Sweet corn insecticide trial in Ohio, 2008

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Celeste Welty, Jim Jasinski, Bob Precheur
Ohio State University

Introduction: Insecticides were evaluated because of the need for alternatives to pyrethroid insecticides due to concern about the development of resistance to pyrethroids in corn earworm populations during the past few years.

Methods: The trial was conducted at the Ohio Agricultural Research and Development Center 's Western Agricultural Research Station near South Charleston in Clark County. Four replicates of fourteen treatments were set up in a randomized complete block design. Twelve treatments used a standard hybrid ('Providence'), and two treatments used its B.t. isoline ('Attribute BC 0805'). Nine insecticides, alone or combined, and untreated controls were evaluated. Each plot was four rows wide and 40 feet long, with 30-inch row spacing. Plots were seeded on 23 June. Corn earworm moths were monitored using a single Hartstack trap baited with a Hercon brand pheromone lure that was changed every two weeks. The spray program was initiated once silks appeared on approximately 20% of plants. Sprays were applied at 3- to 4-day intervals based on temperature and moth catch in the trap. The six application dates were 15, 19, 22, 25, 29 August, and 2 September. Six sprays were applied in all treatments except the Attribute plus Brigade treatment, which had only two sprays, at wilted silk on 8/29 and at brown silk on 9/2; and the Brigade-only treatment which had only sprays 1 to 5 due to the labelled restriction of five sprays maximum. Sprays were applied by a "Hi-Boy"-style Spider sprayer (West Texas Lee Company, Inc., Idalou TX) that applied 36 gallons per acre at 50 PSI, with ConeJet TX-18 nozzles on drop pipes directed at the ear zone in the center two rows per plot. Samples of 20 ears from the center two rows per plot were harvested and evaluated on 8 September for three replicates and on 9 September for one replicate. Larvae of all species were classified by size based on body length: small if under 4 mm, corresponding to first and second instars; medium if 4 to 13 mm, for third and fourth instars; and large if over 13 mm, for fifth and sixth instars. Data were subjected to analysis of variance (ANOVA) and mean comparisons by least significant difference (LSD) tests in the SAS 9.1 microcomputer statistics program.

Results: The corn earworm population was much lower in 2008 than in 2007, both in the adult stage as measured by a pheromone trap and in the larval stage as found in harvested ears. During the silking period in mid to late August, the moth catch in the pheromone trap ranged from 1 to 5 moths per night (Table 1; Figure 1). Although the corn earworm population was only moderate in size, two other pest species were also present: European corn borer and fall armyworm. There were approximately six times as many European corn borer larvae per ear than corn earworm larvae in untreated plots at harvest (Table 2). All treatments except Gemstar resulted in significantly fewer damaged kernels than in the untreated control (Table 2). There were no significant differences among these 12 best treatments, but the least insect damage was found in plots treated by Coragen (5.1 oz/A) or Radiant, and the most damage was found in plots of Attribute without supplemental sprays (Table 2). Among pyrethroid treatments, there were no statistically significant differences but Hero alone performed slightly better and Brigade alone performed slightly worse, while Brigade/Warrior, Warrior alone, and Asana plus Lannate were intermediate (Table 2). There was no difference in performance of Belt with two different adjuvants, NIS and MSO. Coragen at 6.7 oz/A had slightly more damage than at the 5.1 oz/A rate. Most of the corn earworm larvae found at harvest were in the medium size range and were found in kernels in the tip of the ear, but a few were found in lower kernels or silks (Table 3). Most of the European corn borer larvae found at harvest were in the large size range and were found in kernels in the tip of the ear, but some were found in lower kernels, silks, and husks (Table 4). No phytotoxicity was observed in any treatment.

Conclusions: Coragen, Radiant, and Belt are excellent alternatives to pyrethroids for control of corn earworm as well as European corn borer and fall armyworm. Control by Attribute transgenic corn is good if not supplemented with insecticide sprays but is slightly more effective when supplemented by two insecticide applications late in the sillking period.

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Table 1. Number of corn earworm moths caught in pheromone trap next to sweet corn field, Clark County, Ohio, 2008.

