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Abstract

The purpose of this study was to evaluate the effectiveness of Bt corn and soil insecticides, either alone or in combination, for the control of corn rootworm. Evaluation of Bt hybrids included SmartStax, SmartStax with a blended refuge (refuge in the bag), and Herculex XTRA. Soil insecticides evaluated were SmartChoice-SB, Counter-SB, Aztec, and Force.

Keywords

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Disciplines

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Evaluation of Bt and Non-Bt Corn with and without Soil Insecticides for Control of Corn Rootworm

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Introduction

The purpose of this study was to evaluate the effectiveness of Bt corn and soil insecticides, either alone or in combination, for the control of corn rootworm. Evaluation of Bt hybrids included SmartStax, SmartStax with a blended refuge (refuge in the bag), and Herculex XTRA. Soil insecticides evaluated were SmartChoice-SB, Counter-SB, Aztec, and Force.

Materials and Methods

The corn was planted in an area that had been planted the previous year with “trap crop.” The seed planted for the trap crop was a mixed maturity blend with a greater proportion of late-maturing varieties. The trap crop constitutes a favorable environment for adult females late in the season when other fields are maturing, and results in a high abundance of rootworm larvae the following year. The experimental design for this study was a randomized complete block with four replications. Treatments were two rows wide and 75 ft long. This study was planted on May 4 at a population of 35,600 seeds/acre. Seeds were pre-bagged and planted with a four-row John Deere Max Emerge™ 7100 integral planter that had 30-in. row spacing.

Aztec 2.1G granular insecticide was applied to two treatments with modified Noble® metering units mounted on the planter. The Noble units were calibrated in the laboratory to accurately deliver material at a tractor speed of 4 mph. Plastic tubes directed the granular

treatments to the seed furrow, placing all the insecticide in-furrow (Furrow). Eleven-inch poly-bristle skirts were attached to the frame and positioned so the bristle tips touched the ground. Each row was monitored to ensure that insecticides were applied correctly. Final incorporation was accomplished with drag chains mounted behind the closing wheels. The SmartChoice-SB 5G and Counter-SB 20G insecticide treatments were applied with modified SmartBox™ metering units. These products were applied as ounces per 1,000-row foot, with metering units mounted on the planter. The commercial SmartBox™ were removed from their large-base containers and sandwiched between a flat metal plate on the bottom and a custom-made, threaded plastic cap on the top. An inverted one liter bottle attached to the top cap provided a secure and sealed container for insecticide. A short plastic tube attached to the dispenser of the metering unit was connected to the planter’s furrow tubes.

On August 1, five root systems were dug per replication from all treatments except SmartStax with a blended refuge in which we sampled nine root systems (6 Smartstax + 3 Non-Bt). Prior to leaving the field, excess soil was removed and all roots were labeled with study name, plot number, and row using a permanent marker. Roots were transported to the Insectary Building at Iowa State University where they were soaked in water and then washed with a pressurized hose to remove any remaining soil. On August 8, roots were evaluated for rootworm feeding injury following the Iowa State Node-Injury Scale (0–3).

The study was machine harvested on October 14 with a modified John Deere 9450 plot

combine. Weights (pounds) and percent moisture were recorded from Avery-Weigh Tronix load cell bars with an XL900 weigh scale indicator and a Shivers 5010 Moisture meter data collector. These measurements were converted to bushels per acre of No. 2 shelled corn (56 lb/bushel) at 15 percent moisture.

Results and Discussion

The treatment of DeKalb Smartstax with Aztec 2.1G had significantly less node-injury than the other treatments, and the untreated checks (DeKalb isoline and Mycogen isoline) had significantly more injury than all other treatments with over two nodes removed (Table 1). No significant differences were found among treatments for stand counts (Table 2). Lodging was significantly greater

for the untreated checks than for any of the other treatments (Table 3). Yield of the untreated checks was significantly less than all other treatments, which did not differ (Table 4).

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Additional Information

Annual reports for the Iowa Evaluation of Insecticides and Plant-Incorporated Protectants are available through the Iowa State University Department of Entomology <http://www.ent.iastate.edu/>.

