

Fall Armyworm in Cotton

Spodoptera frugiperda (J.E. Smith)

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Description

There are two host strains of fall armyworm. The rice strain is associated with rice, Bermuda grass, and other pasture grasses. The other strain is the corn strain which predominates on corn, sorghum and cotton. Other than feeding habits, these strains are indistinguishable unless using molecular identification techniques. The fall armyworm is a tropical insect and can overwinter only in southern Texas, except during mild winters. The adult migrates northward as temperatures increase in the spring. The adult fall armyworm is a dark brownish-gray, mottled moth with oblique markings near the center of the fore wing. There is an irregular white or gray patch near the wing tip on the males. Female moths are darker than males. The hindwing is white in females with a pearly or pink luster and a brown border. The wing span of the fall armyworm is approximately 1 ½ inches.

Fall armyworm eggs are similar to those of the beet armyworm. They are laid in masses of 50 to 150 for 8 to 10 days. Similar to other armyworm species the eggs are covered with hairs and scales from the female's body. The eggs are difficult to find and are distributed throughout the plant (both sides of leaves). Approximately 3 to 5 days are required for the eggs to hatch. The larva of the fall armyworm, when newly hatched, is white with a black head. Early instar fall armyworms disperse into a solitary feeding habit more rapidly than beet armyworms. First and second instar larvae are very difficult to distinguish from other armyworm species and bollworms. As feeding progresses, the larva becomes darker. Young fall armyworms often curl up on a leaf or suspend from a silken thread. Larvae will feed for 2 to 3 weeks and can be 1 to 1½ inches long with various color patterns depending on the food source. However, they are usually greenish-brown with a white line below the top of the back, usually a brownish-black stripe above the midline and a pale stripe with a reddish-brown tinge below. The most distinct character used to distinguish fall armyworms from other caterpillar pests is the prominent white inverted "Y" on the front of the head. Additionally, fall armyworm larvae can be distinguished from beet armyworms by the presence of black hairs on the body; these hairs may cause confusion with bollworms. The fall armyworm larva also has four large spots that form a square on the upper surface of the last segment of its body. Pupation occurs in the ground near the cotton plant and usually requires 1 to 2 weeks.

Damage

Depending on the strain of fall armyworm encountered, damage may be non-existent to severe.



Prominent “Y” of the front of the head (top), and the distinctive four large spots forming a square on the last body segment (bottom) of a late instar fall armyworm

Although rare, the rice strain has been observed dispersing as larvae from pasture into cotton where they fed exclusively on grassy weeds. The corn strain, however, can be extremely damaging. Fall armyworms that feed on cotton are typically more damaging than other armyworm species infesting cotton because they have a greater propensity to feed upon fruiting structures. However, they do not appear to be as voracious of fruit feeders as bollworms. When abundant in pre-bloom cotton, fall armyworms may cause defoliation but the greatest damage comes from the topping off plants. Branches may be cut off and sometimes the stalks may almost be completely severed. The most damaging populations of fall armyworms are those that occur during boll filling. Because fall armyworms tend to quickly disperse away from the egg mass, and because the egg masses are often laid inside the plant canopy, it is not uncommon to find small larvae individually feeding on squares and bolls much like a bollworm. Also, similar to bollworms, it is not unusual to find small larvae feeding under bloom tags. Because they exhibit a cryptic feeding behavior similar to that of bollworms, they are easy to miss and often become most evident when observed feeding in blooms.



Fall armyworms can often be found feeding in bloom of Bt and non-Bt cotton

Fall armyworms are occasionally observed in fairly high numbers feeding on blooms in *Bt* cotton. Blooms do not produce the *Bt* toxins at a high enough level to induce mortality. There have been a number of instances where these larvae appeared able to complete their entire life cycle feeding exclusively on blooms without causing significant boll damage or pollination issues.

Management and decision making

Currently, the most effective means to control fall armyworms is to plant *Bt* cotton. Third generation *Bt* cottons with three toxins (Bollgard 3, WideStrike 3, TwinLink Plus) develop lower fall armyworm populations compared with second generation *Bt* cotton. However, areas with heavy fall armyworm pressure may occasionally require treatment.

Field monitoring is important in *Bt*-cotton because fall armyworm populations may develop, particularly on blooms and late in the season on stressed cotton where the *Bt* toxin production may be compromised. Thresholds in *Bt* cotton fields are based upon surviving second and third instar larvae and not newly hatched larvae. Newly hatched larvae must feed on the plant for the *Bt* toxin to be effective so, decision making is delayed until survivorship of larger larvae can be determined. Since large acreages of cotton in Texas, particularly in the South Plains and Panhandle, are still planted in varieties that do not contain the *Bt* genes, these fields may become infested with fall armyworms.

Planting date and varietal maturity can influence losses due to fall armyworms. Fall armyworm

populations are usually at their highest level late in the season. Early planting and/or choosing an earlier maturing variety can often avoid the late-season worm populations. Additionally, the attractiveness of other crops in the landscape can influence abundance of fall armyworms in cotton. When corn or sorghum are still attractive to fall armyworms, it is not uncommon for these crops to act as trap crops, attracting large numbers of fall armyworms and yet leaving nearby cotton fields virtually untouched.