Date	*Number of moths*	*Mean number moths per day*
16 June	1	0.3
20 June	2	0.5
23 June	5	1.7
26 June	1	0.3
30 June	0	0.0
7 July	1	0.1
14 July	2	0.3
17 July	5	1.7
23 July	4	0.7
25 July	2	1.0
29 July	1	0.3
1 Aug.	14	4.7
4 Aug.	4	1.3
6 Aug.	8	4.0
8 Aug.	6	3.0
12 Aug.	4	1.0
18 Aug.	14	2.3
19 Aug.	2	2.0
25 Aug.	12	2.0
27 Aug.	3	1.5
29 Aug.	10	5.0
9 Sep.	5	0.5
12 Sep.	16	5.3
15 Sep.	7	2.3
19 Sep.	0	0.0
23 Sep.	6	1.5
28 Sep.	4	0.8
2 Oct.	3	0.8
10 Oct.	0	0.0

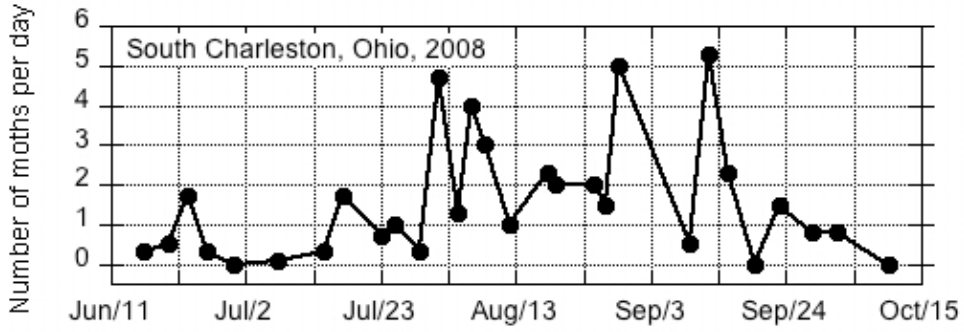

Figure 1. Mean number of corn earworm moths caught per day in pheromone trap, Clark County, Ohio, 2008.

Table 2: Number of kernels damaged and number of larvae present in sweet corn ears at harvest, September 2008, Clark County, Ohio; ranked from best to worst control, based on number of kernels damaged per ear.

Treatment		*Number of kernels damaged per ear*[1]	*Number of larvae per ear*			
Hybrid	*Insecticide spray applications*		*Corn earworm*[1]	*European corn borer*[1]	*Fall armyworm*	*Total*[1]
Providence	Coragen 5.1 fl oz/A + MSO 0.5% (6 sprays)	0.1 B	0.00 C	0.02 C	0.00	0.02 C
Providence	Radiant 6 fl oz/A (6 sprays)	0.1 B	0.00 C	0.01 C	0.00	0.01 C
Providence	Hero 6 fl oz/A (6 sprays)	0.2 B	0.01 C	0.00 C	0.00	0.01 C
Attribute 0805	Brigade 6.4 fl oz/A (2 sprays)	0.2 B	0.00 C	0.00 C	0.00	0.00 C
Providence	Belt 3 fl oz/A + MSO 0.25% (6 sprays)	0.2 B	0.00 C	0.06 C	0.00	0.06 C
Providence	Belt 3 fl oz/A + NIS 0.25% (6 sprays)	0.3 B	0.00 C	0.02 C	0.00	0.02 C
Providence	Asana 6.4 fl oz/A + Lannate 16 fl oz/A (6 sprays)	0.4 B	0.00 C	0.08 C	0.00	0.08 C
Providence	Coragen 6.7 oz/A + MSO 0.5% (6 sprays)	0.4 B	0.00 C	0.02 C	0.00	0.02 C
Providence	Warrior 3.84 fl oz/A (6 sprays)	0.4 B	0.00 C	0.00 C	0.00	0.00 C
Providence	Brigade 6.4 fl oz/A (2 sprays) then Warrior 3.84 fl oz/A (4 sprays)	0.5 B	0.00 C	0.00 C	0.00	0.00 C
Providence	Brigade 2.56 fl oz/A (5 sprays [max allowed])	0.6 B	0.00 C	0.02 C	0.01	0.04 C
Attribute 0805	Untreated	0.8 B	0.02 BC	0.04 C	0.02	0.09 C
Providence	Gemstar 10 fl oz/A (6 sprays)	3.9 A	0.05 B	0.41 B	0.01	0.48 B
Providence	Untreated	4.1 A	0.09 A	0.59 A	0.00	0.68 A
Probability (treatment effect from ANOVA)		*<0.0001*	*<0.0001*	*<0.0001*	*0.62*	*<0.0001*

[1] Within each column, means followed by the same letter are not significantly different ($P>0.05$), by LSD.

Table 3. Size and location of corn earworm larvae in sweet corn ears at harvest, September 2008, Clark County, Ohio. Treatments are listed in the same order as in Table 2 (ranked from best to worst control, based on total number of kernels damaged per ear).

