Ohio Sweet Corn Insecticide Trial 2012

Final report 12/31/2012

Celeste Welty, Jim Jasinski, & Bob Precheur,
Ohio State University

Objective: In response to the apparent development of resistance to pyrethroid insecticides across the midwestern USA, a trial was conducted for the sixth year in Ohio to monitor the performance of pyrethroid insecticides for control of corn earworm, and to evaluate non-pyrethroid alternatives as replacements for the standard pyrethroid spray schedule. A secondary objective was to evaluate the effects of insecticide programs on other pests: European corn borer, fall armyworm, corn rootworm beetles, and corn leaf aphid, as well as effects on natural enemies.

Methods: A 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 seven treatments were set up in a randomized complete block design. Four treatments used a standard hybrid ('Providence'), and three treatments used its transgenic B.t. isoline ('Attribute BC 0805'). Each plot was four rows wide and 40 feet long, with 30-inch row spacing. Plots were seeded on 27 June. Corn earworm moths were monitored by pheromone in one Hartstack trap, and fall armyworm moths were monitored by pheromone in one all-green unitrap; lures for both were Hercon brand and were changed every 2 weeks.

Insecticide products were applied seven times on a 3- to 4-day schedule, as detailed in Table 1. The spray program was initiated on 16 August, once silks appeared on approximately 25% of plants. Sprays were applied by a "HiBoy"-style Spider sprayer (West Texas Lee Company, Inc., Idalou TX) that applied 27.8 gallons per acre at 50 PSI, with ConeJet-18 nozzles on drop pipes directed at the ear zone in the center two rows per plot. Products and rates of insecticides and adjuvants used were: Hero 1.24EC (bifenthrin + zeta-cypermethrin), 6.4 fl oz/A, plus NIS 0.25%; Mustang Max 0.8EC (zeta-cypermethrin), 4 oz/A, plus NIS 0.25%; Belt 4SC (flubendiamide), 3 fl oz/A + MSO 0.5%; Warrior II 2.08CS (lambda-cyhalothrin), 1.92 fl oz/A; Coragen 1.67SC (chlorantraniliprole), 3.5 fl oz/A, plus MSO 0.5%; Lannate LV 2.4WSL (methomyl), 24 fl oz/A; and Voliam Xpress 0.417+0.835 ZC (lambda-cyhalothrin + chlorantraniliprole), 7 fl oz/A.

Silk-clipping by beetles was evaluated on 21 August, between the second and third sprays, on 10 ears per plot; damage was rated on a scale of 0 to 4 with a rating of 1 for light (25% of silk clipped), a rating of 2 for moderate (50% of silk clipped), a rating of 3 for heavy (75% of silk clipped), and a rating of 4 for extreme (100% of silk clipped); density of silk-clipping beetles, generalist predators, and corn leaf aphid were also evaluated. Samples of 20 ears from the center two rows per plot were harvested and evaluated on 6 September. Each ear was rated for the number of kernels damaged, the location of damage, the length of damage from ear tip, and species, size, and location of caterpillars found. 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.

Table 1. Schedule of insecticide treatments in sweet corn trial, South Charleston, Ohio, 2012.

No.	Treatment short name	Hybrid	spray 1 8/16	spray 2 8/19	spray 3 8/22	spray 4 8/25	spray 5 8/28	spray 6 8/31	spray 7 9/4
1	new standard	Providence	Coragen	Coragen	Coragen	Lannate	Lannate	Lannate	Lannate
2	old standard	Providence	Warrior	Warrior	Warrior	Warrior	Warrior	Warrior	Warrior
3	Hero	Providence	Hero	Hero	Hero	Belt	Mustang Max	Mustang Max	Mustang Max
4	BT transgenic plus spray early	Attribute BC0805	Voliam Xpress	Voliam Xpress	none	none	none	none	none
5	BT transgenic plus spray late	Attribute BC0805	none	none	none	none	Voliam Xpress	Voliam Xpress	none
6	BT transgenic, no spray	Attribute BC0805	none	none	none	none	none	none	none
7	Untreated	Providence	none	none	none	none	none	none	none

Results: Plants began silking one week after the corn earworm moth population had a sharp rise in activity, thus there was moderately high pest pressure during the critical period of early silking. During the silking period, the moth catch in the pheromone trap ranged from 2 to 49 moths per night (Table 2). Fall armyworm was also present but at low density (Table 2).

