

Bollworm: *Helicoverpa zea*

The bollworm has long been an important pest of cotton. Unlike the tobacco budworm, which is largely a 'secondary pest', bollworm is more appropriately considered a 'major pest'. This is because large numbers often develop in corn fields and then move to cotton in July as corn becomes unattractive. Because of this mass movement from corn to cotton, bollworms can reach treatable levels in cotton in July, even though few or no bollworms were present in cotton fields in June.

Although the damage potential of individual bollworm larvae is similar to that of tobacco budworm larvae, bollworms were considered to be relatively less important than tobacco budworm during most of the latter half of the 20th century, because they were relatively easy to control. This was because bollworms in Mississippi did not, and still have not, develop resistance to organophosphate and synthetic pyrethroid insecticides that were used to control the bollworm/budworm complex. In contrast, tobacco budworm was often very difficult and costly to control, because of the high levels of resistance that it developed to these classes of chemistry.

However, since the development and introduction of transgenic Bt-cotton in 1996, the overall importance of bollworm has increased considerably, because bollworm is much more tolerant to the Bt toxin than is tobacco budworm. Bt cotton, which is currently planted on approximately 80% of Mississippi's cotton acreage, currently provides essentially 100% control of tobacco budworm. But, although Bt cotton also provides significant control of bollworms, supplemental foliar insecticide sprays are occasionally required to keep bollworms from causing excessive damage in Bt fields. During the past six years, the average number of bollworm treatments applied to Bt fields in Mississippi has ranged from 0.27 to 1.22 treatments per field. Still, this is considerably lower than the 2.44 to 5.18 sprays per field that were applied to control bollworm/tobacco budworm on non-Bt fields over this same time period.

Biology: Like all moths, bollworms have a complete life cycle. The female moths produce from 800 to 1000 eggs during an oviposition period that lasts approximately 8 to 12 days. Eggs are deposited singly and, in cotton, may be found on young leaves and other tissue in the terminal, as well as deeper in the canopy on square bracts, blooms, dried bloom tags, and other areas. The eggs hatch in three to five days; the larval stage lasts 12 to 15 days (longer when temperatures are cool), and there are five to six larval instars. Pupation occurs in the soil near the host plant on which the larva developed. Pupal chambers are usually one to two inches deep and the pupal development period requires approximately 8 to 12 days. Female moths produce a mating pheromone, which is attractive to male moths. Most mating occurs within two to three nights of adult emergence and egg-laying begins soon afterward.

Bollworm has a wider host range than tobacco budworm, and this is thought to be one of the major reasons that it has been slower to develop insecticide resistance than tobacco budworm. The larger host range means that there is a larger "refuge population". During the early spring the primary hosts are similar to those of tobacco budworm: vetches, lespedezas, wild geranium, and several clovers. However bollworm also develop on a number of monocot, or grassy, plants, including corn and sorghum, and these are major hosts for bollworm during late spring and early summer. Generally, bollworms will produce two generations on these crops, one in the whorl stage and one in the ear or head stage. As these crops mature in July, cotton becomes one of the more abundant and more attractive hosts. Soybean is also an important host of bollworms, but it is relatively uncommon to find tobacco budworms in soybeans. A portion of the July and early August generations may lay eggs on other hosts, but, where it is available, cotton is one of the most common hosts during this time. As cotton senesces in the fall, some of the maturing larvae may enter diapause and pupate in the cotton field. However, many larvae will not enter diapause

at this time, and the moths that result from these larvae will complete an additional generation on alternate weedy hosts. These fall hosts are similar to those used by tobacco budworms, and include: prickly sida, hophornbeam copperleaf, velvet leaf, beggar weed, and some morning glories. Like tobacco budworms, bollworms overwinter in the pupal stage. Although bollworms generally emerge from overwintering later than tobacco budworm, bollworm moths can be caught in pheromone traps as early as March, which is before overwintering tobacco budworm emerge. These early catches are thought to represent migrating moths, which emerged in more southerly regions of the country. Bollworm moths are strong fliers and are known to be able to travel as far as 250 miles in a single night, via high altitude, wind assisted flights.

