

PERFORMANCE OF BT SWEET CORN AGAINST CORN EARWORM IN SOUTH GEORGIA

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Introduction

Several species of caterpillars attack sweet corn. The corn earworm, *Helicoverpa zea*, is one of the more common pests of sweet corn. This insect will feed on foliage, but the most destructive damage results from feeding on ears. Moths lay eggs on the silks of ears and larvae feed down the silks to the tip of the ears. Damage is frequently limited to the tip of the ear, but makes the ear unmarketable for the fresh market. Damage can also extend down the ear as larvae grow.

Control of caterpillars in sweet corn generally relies on extensive insecticide use, particularly during silking. It is not uncommon for fields to be sprayed daily during silking, and occasionally more than once in a single day. Sweet corn varieties modified to produce the BT toxin have shown great promise for production of sweet corn with minimal insecticide use. The BT toxin expressed in the plant is lethal to many species of caterpillars and is non-toxic to humans.

Three small plot field trials were conducted in South Georgia in 2003 to evaluate the efficacy of two commercially available Bt sweet corn varieties against corn earworm. The two Bt varieties and two conventional varieties were grown with and without insecticidal sprays during silking to evaluate the potential for production of Bt sweet corn with minimal insecticide use.

Materials and Methods

The experiments were conducted at three University of Georgia Research Farms: the Attapulgus Research and Education Center near Attapulgus, Georgia; the Lang Farm near Tifton, Georgia; and the Vidalia Onion and Vegetable Research Center near Reidsville, Georgia. At each location, treatment combinations were applied in a split-plot design with three replications in Attapulgus, three replications in Vidalia, and four replications in Tifton.

The split-plot design included insecticidal applications (scheduled applications versus no insecticide) as the main plots and sweet corn varieties as subplots. The insecticidal

applications consisted of SpinTor 2 SC (Dow AgroSciences) applied at a rate of 6 oz per acre. The sweet corn variety subplots consisted of two conventional varieties (Prime Plus and Big Time) and two Bt varieties (GSS 0966 and BSS 0977).

Insecticide applications at all three locations were initiated as the earliest variety started silking. Initial plans were for the insecticide to be applied on a two day schedule; however, this was modified somewhat at each location. In Attapulugus and Tifton, rains interfered with the application schedule. In Vidalia, the schedule was modified to applications made on Mondays, Wednesdays, and Fridays during silking. Actual applications dates at each location were: Attapulugus - May 27, 28, 30, June 2, 4, 9; Tifton - May 25, 27, 29, 31, June 2, 5, 9, 11, 13; Vidalia - May 30, June 2, 4, 6, 9, 11, 13, 16.

Application methodology varied by location. At all three locations, the insecticide was applied with a tractor mounted sprayer. In Attapulugus, treatments were broadcast with one nozzle per row in 30 GPA. In Tifton, applications were made with three hollow cone nozzles per row (one over the top, one on drops on each side) in 60 GPA. In Vidalia, applications were broadcast with 3 hollow cone nozzles per row (no drops) in 60 GPA.

Individual plots at each location were 4 rows wide (on 36 inch centers) and 40 (Attapulugus and Vidalia) or 50 (Tifton) feet long. Plots were separated by 10 foot allies within a row and by a fallow 6 foot bed between adjacent plots. The tests were planted in Attapulugus on March 26, in Tifton on March 31, and in Vidalia on April 14.

Twenty-five mature ears were hand harvested from each plot on a single date for each test. Husks were stripped and the ears examined for caterpillar damage and caterpillar presence. Caterpillars were classified as small, medium or large and counted. Ears were graded for damage on a 0 to 3 scale as follows:

- 0 = no damage
- 1 = minimal damage at the tip (1 to 4 kernels damaged)
- 2 = damage at tip (< 1 inch down ear)
- 3 = tip heavily damaged and/or damage extending > 1 inch from tip

Data were analyzed using the PROC ANOVA procedure of PC-SAS with a split-plot model. Where significant differences were detected ($P < 0.05$), means for insecticide treatments and varieties were separated with LSD ($P = 0.05$).

Results and Discussion

Insecticide applications, evaluated across all varieties, had minor effects on earworm damage or infestations at Attapulugus (Table 1). However, in both Tifton and Vidalia, insecticide applications significantly reduced ear damage and larval numbers. The impact was not as large in Vidalia, as pest pressure was apparently lighter, with even the conventional varieties producing a relatively large proportion of ears with little or no damage (rated 0 or 1). The lack of control in Attapulugus was likely a result of both application methodology (lower volume and fewer nozzles per row as compared to Tifton and Vidalia) and precipitation.

Varieties, evaluated across insecticide and insecticide free plots, showed a consistent significant effect on ear damage (Table 2). Both Bt varieties had significantly more ears rated as free of damage (rated 0) at all three locations. The Bt varieties also had fewer ears with extensive tip damage (rated 2) or damage extending down the ear (rated 3), with significant reductions in Tifton and Attapulcus. The lack of significant reductions in the ears rated 2 and 3 at Vidalia probably resulted from the lower level of overall damage at this site. Larval infestations were also significantly effected by varieties, with the Bt varieties having significantly fewer larvae. The largest differences generally occurred with the medium and large larvae. In both Attapulcus and Tifton, the number of small larvae was not significantly effected by variety. The most likely explanation for the overall larval population differences, and lack of differences, is that moths oviposited eggs equally on all varieties, small larvae were somewhat equally distributed because of low mortality (too short of a feeding period for mortality to occur), but medium and large larval densities were greatly reduced by mortality on the Bt varieties.