Treatment	*Number of corn earworm larvae per ear by larva size*			*Number of corn earworm larvae per ear in each of four parts of the ear*			
	Small	*Medium*[1]	*Large*[1]	*Husks*	*Silks*	*Tip kernels*[1]	*Side kernels*
Coragen 5.1 fl oz/A + MSO 0.5% (6 sprays)	0	0 B	0 B	0	0	0 C	0
Radiant 6 fl oz/A (6 sprays)	0	0 B	0 B	0	0	0 C	0
Hero 6 fl oz/A (6 sprays)	0	0 B	0.01 B	0	0	0.01 C	0
Attribute 0805 + Brigade 6.4 fl oz/A (2 sprays)	0	0 B	0 B	0	0	0 C	0
Belt 3 fl oz/A + MSO 0.25% (6 sprays)	0	0 B	0 B	0	0	0 C	0
Belt 3 fl oz/A + NIS 0.25% (6 sprays)	0	0 B	0 B	0	0	0 C	0
Asana 6.4 fl oz/A + Lannate 16 fl oz/A (6 sprays)	0	0 B	0 B	0	0	0 C	0
Coragen 6.7 oz/A + MSO 0.5% (6 sprays)	0	0 B	0 B	0	0	0 C	0
Warrior 3.84 fl oz/A (6 sprays)	0	0 B	0 B	0	0	0 C	0
Brigade 6.4 fl oz/A (2 sprays) then Warrior 3.84 fl oz/A (4 sprays)	0	0 B	0 B	0	0	0 C	0
Brigade 2.56 fl oz/A (5 sprays)	0	0 B	0 B	0	0	0 C	0
Attribute 0805; no sprays	0	0.12 A	0 B	0	0	0.02 BC	0.10
Gemstar 10 fl oz/A (6 sprays)	0	0.04 AB	0.01 B	0	0	0.05 B	0
Untreated	0	0.05 AB	0.05 A	0	0	0.10 A	0
Probability from ANOVA	*-*	*0.42*	*0.0011*	*-*	*-*	*<0.0001*	*0.47*

[1] Within each column, means followed by the same letter are not significantly different (*P*>0.05), by LSD.

Table 4. Size and location of European corn borer larvae in sweet corn ears at harvest, September 2008, Clark County, Ohio. Treatments are listed in the same order as in Table 2 (ranked from best to worst control, based on total number of kernels damaged per ear).

Treatment	*Number of European corn borer larvae per ear by larva size*			*Number of European corn borer larvae per ear in each of four parts of the ear*			
	Small	*Medium*[1]	*Large*[1]	*Husks*[1]	*Silks*[1]	*Tip kernels*[1]	*Side kernels*[1]
Coragen 5.1 fl oz/A + MSO 0.5% (6 sprays)	0.01	0.01 B	0.00 C	0.00 B	0.00 B	0.01 C	0.01 BC
Radiant 6 fl oz/A (6 sprays)	0	0.00 B	0.01 C	0.00 B	0.00 B	0.01 C	0.00 C
Hero 6 fl oz/A (6 sprays)	0	0.00 B	0.00 C	0.00 B	0.00 B	0.00 C	0.00 C
Attribute 0805 + Brigade 6.4 fl oz/A (2 sprays)	0	0.00 B	0.00 C	0.00 B	0.00 B	0.00 C	0.00 C
Belt 3 fl oz/A + MSO 0.25% (6 sprays)	0	0.02 B	0.02 C	0.00 B	0.01 B	0.01 C	0.02 BC
Belt 3 fl oz/A + NIS 0.25% (6 sprays)	0	0.02 B	0.01 C	0.00 B	0.01 B	0.02 C	0.00 C
Asana 6.4 fl oz/A + Lannate 16 fl oz/A (6 sprays)	0.01	0.01 B	0.04 C	0.00 B	0.00 B	0.04 C	0.02 BC
Coragen 6.7 oz/A + MSO 0.5% (6 sprays)	0	0.02 B	0.00 C	0.01 B	0.00 B	0.01 C	0.00 C
Warrior 3.84 fl oz/A (6 sprays)	0	0.00 B	0.00 C	0.00 B	0.00 B	0.00 C	0.00 C
Brigade 6.4 fl oz/A (2 sprays) then Warrior 3.84 fl oz/A (4 sprays)	0	0.00 B	0.00 C	0.00 B	0.00 B	0.00 C	0.00 C
Brigade 2.56 fl oz/A (5 sprays)	0	0.00 B	0.02 C	0.00 B	0.00 B	0.01 C	0.01 BC
Attribute 0805; no sprays	0	0.01 B	0.02 C	0.00 B	0.00 B	0.04 C	0.00 C
Gemstar 10 fl oz/A (6 sprays)	0.01	0.19 A	0.20 B	0.04 A	0.08 A	0.22 B	0.06 B
Untreated	0.02	0.18 A	0.40 A	0.05 A	0.06 A	0.36 A	0.12 A
Probability from ANOVA	*0.27*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*0.0005*

[1] Within each column, means followed by the same letter are not significantly different ($P>0.05$), by LSD.