

Sustainable Agriculture

Protecting Sweet Corn from the Corn Earworm with Vegetable Oil and Btk

Sweetcorn is one of the most popular treats from the garden and an easy crop to grow for farmers accustomed to raising field corn. Unfortunately, sweetcorn isn't easy to grow well because of the worms that often infest the ripe ears. At least three moths lay their eggs on sweetcorn, the European corn borer (*Ostrinia nubilalis*, Hübner), the fall armyworm (*Spodoptera frugiperda*, J.E. Smith), and the corn earworm (*Helicoverpa zea*, Boddie). The caterpillars (larvae) of all three insects can infest the ears of sweetcorn, but in Iowa the most consistent problem is caused by the corn earworm.

The adult female moth of the earworm lays single, white eggs on the emerging silk of developing ears. A female can lay up to 1,000 eggs. The larvae hatch and move down the silk into the ear, feeding as they go. Caterpillars will spend up to two weeks in the ear feeding on the swelling kernels near the tip. They reach 1-1/2 inches in length and can be recognized by their tan head, stripes running the length of the body, and "hairs" or microspines (University of Missouri, 1999.)

Because earworm caterpillars spend most of their time within the ear, pesticide applications to the plant surface are of limited value. However, since the 1940s some growers have successfully controlled earworm by treating the corn silks with oil. In the 1990s a new twist was added. Growers spiked the oil with Btk, a protein crystal toxic to the larvae that is produced by the naturally occurring soil bacterium *Bacillus thuringiensis*, var. *kurstaki*. The oil spreads down the silks and smothers the caterpillars, and the Bt toxin is carried by the oil into the ear, where it kills any caterpillars still feeding.

Iowa On-farm Research

Gary and Nancy Guthrie raise vegetables organically near Nevada, Iowa. Most of their produce goes to feed the members of their CSA (Consumer-Supported Agriculture). Gary was curious to know if the oil-Btk method would be practical in his system. In 1998 and 1999, he carried out research comparing treated and untreated corn of several varieties and maturity dates. The two practices in each combination of planting date and variety were replicated six times for statistical precision.

This publication is based on on-farm research by a member of the Practical Farmers of Iowa.

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“When the silks were turning brown, I treated. I used a quart oil can treating the plots with (refined) soybean vegetable oil and Btk. (3 teaspoons per quart of oil)... I placed a small squirt from the can on the tip of each ear as quickly as I could.” Research elsewhere has used as much as one part Btk to five parts oil, applying about 0.5 ml (1/10 teaspoon) to the silk where it enters the silk channel (Hazzard et al., 2003). If the Btk is a powdered product, a food grade emulsifier such as lecithin may be added as well (Hazzard, 2001). In some of those trials mineral oil was a little more effective than vegetable oil, but mineral oil is not permitted for use on commercial food crops unless it is part of a registered pesticide. In the Guthries’ organic system, a refined vegetable oil was the clear choice.

“It is very important that treatment is done two days after full silk, when the silks are beginning to brown. Too-early treatment causes non-pollination at the tips of the ears. I treated Incredible (the variety) perhaps a couple of days too early and had a fair number of ears that were not filled out. They would still be clean ears but just not filled out. If you treat too late, you will get less effective control of the corn earworm.”

Performance

The table shows the percentage of damaged ears from the treated and untreated corn in the Guthrie trials. In 1998, the oil-Btk treatment reduced the number of damaged ears by more than two-thirds in the Bodacious, harvested July 21. The Incredible, harvested 10 days later, showed little earworm damage whether it was treated or not.

In 1999, Guthrie carried out the trial in four varieties: Seneca Daybreak (65 days to harvest), Bodacious (75 days), Incredible (85 days), and Tender Treat (95 days), all planted May 1. The table shows that earworm infestation in untreated corn gradually declined from the early harvested Seneca Daybreak to the late-season Tender Treat. The oil-Btk treatment reduced the proportion of damaged ears by a third to three-quarters when there

Percent Damage				
				Partial Budget
Variety	Year	Untreated	Treated	Net Profit
Bodacious	1998	48%	15%	\$501
Bodacious	1999	66%	22%	\$1,191
Incredible	1998	5%	2%	-\$799
Incredible	1999	31%	7%	\$289
Seneca Daybreak*	1999	86%	58%	-\$799
Tender Treat	1999	3%	3%	-\$836

* Bt used was not fresh.

was a significant earworm presence. Experiments in Massachusetts have demonstrated reductions in damaged ears of 90 percent or more (Hazzard et al., 2003).

Economics

The oil-Btk treatment has proven effective in reducing ear damage from corn earworm, but is the practice economical? The expenses involved are materials and labor. Gary Guthrie calculated the cost of oil-Btk at \$145 per acre. For Guthrie, the greater expense was labor. Using the oil can, his hand labor was approximately 73 hours per acre (priced at \$9 per hour).

Other studies have placed labor at only 8-10 hours for an acre of 12-16,000 plants (Diver et al., 2001; Hazzard, 2001). An applicator has also been designed specifically for the task (the "Zea-later," (Hazzard, 2001), and it may help speed the work. Using local farmers' market prices, Gary Guthrie estimated the worth of marketable ears at \$3 per dozen. (Guthrie's corn is only sold to CSA customers as part of their subscription.) The table shows estimated net value of the practice for each of the six trials. In some cases the net was negative (a loss).

However, the table does not directly reflect a further economic consideration – the intangible value of a satisfied customer or CSA member who is spared confrontations with wriggling worms hiding in the ears of sweet-corn.

When there was a significant earworm presence and fresh Btk was used, the oil-Btk treatment was cost effective, even using Gary Guthrie's high cost for labor. The treatment didn't pay when there were few earworms present. Growers could estimate the season in which earworm would most likely affect yields, or they could employ a baited trap like the Scentry HeliothisTrap (Hazzard, 2001) to directly monitor fluctuations in moth pressure.

Gary Guthrie's on-farm research confirmed that Iowa sweetcorn producers can effectively manage corn earworm by applying vegetable oil-Btk to the silks. In addition, the practice has been shown effective against fall armyworm and European corn borer that enter the ear via the silk. Since these other two pests can also chew their way directly into the ear through the husk, growers may consider combining the oil-Btk silk treatment with a foliar spray of Btk.

References

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