Insecticide-variety interactions were frequently significant in this test (particularly in Tifton and Vidalia), indicating that addition of insecticide did not provide similar benefits across all varieties. Percent of ears rated as 0 or 1 (no or minimal damage) are presented in Table 3 and provides a good look at where these differences occurred and provides a reasonable view of the overall efficacy of the varieties and insecticide. At Attapulcus, insecticide treatments provided little benefit on any variety (for reasons previously discussed), although, there was generally a trend for decreased damage with addition of insecticides on three of the four varieties. In Tifton, insecticide applications improved damage ratings in all four varieties, but had a much more pronounced effect in the conventional varieties. In Vidalia, damage incidence was lower overall, and addition of insecticides showed a reduction in damage in the conventional varieties; however, the Bt varieties produced 100 and 98.7 percent of ears rated 0 or 1 without insecticides, which left little room for improvement with addition of insecticide.

Overall, the Bt varieties grown without insecticides consistently produced a higher percentage of ears with no or minimal damage than the conventional varieties grown with insecticidal controls (Table 3). However, addition of insecticidal controls to the Bt varieties generally increased the percentage of ears with no or minimal damage to near 100 percent.

Table 1. Effects of insecticide applications on corn earworm (CEW) infestation and damage levels across all varieties.

Treatment	Average number of ears per 25 ears				Average number of CEW per 25 ears			
	Rated 0	Rated 1	Rated 2	Rated 3	Small	Medium	Large	Total
Attapulgus								
Check	9.17 ⁺	4.42	4.17	7.25	5.33 ⁺	5.08 ⁺	4.00	14.42*
Spintor	12.50	2.67	3.33	6.50	2.83	3.75	4.00	10.58
Tifton								
Check	8.06**	5.38	4.50 *	7.06*	3.13*	2.63 ⁺	1.38*	7.13*
SpinTor	18.25	4.50	1.13	1.13	1.25	0.69	0.56	2.50
Vidalia								
Check	15.75**	4.92	1.50	2.83	7.17	0.58	0.00	7.75 ⁺
SpinTor	23.00	0.83	0.67	0.50	1.17	0.16	0.00	1.33

⁺Paired comparison different at P<0.1.

* Paired comparison different at P<0.05.

** Paired comparison different at P<0.01.

Table 2. Effects of varieties on corn earworm (CEW) infestation and damage levels across insecticide treated and non-treated plots.

Variety	Average number of ears per 25 ears				Average number of CEW per 25 ears			
	Rated 0	Rated 1	Rated 2	Rated 3	Small	Medium	Large	Total
Attapulgus								
BigTime	3.17 b	1.67 b	6.67 a	14.00 a	2.83 a	8.33 a	9.33 a	20.50 a
PrimePlus	3.50 b	1.67 b	5.83 a	13.50 a	3.33 a	7.50 a	6.67 b	17.50 a
BSS 0977	17.33 a	5.33 a	2.33 b	0.00 b	5.33 a	1.67 b	0.00 c	7.00 b
GSS 0966	19.33 a	5.50 a	0.17 b	0.00 b	4.83 a	0.17 b	0.00 c	5.00 b
Tifton								
BigTime	8.00 b	4.00 a	5.50 a	7.50 a	1.75 a	2.88 a	2.13 a	6.75 a
PrimePlus	7.38 b	4.88 a	4.38 a	8.38 a	2.63 a	3.00 a	1.38 ab	7.00 a
BSS 0977	18.00 a	5.63 a	1.13 b	0.25 b	2.63 a	0.38 b	0.25 bc	3.25 b
GSS 0966	19.25 a	5.25 a	0.25 b	0.25 b	1.75 a	0.38 b	0.13 c	2.25 b
Vidalia								
BigTime	14.33 b	6.00 a	1.33 a	3.33 a	9.33 a	1.00 a	0.00 a	10.33 a
PrimePlus	14.67 b	4.17 a	2.83 a	3.33 a	6.67 a	0.33 a	0.00 a	7.00 a
BSS 0977	24.33 a	0.67 a	0.00 a	0.00 a	0.17 b	0.00 a	0.00 a	0.17 b
GSS 0966	24.17 a	0.67 a	0.17 a	0.00 a	0.50 b	0.17 a	0.00 a	0.67 b

Numbers within columns and location followed by the same letter are not significantly different (LSD; P=0.05).

Table 3. Percent of ears rated as no damage (rated 0) or with 1 to 4 kernels damaged (rated 1).

Variety	Insecticide	Percent of ears rated 0 or 1		
		Attapulgus	Tifton	Vidalia
Bigtime	No	9.3	16.0	72.0
Bigtime	YES	29.3	80.0	90.6
Prime Plus	No	22.7	13.0	60.0
Prime Plus	YES	18.7	85.0	90.6
BSS 0977	No	86.7	90.0	100.0
BSS 0977	YES	94.7	99.0	100.0
GSS 0966	No	98.6	96.0	98.7
GSS 0966	YES	100.0	100.0	100.0