Damage: Bollworm larvae feed on both squares and bolls. However, damage to bolls is considered to be the most serious type of injury. Heavy, uncontrolled infestations are capable of inflicting severe yield losses. Although Bt cotton is much less susceptible to injury than is non-Bt cotton, boll damage as high as 30% has been observed in Bt fields where damaging infestations of bollworms were not controlled. During the recent years estimated yield losses attributed to the bollworm/tobacco budworm complex have ranged from 1.9 to 4.2%. Because most of Mississippi's cotton acreage is planted to Bt varieties, which currently provide near 100% control of tobacco budworm, the majority of this yield loss is attributed to bollworms.

Control: As mentioned previously, bollworms are generally more susceptible to foliar applied insecticides than are tobacco budworms. However, because larger larvae spend most of their time feeding inside squares and bolls, where they are protected from exposure to insecticides, it is important that foliar insecticide treatments be applied while larvae are still small, less than ½ inches in length. Also, bollworm moths often tend to deposit their eggs deeper in the crop canopy, which makes insecticide coverage more difficult. During the boll-setting period, treatment is recommended on non-Bt cotton when larval numbers reach or exceed 4 per 100 plants. The threshold is similar for Bt cotton, with the important exception that, in Bt-cotton, larvae smaller than 1/8 inch should not be counted. This criterion prevents unnecessary treatment of newly hatched larvae that would be controlled by the Bt toxin. The table below lists the foliar-applied insecticides recommended for control of bollworms.

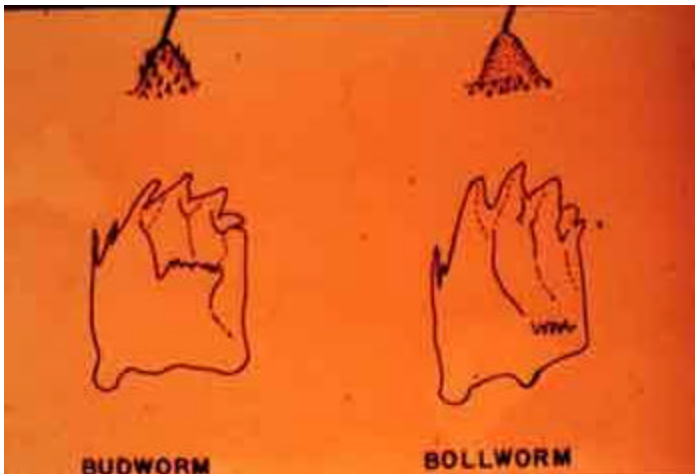
Table 10: Foliar Insecticides Recommended for Control of Bollworms

| Insecticide | Trade Name | Lbs ai/acre |
|---------------|------------|----------------|
| Bifenthrin | Capture | 0.06 to 0.1 |
| Cyfluthrin | Baythroid | 0.025 to 0.05 |
| Cyhalothrin | Karate | 0.025 to 0.04 |
| Cypermethrin | Ammo | 0.04 to 0.1 |
| Deltamethrin | Decis | 0.02 to 0.03 |
| Esfenvalerate | Asana XL | 0.03 to 0.05 |
| Zetamethrin | Fury | 0.033 to 0.045 |
| Methomyl | Lannate | 0.45 |
| Indoxacarb | Steward | 0.09 to 0.11 |
| Spinosad | Tracer | 0.067 to 0.089 |
| Thiodicarb | Larvin | 0.6 to 0.9 |
| Profenofos | Curacron | 1.0 |

Source: Cotton Insect Control Guide, 2003, Publication 343, Mississippi State University Extension Service



Bollworm/Tobacco Budworm: Although bollworm and tobacco budworm are two distinct species, the larvae can be difficult to distinguish. Both are robust, variously colored caterpillars that feed on cotton fruit.



One of the best ways to distinguish between these two species of caterpillars is to check for the presence of an extra tooth on the inner surface of the mandible, a character that is present in tobacco budworm but absent in bollworm. However, this method is difficult to use with small caterpillars. The moths, on the other hand, are easy to distinguish.



The **tobacco budworm moth** has three distinct diagonal stripes on each wing



The **bollworm moth** is larger, buff tan in color, and usually has a distinct dark spot in the center of each front wing.



Both species deposit their **eggs** individually. Eggs are most commonly deposited on the upper surface of developing leaves, but eggs are laid on many other locations on the plant as well.



Small larvae of both species are most commonly found feeding in terminals or squares



Larger larvae are most often found feeding in bolls.



Both species form their **pupae** in the soil, which is also the stage and site in which overwintering occurs.