Silk clipping was significantly less in plots that had been treated with Warrior, Hero, or Voliam Xpress than in plots treated with nothing ($P = 0.0107$; Table 3). The most common silk clipping insect was the western corn rootworm beetle, but northern and southern corn rootworm beetles were also present (Table 3). The total number of beetles per ear was significantly lower in plots that had been treated with Warrior, Hero, or Voliam Xpress than in those treated with Coragen or nothing ($P = 0.0047$; Table 3). The number of predatory *Orius* bugs was significantly lower in plots that had been treated with Warrior, Hero, or Voliam Xpress than in those treated with Coragen or nothing ($P < 0.0001$; Table 3). No corn leaf aphids were detected during early silking.

The percentage of ears with no damaged kernels was significantly higher in four treatments (the new standard of Coragen/Lannate, the old standard of Warrior, the Hero/Belt/Mustang Max treatment, and in the BT transgenic with Voliam Xpress in the first two sprays) than in three treatments (BT transgenic with no spray, BT transgenic with Voliam Xpress in the fifth and sixth spray, and untreated) ($P < 0.0001$, Table 4), as was the percentage of ears with no worm damage to kernels as well as no damage to husks, silks, or shanks ($P < 0.0001$, Table 4).

The number of damaged kernels per ear was significantly lower in all treatments than in untreated plots, and significantly lower in the new standard and old standard than in the BT transgenic with no spray or the BT transgenic with sprays late ($P = 0.0001$, Table 5). The length of damage from the ear tip followed similar trends ($P = 0.0001$, Table 5).

Corn earworm was the most common species found in harvested ears, and more of the corn earworm larvae were in the large size category than in small or medium (Table 6). European corn borer was also present in some plots and there was a trace of fall armyworm (Table 6).

Conclusions: Under the conditions of moderately high populations of corn earworm in 2012, the pyrethroids Hero at a mid-range rate and Warrior at the maximum rate were still effective for control of corn earworm. Chlorantraniliprole alone, as found in Coragen, or in a premix, as in Voliam Xpress, is an excellent alternative to pyrethroids for corn earworm control. Pyrethroids also controlled silk clipping beetles during early silking but did not allow survival of *Orius* predatory bugs. Chlorantraniliprole alone did not control silk clipping beetles but it allowed survival of *Orius* predatory bugs. The BT transgenic hybrid 'Attribute BC 0805' provided significantly better caterpillar control when supplemented by two sprays of insecticide in the early portion of the spray program than when supplemented by two sprays of insecticide during the late portion of the spray program or when not supplemented with any insecticide sprays.

Acknowledgements: We appreciated assistance with field preparation, planting, and spraying from Joe Davlin and Bryan Reeb, with trap monitoring from Derek Zirkle, and with insect evaluations from Amadou Bal, Emily Linkous, and Mackenzie Dorner. Seed was provided by Syngenta. Insecticides and funding were provided by FMC. Additional insecticide products were supplied by DuPont, Syngenta, and Bayer.

Table 2. Pheromone trap catches in sweet corn trial, S. Charleston, Ohio, 2012.

Date	Corn earworm moths per day	Fall armyworm moths per day	Notes
5-Jul	0.3	-	
9-Jul	0.8	-	
12-Jul	1.0	-	
19-Jul	1.1	-	
23-Jul	0.0	-	
26-Jul	0.7	-	
1-Aug	2.7	-	
3-Aug	2.0	0.5	
6-Aug	6.7	2.0	
8-Aug	3.5	0.0	
9-Aug	75.0	0.0	
13-Aug	11.8	0.0	
15-Aug	49.0	0.0	
17-Aug	24.5	1.5	Spray 1 on 8/16
20-Aug	36.7	0.7	Spray 2 on 8/19
23-Aug	16.0	0.0	Spray 3 on 8/22
24-Aug	11.0	0.0	Spray 4 on 8/25
27-Aug	14.3	0.3	Spray 5 on 8/28
30-Aug	6.0	0.0	Spray 6 on 8/31
4-Sep	2.2	1.2	Spray 7 on 9/4
6-Sep	5.5	0.0	Harvest on 9/6
10-Sep	2.5	0.0	
17-Sep	0.7	0.4	
24-Sep	4.1	0.1	
1-Oct	1.0	0.6	
9-Oct	0.6	1.0	

Table 3. Silk clipping damage on 8/21/2012, after the first two insecticide sprays; S. Charleston, Ohio.

