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ENY-666

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Sugarcane Borer in Florida[1]

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The sugarcane borer, *Diatraea saccharalis*, is one of the most important of the above-ground pests of sugarcane in Florida. Although this insect's principal host is sugarcane, other grasses including rice and corn have been reported as alternative hosts.

Biology

The life cycle of the sugarcane borer includes four main stages of development - the egg, larval, pupal and adult stages. The adult is nocturnal and seldom seen. It is a straw-colored moth with one inch wing span. The forewings are marked with black dots in a V-shaped design. There are wide variations in reports about how many eggs the females lay. A good approximation is 200 to 300 creamy white eggs laid in clusters of 25 to 30 on the leaves. Generally, the adult female moth deposits eggs (Figure 1) on the underside of a leaf in the upper half of the sugarcane plant canopy.

Figure 1. An adult female sugarcane borer moth and its eggs. Credits: David Hall, USDA

The larval stage is the most familiar and causes the damage to sugarcane (Figure 2). Larva emerge from eggs as a yellowish-white, brown-spotted caterpillar only about 1/16 of an inch long. It migrates immediately into the tight whorl, or spindle, of the plant or feeds its way into a midrib or leaf sheath. The larvae molt 5 to 7 times depending upon climatic conditions during their growth. After undergoing its first molt, larvae in the whorl often tunnel across the unfurled tender leaves of the whorl resulting in a pattern of small "pin-holes" straight across the leaf when it unfurls (Figure 3).

Early instar larvae feed on the leaves, leaf sheaths or, briefly, on the outer surface of the stalk. Later instar larvae tunnel in the internodes of the

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Figure 2. Larva of the sugarcane borer. Credits: David Hall, USDA

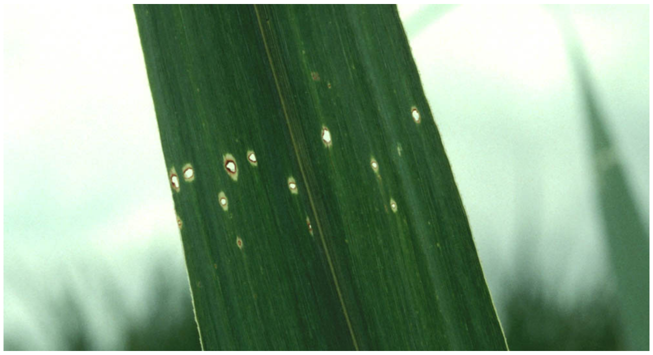

Figure 3. Pin-hole damage by sugarcane borer larva. Credits: David Hall, USDA

stalk. Finally, after having reached a length of about an inch, the larva molts into the inactive pupal stage within the stalk. Over the following five to seven days it metamorphosizes into an adult. The newly emerged adult leaves the stalk through an exit hole, mating takes place, and the cycle is repeated. There may be as many as six generations per year with the average generation - egg to adult - requiring around 40 to 45 days in the summer. Generation time varies with temperature, being shorter at higher temperatures.

Damage

Borer-infested stalks will be found in the vicinity of leaves with pin-hole damage. Infested stalks may have small larvae behind leaf-sheaths, or the larvae may have already bored into stalks. A hole with fresh frass (light-brown fibrous waste material) is a good indication of an infested stalk (Figure 4). The most important damage caused by the sugarcane borer is the result of tunneling within the stalk (Figure 5 & 6). This can cause a significant loss of stalk weight (tonnage/acre) and sucrose yield. Also, the borer's tunneling into the stalk allows points of entry for secondary invaders including fungal, bacterial, and viral disease organisms. Plants with bored internodes can produce 45% less sugar than undamaged ones. If the tunneling is extensive, death of the terminal growing point of the plant ("dead-heart") may result. Also, weakened stalks are more subject to breaking and lodging.