Irrigation and fertilization can affect fall armyworm infestations by affecting the attractiveness of the plant to egg laying females. Avoiding excesses fertility and post cutout irrigation can drastically reduce the number of eggs laid in a cotton field.

Biological control. There are a vast number of general predators and parasitoids that prey on fall armyworm eggs and larvae. Common predators include big-eyed bugs, minute pirate bugs, damsel bug, lacewing larvae, assassin bugs, spiders, lady beetles and Collops beetles. When possible, avoid treating cotton with broad-spectrum insecticides that will negatively impact the beneficials that prey on insect pests.

Scouting.

Small fall armyworms are very difficult to distinguish from bollworms and budworms, and unless these larvae are found feeding in a mass they should be included with the bollworm/budworm counts and the thresholds used should be cumulative with the bollworms and budworms. As for bollworms, it is often necessary to thoroughly go through the entire plant. Fall armyworms are cryptic feeders, often concealed by square bracts and bloom tags. Fall armyworms tend to be most noticeable when feeding in blooms.

When larger, distinguishable worms are detected, it is important to note whether they are bollworm/budworms, fall, beet or yellow striped armyworms because control tactics between armyworm, bollworm/budworms or mixed populations will differ. Bollworms and budworms can still be controlled with pyrethroids on the Texas High Plains, which are generally weak against armyworms. When mixed populations of armyworms and bollworms are encountered, it may be necessary to use tank mixes of insecticides to achieve adequate control of multiple species.

In Bt cotton, the entire plant should be searched for tobacco budworm, bollworm, and fall armyworm larvae and injury. A proper sample includes squares, white blooms, pink blooms, bloom tags and bolls. Scouting intervals should be reduced to 3 to 4 days during periods of increasing egg laying, especially during peak bloom. **Treatment should not be triggered by the presence of eggs alone as hatching larvae must first feed on the cotton plant to receive a toxic dose.**

Terminal/square inspection method. Divide the cotton field into four or more manageable sections depending upon field size and examine 25 plant terminals (upper third of the plant), selected at random from each quadrant, for small larvae and eggs. Also, from each quadrant, examine 25 one-half grown and larger green squares, and small, medium and large bolls for worms and worm damage. Keep track of the number of undamaged and damaged squares and bolls. Fruit should be selected at random and flared or yellow squares should not be included in

the sample. Pay attention to bloom tags on bolls, these will often hide larvae which burrow into the tip of the boll.

Whole plant inspection method. Divide the cotton field into four or more manageable sections depending upon field size. Make whole plant inspections of five randomly chosen groups of three adjacent cotton plants in each section. This entails looking in every square, bloom and boll. Particular attention should be paid to dried blooms attached to the bolls (sometimes called “bloom tags”). Count the number of undamaged and damaged fruit, and calculate percent damaged fruit.

Chemical control and action thresholds.

Thresholds are based on how many worms survive to late first or second instar larval stage, not on newly hatched larvae or the presence of eggs. In both non-Bt and Bt cotton fields, predation of newly hatched larvae is often quite high. In Bt cotton, newly hatched larvae must feed on the plant before the Bt toxins take effect. So, in both Bt and non-Bt cotton, base your decision on damaged fruit and the presence of larvae.

Bollworm/Tobacco Budworm/Fall Armyworm Action Threshold Based on Boll Damage

Cotton stage	Action threshold (both Bt and non-Bt cotton)
Before bloom	≥ 8 worms (≥1/4 inch) per 100 plants or when populations threaten to reduce square retention below 80 percent
After boll formation	≥ 6% damaged squares and/or bolls and worms are present

Fields that have accumulated 350 DD60s beyond 5 NAWF are no longer susceptible to first or second instar bollworm/tobacco budworm larvae. Action thresholds should be adjusted according to yield potential and production system (dryland vs irrigated).

Suggested Insecticides and Rates for Managing Fall Armyworm in Cotton

Insecticide (Trade name)	Lb active ingredient per acre	Amount of formulated per acre	Acres treated per gal or lb of formulated	Mode of Action Group (*IRAC)
Chlorantraniliprole (Prevathon)	0.047-0.09	14-27 fl oz	9.14-4.74	28
Indoxacarb (Steward EC)	0.09-0.11	9.2-11.3 fl oz	14-11.5	22A
Methomyl (Lannate LV)	0.45-0.68	24-36 fl oz	5.5-3.5	1A
Acephate ¹ (Orthene 97)	0.974	16 oz	8	1B
Spinosad (Blackhawk)	0.054-0.072	2.4-3.2 fl oz	6.67-5	5

¹rates will vary depending on product and formulation.

*IRAC = Insecticide Resistance Action Committee (1A = Carbamate, 1B = Organophosphates, 5 = Spinosyn, 22A = Oxadiazines, 28 = Diamide)