Tobacco Hornworm, *Manduca sexta* (Linnaeus), and Tomato Hornworm, *Manduca quinquemaculata* (Haworth), (Insecta: Lepidoptera: Sphingidae)[1]

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Introduction

Tobacco and tomato hornworms are common large caterpillars that defoliate tomato plants. Their large size allows them to strip a plant of foliage in a short period of time, so they frequently catch gardeners by surprise. They are quite similar in appearance and biology.

Figure 1. Newly hatched tobacco hornworm, *Manduca sexta (Linnaeus)*, larva and egg.
Credits: James Castner, UF/IFAS

Distribution

The tobacco hornworm is more common in the southern United States, especially the Gulf Coast states. Its range extends northward to New York. The tomato hornworm, in contrast, uncommon along the Gulf Coast, is more likely to be encountered in northern states. However there is some overlap in the ranges of the tobacco and and tomato hornworm, and they may appear together on the same plant.

Description

Eggs: Hornworm eggs are spherical to oval in shape, measure about 1.50 mm in diameter, and vary in color from light green to white. Eggs are deposited principally on the lower surface of foliage, but also on the upper surface. Duration of the egg stage is two to eight days, but averages five days.

Larva: The larva is cylindrical in form and bears five pairs of prolegs in addition to three pairs of thoracic legs. The most striking feature of the larva is a thick pointed structure or "horn" located dorsally on the terminal abdominal segment. The tobacco hornworm (Figure 1) develops seven straight oblique whitish lines laterally. The white lines are edged with black on the upper borders, and the "horn" is usually red in color (Figure 2). The tomato hornworm (Figure 3) is superficially similar, but instead of the seven

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oblique lateral bands it bears eight whitish or yellowish "V"-shaped marks laterally, and pointing anteriorly (Figure 4). The "V"-shaped marks are not edged in black. Also, in tomato hornworm the "horn" tends to be black in color. There normally are five instars, but occasionally six are observed. Corresponding mean larval body lengths are 6.7, 11.2, 23.4, 49.0, and 81.3 mm, respectively. Larval development time averages about 20 days.

Figure 2. Larva of tobacco hornworm, *Manduca sexta* (Linnaeus).
Credits: James Castner, UF/IFAS

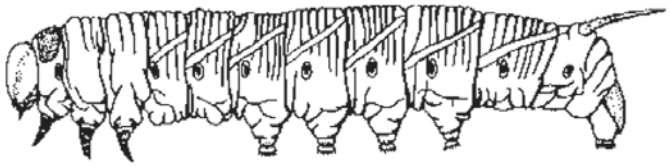

Figure 3. Tobacco hornworm larva.

Figure 4. Last instar larva of the tomato hornworm, *Manduca quinquemaculata* (Haworth).
Credits: Paul M. Choate, UF/IFAS

Figure 5. Tomato hornworm larva.

Pupa: Mature larvae drop to the soil at maturity and burrow to a depth of 10 to 15 cm, where they form a pupal cell. The pupa is large and elongate-oval in form, but pointed at the posterior end. It measures 45 to 60 mm in length. The pupa bears a pronounced maxillary loop, a structure which encases the mouthparts. The maxillary loop in tobacco hornworm (Figure 5) extends back about one-fourth the length of the body, whereas in tomato hornworm it is longer, usually extending for about one-third the length of the body (Figure 6). The color of the pupa is brown or reddish brown (Figure 7). Duration of the pupal stage is protracted and variable.

Figure 6. Prepupa of the tomato hornworm, *Manduca quinquemaculata* (Haworth).
Credits: Paul M. Choate, UF/IFAS

Figure 7. Newly formed pupa of the tomato hornworm, *Manduca quinquemaculata* (Haworth).
Credits: Paul M. Choate, UF/IFAS

Figure 8. Late pupa stage of the tomato hornworm, *Manduca quinquemaculata* (Haworth).
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Adults: The adults of both species are large moths with stout, narrow wings, and a wing span of about 100 mm. The forewings are much longer than the hind wings. Both species are dull grayish or grayish brown in color, though the sides of the abdomen usually are marked with six orange-yellow spots in tobacco hornworm (Figure 8) and five spots in tomato hornworm (Figure 9). The hind wings of both species bear alternating light and dark bands.