Figure 4. Signs of a stalk infested by a sugarcane borer larva. Credits: David Hall, USDA

Figure 5. Sugarcane stalk damaged by a tunneling sugarcane borer. Credits: David Hall, USDA

All varieties of sugarcane currently grown in Florida are susceptible to sugarcane borer infestation, but they exhibit significant variation in damage and yield losses. One study of five commercial varieties showed that an average of one bored internode per stalk reduced sugar yield by an average of 5.6 lb/ton of sugarcane. The range of loss was from 2.3 lb/ton to 6.7 lb/ton for the different varieties examined. One interesting observation is that certain regions of the Everglades Agricultural Area, where most of Florida's sugarcane is grown, seem to be considerably less prone to borer infestations. Environmental explanations are presumed, but definite reasons are not clear.

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Figure 6. Sugarcane stalks not damaged (left) and damaged by sugarcane borer (right). Credits: David Hall, USDA

Scouting

An integrated pest management (IPM) program consisting of several well-balanced components is recommended. A good IPM program will provide effective borer control and increase profits without harming the environment. Several Florida sugarcane growers have been using formal IPM programs for many years. The most important part of an IPM program for sugarcane borers is regular scouting. Scouting, in conjunction with a reliable sampling plan, is necessary to detect infested fields and estimate the infestation level within these fields. A regular scouting program will also increase the chances of detecting other pests that may be damaging the crop. Fields should be scouted every two or three weeks from March through November. One Florida sugarcane company scouts each 40 acre field in at least 4 locations. At each location, 5 stalks are randomly sampled from each of 5 stools spaced 10 feet apart (5 stalks/5 stools/location). It is desirable to detect borers before they tunnel in stalks, as control measures, if necessary, can then be applied before any damage to stalks occurs. Good signs that plants are infested are pinholes in leaves, tiny holes into midribs, holes into stalks, and frass at these holes. An infestation of borers can not be positively identified until the sugarcane borers are actually observed. Examine leaves, the whorl, and behind leaf-sheaths. Split stalks to detect borers tunnelling inside stalks. Detecting 2 to 3 live larvae per 100 sampled stalks is generally thought to be enough to cause economic damage, a level called the economic threshold.

Biological Control

Alabagrus stigmatera and *Cotesia flavipes* are important wasp parasitoids of the sugarcane borer larvae in Florida. *Alabagrus* is active all year long while *Cotesia* is usually most active after July. *Cotesia* is the most important parasitoid. Eggs of these endoparasites (parasites that grow within the host) are injected directly into the borer larvae. *Alabagrus stigmatera* is a large, solitary (one per host) parasite, whereas *Cotesia flavipes* is a small, gregarious (many per host) parasite. Whenever the economic injury threshold is approached, sugarcane borer larvae from a field should be dissected to determine the level of parasitism. If 50% or more of the sugarcane borer's larvae are parasitized, insecticides are not recommended. Insecticide applications may harm the parasite population without gaining additional control of the sugarcane borer. Sugarcane borer larvae from a sampled field can be collected and later dissected with a small knife and tweezers; borers parasitized by *Cotesia* will contain 20 to 30 or more white parasitoid larvae with a large bulb at the tip of their abdomen (Figure 7) while borers parasitized by *Alabagrus* will contain one large, more slender parasitoid larva (Figure 8). Borers parasitized by *Cotesia* die within two weeks, at which time the parasitoid larvae exit the cadaver (Figure 9) and form a mass of pupae collectively resembling a cotton ball (Figure 10). Adult parasitoids emerge several days later and go out in search of more borer larvae to parasitize. Augmentative releases of *Cotesia* parasitoids has been shown to be highly effective for managing the sugarcane borer in sugarcane within Florida, Brazil and Costa Rica.