Table 1. Average root-injury and product consistency for evaluation of insecticide treatments and plant-incorporated protectants.¹

Treatment ^{2,3}	Form.	Rate ⁴	Placement ⁵	Node-injury ^{6,7,8}	Product consistency ^{9,10}
DeKalb-SmartSTAX + Aztec	2.1G	0.14	In-Furrow	0.00a	100a
My-HXX + SmartChoice-SB	5G	0.18	In-Furrow	0.24 b	75ab
My-SmartSTAX	-----	-----	-----	0.38 bc	55ab
DeKalb-Iso + Aztec	2.1G	0.14	In-Furrow	0.64 cd	15 bc
My-HXX + Force	3G	0.12	In-Furrow	0.68 cd	35abc
My-HXX + Counter-SB	20G	0.90	In-Furrow	0.85 d	15 bc
My-95%SSTX/5%Non-Bt ¹¹	-----	-----	-----	0.88 cd	50ab
My-HXX	-----	-----	-----	1.03 de	15 bc
My-Iso + Force	3G	0.12	In-Furrow	1.51 ef	0 c
DeKalb-Iso	-----	-----	-----	2.27 fg	0 c
My-Iso	-----	-----	-----	2.51 g	0 c

¹Planted May 4, 2011; evaluated August 8, 2011.

²My-SmartSTAX = Mycogen Smartstax (Mycogen 2K594); My-HXX = Mycogen brand Herculex XTRA (Mycogen 2K592); DeKalb-SmartSTAX = DeKalb Smartstax (DKC61-21); DeKalb-Iso = DeKalb brand RR Isoline (DKC 61-72); My-Iso = Mycogen brand RR2 (Mycogen 2K591); My-95%SSTX/5%Non-Bt = Mycogen 95% Smartstax + 5% Non-Bt (Refuge in a Bag) (Mycogen 2K594+ Mycogen 2K591).

³My-Iso (Mycogen 2K591) is the isoline of My-HXX (Mycogen 2K592).

⁴Insecticide listed as ounces a.i. per 1,000 row-feet.

⁵In-Furrow = insecticide applied at planting time; SB = SmartBox application at planting time.

⁶Chemical and check means (except My-95%SSTX/5%Non-Bt treatment) based on 20 observations (5 roots/2 rows × 4 replications).

⁷Iowa State Node-Injury scale (0–3). Number of full or partial nodes completely eaten.

⁸Means within a column sharing a common letter do not differ significantly according to Ryan's Q Test ($P \leq 0.05$).

⁹Product consistency = Percentage of times nodal injury was 0.25 (¼ node eaten) or less.

¹⁰Means sharing a common letter do not differ significantly according to Ryan's Q Test ($P \leq 0.05$).

¹¹For the SmartStax with a blended refuge treatment (My-95%SSTX/5%Non-Bt), mean based on 36 observations (9 roots/2 rows (6 Smartstax (3 adjacent roots and 3 distant roots to a Non-Bt plant) + 3 Non-Bt) × 4 replications).

Table 2. Average stand counts for evaluation of insecticide treatments and plant-incorporated protectants.¹

Treatment ^{2,3}	Form.	Rate ⁴	Placement ⁵	Stand count ^{6,7}
My-Iso + Force	3G	0.12	In-Furrow	36.00
DeKalb-Iso + Aztec	2.1G	0.14	In-Furrow	35.75
My-HXX + SmartChoice-SB	5G	0.18	In-Furrow	35.50
My-SmartSTAX	-----	-----	-----	35.50
My-HXX + Counter-SB	20G	0.90	In-Furrow	35.25
DeKalb-SmartSTAX + Aztec	2.1G	0.14	In-Furrow	35.25
My-HXX	-----	-----	-----	34.50
My-Iso	-----	-----	-----	34.50
My-HXX + Force	3G	0.12	In-Furrow	34.25
DeKalb-Iso	-----	-----	-----	34.25
My-95%SSTX/5%Non-Bt	-----	-----	-----	34.00

¹Planted May 4, 2011; evaluated June 7 and September 23, 2011.

²My-SmartSTAX = Mycogen Smartstax (Mycogen 2K594); My-HXX = Mycogen brand Herculex XTRA (Mycogen 2K592); DeKalb-SmartSTAX = DeKalb Smartstax (DKC61-21); DeKalb-Iso = DeKalb brand RR Isoline (DKC 61-72); My-Iso = Mycogen brand RR2 (Mycogen 2K591); My-95%SSTX/5%Non-Bt = Mycogen 95% Smartstax + 5% Non-Bt (Refuge in a Bag) (Mycogen 2K594+ Mycogen 2K591).

³My-Iso (Mycogen 2K591) is the isoline of My-HXX (Mycogen 2K592).

⁴Insecticide listed as ounces a.i. per 1,000 row-feet.

