The Benefits of Insecticide Use: Sweet Corn

Corn Earworm Moth

Fall Armyworm Larvae

Insect Damaged Sweet Corn

Spraying Sweet Corn

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Leonard Gianessi
Key Points

- The Florida sweet corn industry did not exist until modern insecticides were developed for worm control.
- More than 90% of the sweet corn ears would be damaged by worms in Florida without insecticide sprays.
- Each female earworm lays as many as 3000 eggs on sweet corn plants.
- Florida sweet corn is sprayed with insecticides 10-12 times which reduces insect damage to 3% or less.

Technical Summary

Modern sweet corn cultivars arose in the nineteenth century when a single gene mutated in field corn. Plants descended from this mutant had kernels with a sugary, rather than a starchy, endosperm and a creamy texture. Sweet corn also has a thinner seed coat than field corn, making it more tender.

Florida ranks number one nationally in the production and value of fresh market sweet corn, typically accounting for 25% of both national sweet corn production and of U.S. cash receipts for fresh sales. A total of 564 million pounds of fresh sweet corn valued at $101 million is produced annually on 40,000 acres in Florida.

Florida’s warm humid climate is ideal for the development of pest populations [1]. Corn earworm and fall armyworm are two of the most important insect pests of sweet corn in Florida. Damage occurs when the larvae of these two pests eat the kernels. Corn earworm initially feeds on the silk, then tunnels downward, leaving a trail of damage and waste that often ruins the entire ear. Fall armyworm causes similar damage, though larvae may enter ears by burrowing through the husks on the side [2]. Corn earworm has a wide host range and is also known as the cotton bollworm and tomato fruitworm [3]. Fall armyworms overwinter in south Florida and are capable of damaging sweet corn throughout the growing season that lasts from August until June.

USDA standards require sweet corn receiving the grade of “U.S. Fancy” have less than 10% of the ears injured by smut, decay, worms, insects, rust, discoloration, birds or other means. Most growers consider 2% to be the maximum amount of fall armyworm or corn earworm damage that they can tolerate [4].

Sweet corn is grown in Florida in successive overlapping crops from late August to mid June. Female earworm moths are attracted to the silks for egg laying. Corn earworm eggs are deposited on the silks, and newly-hatched larvae have ready access to the silk channel route to the kernels. Each female earworm lays from 500 to 3,000 eggs. As the earworm larvae mature, they become very aggressive, killing and cannibalizing other larvae. Masses of fall armyworm eggs are laid on various parts of the plant and larvae from these eggs find their way to the silks and other parts of the corn [5]. Each armyworm moth may lay over 1,000 eggs in total.
The fall armyworm is reported to be susceptible to viruses, fungi, protozoa and nematodes. These pathogens vary in their occurrence, distribution and pathogenicity. Some have been observed only as infections that occur in the laboratory [6]. Initiation and development of natural controls of fall armyworms are guided by a complex of factors, including environmental conditions. By the time the conditions become favorable for natural enemies, the fall armyworm has already increased to enormous populations and migrates [7]. For example, despite causing high levels of mortality in some populations, diseases typically appear too late to alleviate high levels of defoliation. Therefore, biological control at this time is not a feasible economical control strategy.

Partial resistance to fall armyworm is present in some sweet corn cultivars, but it is inadequate for complete protection [8].

Three mechanisms of resistance (tolerance, non-preference and antibiosis) have been reported for corn in relation to corn earworm. The long tight husks of some corn cultivars provide some tolerance. In some studies, when larvae were given a choice, or even placed on the silks of certain resistant cultivars, more than 90% of the larvae preferred to move to susceptible silks or to leave resistant silks in search of other hosts or plant parts [9]. For some cultivars, the presence of maysin, a flavone glycoside, retards earworm growth and is primarily responsible for the chemical basis of resistance or antibiosis.

Prior to the development of DDT in the 1940’s, Florida was considered an unlikely place for growing sweet corn. Control of insects was economically prohibitive. The first commercial production of sweet corn in Florida was reported in the 1947-48 season after the introduction of DDT. Research determined that DDT sprays would result in 96% worm-free ears in comparison to only 2% worm-free in untreated plots [16]. A great expansion in sweet corn production occurred in Florida in the 1950’s after the introduction of DDT for insect control [10] (Figure 1). The establishment of sweet corn in Florida is attributed largely to successful control of insects with the new insecticides [16]. Per capita consumption of sweet corn increased dramatically in the period following the introduction of DDT (Figure 2).

Growers were making 10-14 applications of DDT dust at one to two day intervals at a rate of 30-50 pounds of dust per acre per application [15]. DDT was used to prevent earworm damage to Florida sweet corn until the 1960’s when it was replaced by the use of organophosphate insecticides [10]. Research with the organophosphates showed that 97% of the ears were worm-free in comparison to 7% in the untreated plots [17].

Other insecticides recommended for sweet corn use in Florida in the early 1950’s included chlordane and toxaphene [12]. In the 1960’s, the recommendations included methyl parathion and carbaryl [13]. Methomyl’s first inclusion in the recommendations occurred in 1971.

Once the first silks appear, most growers initiate a rigorous insecticide spray program. In southern Florida, a typical fall armyworm control program for a sweet corn variety that takes 21 days from first silks to harvest would include at least ten sprays during the silking period to control any fall armyworm that survived pre-silking insecticide applications and have not yet entered the plant [4]. Because fall armyworm larvae feed deep in the whorl of growing corn
plants, a high volume of liquid insecticides is required to obtain adequate penetration. Granular insecticides also are applied over the growing plants because the granules fall deep into the whorl [8]. Repeated sprayings are necessary due to the short time period for incubation of earworm eggs (24 to 36 hours) and due to the rapid rate of silk elongation.

98 to 99% of Florida’s sweet corn acreage is treated annually with insecticides. 10 to 12 sprays are made to each acre. Out of a total production cost of $4000/A, insecticides cost Florida sweet corn growers $300/A [20].

The American Farm Bureau has estimated that without the use of insecticides, no commercial sweet corn production would exist in Florida because of the severe insect damage to the ears [18].

References


Figure 1. Florida Sweet Corn

Figure 2. U.S. Sweet Corn Consumption