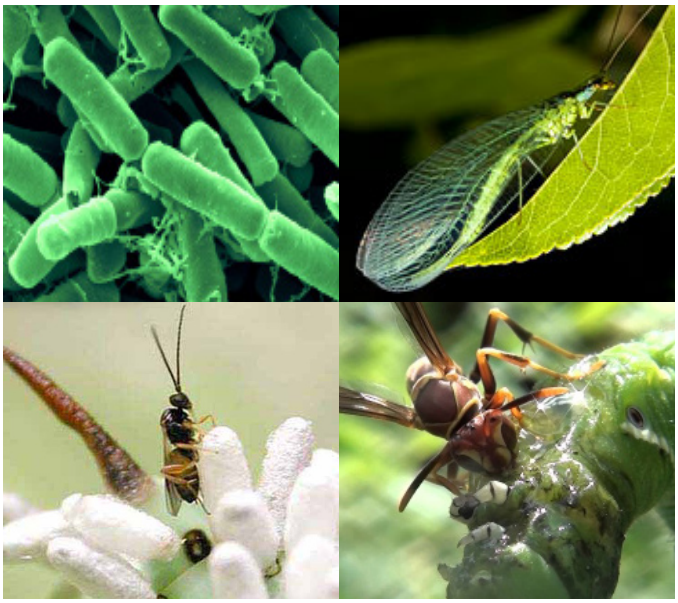

Fig. 10. Biological control agents for hornworms: ***Bacillus thuringiensis*** bacteria that forms toxic crystals during sporulation is often found in pesticides (top left). **Green lacewing** (Chrysopidae) (top right). **Braconid wasp** (*Cotesia congregata*) (bottom left). **Paper wasp** (Vespidae) consuming a hornworm (bottom right).

Examples of effective HOME use and COMMERIAL insecticides registered in Utah.

Use	Active Ingredient	Brand Name	MoA*	Residual (Days)	Notes
Home	zeta-cypermethrin	Garden Tech Sevin	3A	3	
Home	spinosad	Bonide Captain Jack's Deadbug[B], Monterey Garden Insect Spray[OB], Natural Guard Spinosad Spray[OB]	5	4	
Home	*Bacilus thuringiensis* (subspecies *kurstaki*)	Bonide Thuricide[OB], Safer Caterpillar killer with Bt[OB], Natural Guard Caterpillar Killer w/ Bt[OB], Dipel Dust[OB], Garden Safe Bt Worm and Caterpillar Killer[OB]	11A	5-7	Only effective on young caterpillars (less than 0.5 inch)
Commercial	*Bacillus thuringiensis* (subspecies *aizawai* strain)	XenTari[OB]	11A	3	Only effective on young caterpillars (less than 0.5 inch)
Commercial	carbaryl	Sevin, Carbaryl	1A	3	
Commercial	spinosad	Entrust[O], Success	5	5-7	
Commercial	fenpropathrin	Danitol[R]	3	7	
Commercial	emamectin-benzoate	Proclaim[R]	6	7	Effective on eggs and small caterpillars.

*Mode of Action (MoA) is a classification number based on guidelines from the Insecticide Resistance Action Committee. Rotate among insecticide classes to reduce the development of resistance.

[O] Organically certified insecticide products.
[R] Restriced use products that require an applicator license.
[B] Biological pesticide

Note: All brand names are registered trademarks. Examples of brands may not be all-inclusive, but are meant to provide examples of insecticides registered on vegetables in Utah. The availability of insecticides and active ingredients in brands can change. Always check the label for active ingredient(s), registered use, application and safety information, and protection and pre-harvest intervals.

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