⁵In-Furrow = insecticide applied at planting time; SB = SmartBox application at planting time.

⁶Means based on 16 observations (2-row treatment × 17.5 row-feet/treatment × 4 replications × 2 evaluation dates).

⁷No significant differences between means (ANOVA, P<0.05).

Table 3. Average percent lodging for evaluation of insecticide treatments and plant-incorporated protectants.¹

Treatment ^{2,3}	Form.	Rate ⁴	Placement ⁵	% Lodging ^{6,7}
My-Iso + Force	3G	0.12	In-Furrow	0a
My-SmartSTAX	-----	-----	-----	0a
My-95%SSTX/5%Non-Bt	-----	-----	-----	0a
My-HXX + Force	3G	0.12	In-Furrow	0a
My-HXX	-----	-----	-----	0a
My-HXX + Counter-SB	20G	0.90	In-Furrow	0a
My-HXX + SmartChoice-SB	5G	0.18	In-Furrow	0a
DeKalb-Iso + Aztec	2.1G	0.14	In-Furrow	0a
DeKalb-SmartSTAX + Aztec	2.1G	0.14	In-Furrow	1a
My-Iso	-----	-----	-----	37 b
DeKalb-Iso	-----	-----	-----	61 b

¹Planted May 4, 2011; evaluated September 23, 2011.

²My-SmartSTAX = Mycogen Smartstax (Mycogen 2K594); My-HXX = Mycogen brand Herculex XTRA (Mycogen 2K592); DeKalb-SmartSTAX = DeKalb Smartstax (DKC61-21); DeKalb-Iso = DeKalb brand RR Isoline (DKC 61-72); My-Iso = Mycogen brand RR2 (Mycogen 2K591); My-95%SSTX/5%Non-Bt = Mycogen 95% Smartstax + 5% Non-Bt (Refuge in a Bag) (Mycogen 2K594+ Mycogen 2K591).

³My-Iso (Mycogen 2K591) is the isoline of My-HXX (Mycogen 2K592).

⁴Insecticide listed as ounces a.i. per 1,000 row-feet.

⁵In-Furrow = insecticide applied at planting time; SB = SmartBox application at planting time.

⁶Means based on eight observations (2-row treatment × 17.5 row-feet/treatment × 4 replications).

⁷Means sharing a common letter do not differ significantly according to Ryan's Q Test (P<0.05).

Table 4. Average yield for evaluation of insecticides treatment and plant-incorporated protectants.¹

Treatment ^{2,3}	Form.	Rate ⁴	Placement ⁵	Bushels/acre ^{6,7,8}
DeKalb-Iso + Aztec	2.1G	0.14	In-Furrow	212a
My-HXX + SmartChoice-SB	5G	0.18	In-Furrow	207a
My-SmartSTAX	-----	-----	-----	205a
My-HXX + Force	3G	0.12	In-Furrow	200a
My-HXX + Counter-SB	20G	0.90	In-Furrow	200a
My-HXX	-----	-----	-----	199a
DeKalb-SmartSTAX + Aztec	2.1G	0.14	In-Furrow	197a
My-Iso + Force	3G	0.12	In-Furrow	197a
My-95%SSTX/5%Non-Bt	-----	-----	-----	192a
My-Iso	-----	-----	-----	169 b
DeKalb-Iso	-----	-----	-----	166 b

¹Planted May 4, 2011; machine harvested October 14, 2011.

²My-SmartSTAX = Mycogen Smartstax (Mycogen 2K594); My-HXX = Mycogen brand Herculex XTRA (Mycogen 2K592); DeKalb-SmartSTAX = DeKalb Smartstax (DKC61-21); DeKalb-Iso = DeKalb brand RR Isoline (DKC 61-72); My-Iso = Mycogen brand RR2 (Mycogen 2K591); My-95%SSTX/5%Non-Bt = Mycogen 95% Smartstax + 5% Non-Bt (Refuge in a Bag) (Mycogen 2K594+ Mycogen 2K591).

³My-Iso (Mycogen 2K591) is the isoline of My-HXX (Mycogen 2K592).

⁴Insecticide listed as ounces a.i. per 1,000 row-ft.

⁵In-Furrow = insecticide applied at planting time; SB = SmartBox application at planting time.

⁶Means based on four observations (2-row treatment × 69 row-feet/treatment × 4 replications).

⁷Means sharing a common letter do not differ significantly according to Ryan's Q Test ($P \leq 0.05$).

⁸Yields converted to 15 percent moisture.