Figure 9. Adult tomato hornworm, *Manduca quinquemaculata* (Haworth).
Credits: John Capinera, UF/IFAS

Figure 10. Adult tobacco hornworm, *Manduca sexta* (Linnaeus).
Credits: John Capinera, UF/IFAS

Life Cycle

The number of annual generations is three to four in northern Florida, but two generations per year is common over most of the range of these species. The proportion of insects that enter diapause, which occurs in the pupal stage, increases from about 5% in June to 95% in mid-August, as day length decreases. In northern Florida the insects are active from April to November, but they are abundant only for the first two generations because many pupae enter diapause. The life cycle can be completed in 30 to 50 days, but often is considerably protracted due to cold weather or diapause.

Host Plants

These insects feed only on solanaceous plants, most commonly on tomato and tobacco. They have been recorded on other vegetables such as eggplant, pepper, and potato, but this is rare. Several *Solanum* spp. weeds are reported to serve as hosts. Adults imbibe nectar from flowers of a number of plants, and can be seen hovering about flowers at dusk.

Damage

Larvae are defoliators, usually attacking the upper portion of plants initially, and consuming foliage, blossoms, and green fruits. They usually consume the entire leaf. Because the larvae of hornworms attain such a large size, they are capable of high levels of defoliation. About 90% of the foliage consumption occurs during the final instar. Larvae blend in with the foliage and are not easy to detect. Thus, it is not surprising that they often are not observed until they cause considerable damage at the end of the larval period. Hornworms are not considered to be pests of commercial crops in Florida and only occasionally damage garden crops, probably due to the activities of natural enemies.

Figure 11. Defoliation of a tomato leaflet caused by tobacco hornworm, *Manduca sexta* (Linnaeus).
Credits: James Castner, UF/IFAS

Figure 12. Damage to tomato fruit caused by tobacco hornworm, *Manduca sexta* (Linnaeus).
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Management

Insecticides: Chemical insecticides or the bacterial insecticide *Bacillus thuringiensis* are applied to the foliage for larval suppression (Creighton et al. 1961). The mature caterpillars are difficult to kill, so young larvae should be targeted. For additional information on chemical control, consult the Florida Insect Management Guide:

Insect Management in Tobacco (http://edis.ifas.ufl.edu/IG066)

Insect Management in Tomatoes, Peppers and Eggplant (http://edis.ifas.ufl.edu/IN169).

Cultural practices: The pupae are large and not buried very deeply in the soil, so greater than 90% mortality is caused by normal soil tillage practices. Hand picking and destruction of larvae is often practical in the home garden.

Moths are attracted to light and can be captured in light traps. Light traps have been used to attempt suppression of hornworm populations, and although some reduction was noted, this approach has not proved practical.

Biological control: Natural enemies of these pests are abundant (Figure 10). *Polistes* spp. wasps prey on the larvae and several wasp parasitoids (e.g., *Trichogramma* spp., *Cotesia congregata*, *Hyposoter exigua*) are sometimes effective. In Florida, *Trichogramma pretiosum* was released to control larvae at a rate of 378,000/acre at 3-day intervals and high levels of egg parasitism were attained.

Figure 13. Even though it is still capable of movement, this hornworm larva is already "dead." The white capsules on its back, frequently mistaken for "hornworm eggs" by many gardeners, are actually Hymenopterous wasp pupae of the Braconidae family. These wasps fed on the hornworm while in the larval stage and are now pupating into adults. When home gardeners find hornworms in this stage, they should let them be as they are not capable of more damage. And when they emerge, the adult wasps will hunt for other hornworms to parasitize.
Credits: UF/IFAS

To take advantage of the preference of *Polistes* wasps for hornworm larvae, wasp shelters or nesting boxes have been placed in tobacco fields to encourage the wasps, and wasp colonies were relocated to tobacco fields. Although wasp predation was inadequate in preventing damage to tobacco, this approach might be satisfactory for tomato crops.

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