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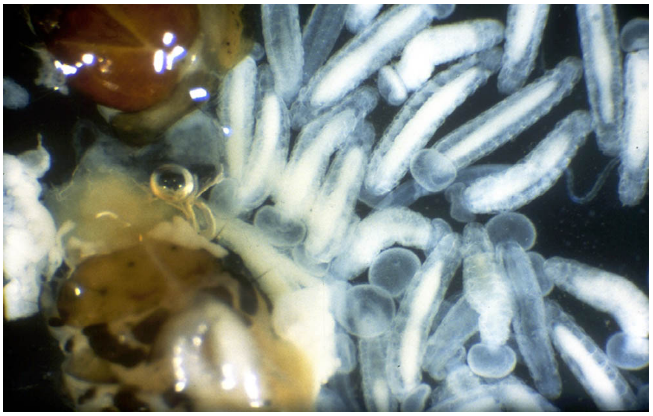

Figure 7. *Cotesia* parasitoid larvae observed during dissection of a sugarcane borer larvae. Credits: David Hall, USDA

Figure 8. *Alabagrus* parasitoid larva observed during dissection of a sugarcane borer larvae. Credits: David Hall, USDA

Figure 9. Dead borer larva and emerging *Cotesia* larvae. Credits: David Hall, USDA

Cultural Practices

It is economically advantageous to use varieties that exhibit resistance to infestation and damage. Varieties highly susceptible to the sugarcane borer

Figure 10. Cotton-like pupal mass formed by *Cotesia.* Credits: David Hall, USDA

are eliminated during the process of developing new varieties for commercial release. Varieties resistant to sugarcane borers were identified in joint projects between USDA plant breeders and entomologists in Florida and Louisiana during the late 1970s. Subsequent research by these two breeding programs have identified clones even more resistant to borers. While the resistance mechanism of these clones is not known, one Florida researcher (O. Sosa) found that a clone with dense leaf pubescence (leaf surface hairs) reduced adult borer egg laying and larval mobility, as well as yellow sugarcane aphid reproduction. To date, commercial clones with leaf pubescence have not been made available for commercial release.

Besides growing varieties that show at least moderate resistance, the destruction of infested cane trash and stubble in infested fields and the use of seed pieces free of borer damage are important cultural control tactics.

Chemical Control

In an IPM program, insecticides should be used as a supplement to other control methods. Minimal use of insecticides will help preserve the parasites and predators beneficial for biological control. Also, minimal use of insecticides reduces the chance of the insect building up a resistance to the chemical. Insecticides are most effective against borer larvae before they feed their way into stalks. Although less effective against larvae after they are inside stalks, insecticide treatments may be worthwhile if infestation levels are large and parasite activity is low. Even non-systemic insecticides may kill some borers inside the stalks since these larvae move

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outside of stalks in the process of cleaning their tunnels.

Table 1 lists the insecticides presently labeled for the control of the sugarcane borer in Florida.

Table 1. Chemical control for sugarcane borers in Florida.

Commercial Insecticide	Active Ingredient (ai)	Rate Per Acre	Comments
Asana XL	esfenvalerate	5.8 -9 .6 oz	Wait >= 21 days till harvest
Bathroid 2 (2EC)	cyfluthrin	2.1 oz	Wait >= 15 days till harvest
Confirm 2F	tebufenozide	6.0 - 8.0 oz	Wait >= 14 days till harvest
Dipel ES	*Bacillus thuringiensis* subspecies *kurstaki*	2 - 6 pints	
Furadan 4F	carbofuran	1.5 pints	Wait >= 17 days till harvest
Karate with Zeon	lambda-cyhalothrin	1.6 - 2.56 oz	Wait >= 21 days till harvest
Mustang Max	zeta-cypermethrin	3 - 4 oz	Wait >= 21 days till harvest
Proaxis	gamma-cyhalothrin	3.2 - 5.12 oz	Wait >= 21 days till harvest
As with all agricultural chemicals the user must **read and understand all the label instructions** prior to use. Use all pesticides only as directed by the label. Insect populations and crop response to insecticide applications should be monitored closely in order to develop the most efficient and effective insect pest control program for each particular situation.			

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