Treatment	Insecticide applied by time of evaluation	% of silk clipped[a,b]	Rating of silk clipping (scale 0 to 4)[c]	Number of beetles per ear				Number of *Orius* predators per ear[a]
				Western corn rootworm[a]	Northern corn rootworm[a]	Southern corn rootworm[a]	total[a]	
Old standard	Warrior, twice	0 C	0	0 B	0 B	0 B	0 B	0.3 C
Hero	Hero, twice	0 C	0	0 B	0 B	0 B	0 B	0.2 C
BT transgenic + spray early	Voliam Xpress, twice	0 C	0	0 B	0 B	0 B	0 B	0.3 C
New standard	Coragen, twice	1.2 BC	0.05	0.15 AB	0.18 A	0 B	0.3 A	2.3 A
Untreated	(none)	2.5 ABC	0.10	0.30 A	0.08 AB	0.02 B	0.4 A	1.6 B
BT transgenic plus spray late	(none)	3.1 A	0.12	0.28 A	0.08 AB	0.12 A	0.5 A	1.6 B
BT transgenic, no spray	(none)	3.8 AB	0.15	0.12 AB	0.15 A	0 B	0.3 AB	1.4 B
ANOVA treatment effect		*P = 0.0107*	*P = 0.0742*	*P = 0.0282*	*P = 0.0069*	*P <0.0001*	*P = 0.0047*	*P < 0.0001*

[a] Within each column, means followed by same letter are not significantly different (*P*>0.05); mean separations by LSD.

[b] Values shown are actual percentages but ANOVA based on transformed values.

[c] Silk clipping rating: 0 = none, 1 = light (25%), 2 = moderate (50%), 3 = heavy (75%), 4 = extreme (100%).

Table 4. Evaluation of insect damage to sweet corn ears at harvest on 9/6/2012, S. Charleston, Ohio.

Treatment	% of husked ears with no worm-damaged kernels[a,b]	% of ears with no worm damage to kernels or to husks, silks, shanks[a,b]
New standard (Coragen)	97.5 A	96.2 A
Old standard (Warrior)	96.2 A	96.2 A
Hero	96.2 A	95.0 A
BT transgenic + spray early	95.0 A	92.5 A
BT transgenic, no spray	75.0 B	65.0 B
BT transgenic + spray late	71.2 B	70.0 B
Untreated control	61.2 B	53.8 B
ANOVA treatment effect	*P < 0.0001*	*P < 0.0001*

[a] Within each column, means followed by same letter are not significantly different (*P*>0.05); mean separations by LSD.

[d] Values shown are actual percentages but ANOVA based on transformed values.

Table 5. Evaluation of insect damage to sweet corn kernels at harvest on 9/6/2012, S. Charleston, Ohio.

Treatment	Number of damaged kernels per ear[a]				Length of damage from tip (cm)[a]
	Tip third of ear	Middle third of ear	Butt third of ear	Total	
New standard	0.2 C	0	0	0.2 D	0.04 B
Old standard	0.2 C	0	0	0.2 D	0.04 B
Hero	0.3 C	0	0	0.3 CD	0.06 B
BT transgenic + spray early	0.6 C	0	0	0.6 CD	0.10 B
BT transgenic, no spray	1.5 BC	0.11	0	1.6 BC	0.54 A
BT transgenic + spray late	2.2 B	0.04	0	2.3 B	0.69 A
Untreated control	4.0 A	0	0.02	4.0 A	0.89 A
ANOVA treatment effect	*P = 0.0001*	*P = 0.46*	*P = 0.46*	*P = 0.0001*	*P = 0.0008*

[a] Within each column, means followed by same letter are not significantly different (*P*>0.05); mean separations by LSD.

Table 6. Evaluation of insect larvae in sweet corn ears at harvest on 9/6/2012, S. Charleston, Ohio.

Treatment	Number of larvae per ear						
	Corn earworm[a]				European corn borer	Fall army-worm	Total[a]
	Small	Medium	Large	Total			
New standard	0.00 C	0.00	0.00 B	0.00 C	0.01 B	0	0.01 C
Old standard	0.00 C	0.01	0.01 B	0.02 C	0 B	0	0.02 C
Hero	0.01 C	0.01	0.00 B	0.02 C	0 B	0	0.02 C
BT transgenic + spray early	0.02 C	0.02	0.02 B	0.08 C	0 B	0	0.08 BC
BT transgenic, no spray	0.22 A	0.12	0.02 B	0.38 A	0 B	0	0.38 A
BT transgenic + spray late	0.12 B	0.12	0.04 B	0.29 AB	0 B	0.01	0.30 A
Untreated control	0.01 C	0.02	0.11 A	0.15 BC	0.09 A	0	0.24 AB
ANOVA treat effect	*P = 0.0007*	*P = 0.0785*	*P = 0.0026*	*P = 0.0013*	*P < 0.0001*	*P = 0.46*	*P = 0.0007*

[a] Within each column, means followed by same letter are not significantly different (*P*>0.05); mean separations by LSD.