2013

Evaluation of Corn Rootworm Management Practices in Northeast Iowa

Aaron J. Gassmann
Iowa State University, aaronjg@iastate.edu

Patrick J. Weber
Iowa State University, pjweber@iastate.edu

Evaluation of Corn Rootworm Management Practices in Northeast Iowa

Abstract
The purpose of this study was to evaluate the effectiveness of Bt corn and soil insecticides, either alone or in combination, for management of corn rootworm. Evaluation of Bt hybrids included Smartstax, YieldGard VT3, Pioneer Optimum AcreMax1, Agrisure 3000GT, and Herculex XTRA. Soil insecticides evaluated were SmartChoice-SB 5G, Counter-SB 20G, Aztec-SB 4.67G, Lorsban 15G, Capture LFR 1.5FL, Aztec 2.1G, Force 3G, and Force 250CS.

Keywords
Entomology

Disciplines
Agricultural Science | Agriculture | Entomology

Evaluation of Corn Rootworm Management Practices in Northeast Iowa

RFR-A1299

Aaron Gassmann, assistant professor
Patrick Weber, agricultural specialist
Department of Entomology

Introduction

The purpose of this study was to evaluate the effectiveness of Bt corn and soil insecticides, either alone or in combination, for management of corn rootworm. Evaluation of Bt hybrids included Smartstax, YieldGard VT3, Pioneer Optimum AcreMax1, Agrisure 3000GT, and Herculex XTRA. Soil insecticides evaluated were SmartChoice-SB 5G, Counter-SB 20G, Aztec-SB 4.67G, Lorsban 15G, Capture LFR 1.5FL, Aztec 2.1G, Force 3G, and Force 250CS.

Materials and Methods

The study was conducted in a field that had been planted the previous year with a trap crop, which is a mixed-maturity blend with a greater proportion of late-maturing varieties. This trap crop constitutes a favorable environment for adult female rootworm 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 design with four replications. Treatments were two rows wide, and 75 feet in length. This study was planted on May 11 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.

The granular insecticides Aztec 2.1G, Force 3G, and Lorsban 15G were applied 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 four mph. Both the Aztec 2.1G and Lorsban 15G insecticides were applied with in-furrow (Furrow) placement and the Force 3G insecticide was applied with T-band placement. The SmartChoice-SB 5G, Counter-SB 20G, and Aztec-SB 4.67G insecticide treatments were applied with modified SmartBox™ 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. The bottom plate had been fabricated so that it could slide in and out of the same planter mounting brackets used for the Noble units. An inverted 1-liter Nalgene bottle attached to the top provided a secure and sealed container for insecticide for the SmartBox™ units. Clear plastic tubes directed the granular insecticides to both the in-furrow and T-band placement.

The liquid insecticides Force 250CS and Capture LFR 1.5FL were applied at planting with a compressed-air system built directly into the planter by Almaco (Nevada, IA). The liquid product Force 250CS was applied T-band and Capture LFR 1.5FL was applied in-furrow. Both were applied as ounces per 1,000 row feet using Teejet XR80015 spray nozzles at 21 psi to deliver 5 GPA of finished spray at a tractor speed of 4 mph.

Eleven-inch poly-bristle skirts were attached to the frame of the planter and positioned so the bristle tips touched the ground. Each row was constantly monitored to ensure that insecticides were applied correctly. Final incorporation was accomplished with drag chains mounted behind the closing wheels.

On June 1, early season stand counts were measured in all treatments. These were measured by laying a 1-in. PVC pipe cut to a length of 17.5 ft between the two rows and counting the number of plants (Table 2).

On September 14, two root systems were dug per replication from all treatments for a total of eight roots per treatment. 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. Roots were then evaluated for rootworm feeding injury following the Iowa State Node-Injury Scale (0-3) (Table 1).

This study was machine harvested on October 4 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 Shivvers 5010 Moisture meter data collector. These measurements were converted to bushels/acre of No. 2 shelled corn (56 lb/bushel) at 15 percent moisture (Table 3).

Percent product consistency was calculated as the percentage of times a treatment limited feeding injury to 0.25 node or less (greater injury can result in economic yield loss, especially when plants are moisture stressed).

All data were analyzed with standard ANOVA procedures using SAS 9.3. When a significant treatment effect was present, pairwise comparisons made among means with an experiment were error rate of $P < 0.05$.

Results and Discussion

There was heavy rootworm pressure at this study location with injury to the untreated checks exceeding 2.5 nodes. This research site also contains pockets of western corn rootworm that are resistant to Cry3Bb1 and mCry3A. Injury to DeKalb VT3 corn (Cry3Bb1) and Agrisure3000GT (mCry3A) corn was very high and did not differ statistically from the untreated checks. Significant reductions in root injury were observed for other Bt traits and for roots protected with soil insecticides.

Because of the high level of root injury and dry conditions in 2012, root injury had a strong effect on yield. Herculex and SmartStax corn alone and VT3 and OAM1 with insecticide were some of the treatments with the highest yields. Insecticides with non-rootworm Bt corn, OAM1 alone, and VT3 alone tended to have intermediate yield. The lowest yields were observed for untreated checks and Agrisure 3000GT.

Additional Information

Due to the 70+ mph winds this farm experienced on July 25, we had severe corn plant lodging throughout these plots, which prevented us from completing late season stand and lodging count measurements.

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/ .

Acknowledgements

We thank Dow AgroSciences, FMC Corporation, Syngenta, and AMVAC for providing the funding for this study. Seed was provided by Monsanto, Pioneer, Syngenta, and Dow AgroSciences. We thank Ken Pecinovsky and his staff for their work on this study.

Table 1. Comparison of corn rootworm management for node injury and product consistency, Nashua, IA.[1]

Treatment[2]	Form.	Rate[3]	Placement[4]	Node-Injury[5,6,7]	Product Consistency[8,9]
Pioneer OAM1 + Capture LFR	1.5FL	0.09	In-Furrow	0.24a	63a
Pioneer HXX + SmartChoice	5G	0.25	SB/In-Furrow	0.27ab	63a
DeKalb VT3 + Aztec	2.1G	0.14	In-Furrow	0.27ab	38ab
Pioneer OAM1 + Force	3G	0.12	T-Band	0.53abc	63a
Agrisure 3000GT + Counter	20G	0.90	SB/In-Furrow	0.56abcd	38ab
Mycogen Smartstax	-------	-------	-------	0.56abcd	13ab
Pioneer non-RW Bt + Lorsban	15G	0.18	In-Furrow	0.76abcd	25ab
Mycogen HXX	-------	-------	-------	0.81abcd	25ab
DeKalb VT3 + Capture LFR	1.5FL	0.09	In-Furrow	0.95abcd	0 b
Pioneer OAM1	-------	-------	-------	0.96abcd	29ab
Pioneer HXX	-------	-------	-------	1.00abcd	13ab
Pioneer non-RW Bt + Aztec	4.67G	0.14	SB/In-Furrow	1.07 cd	13ab
Pioneer non-RW Bt + Force	250CS	0.12	T-Band	1.28 d	13ab
DeKalb VT3	-------	-------	-------	2.32 e[10]	0 b
DeKalb non-RW Bt	-------	-------	-------	2.64 e	0 b
Mycogen non-RW Bt	-------	-------	-------	2.65 e	0 b
Agrisure 3000GT	-------	-------	-------	2.65 e	0 b
Pioneer non-RW Bt	-------	-------	-------	2.66 e	0 b
Agrisure non-RW Bt	-------	-------	-------	2.79 e	0 b

[1]Planted May 11, 2012; evaluated September 14, 2012.

[2]Non-RW Bt = an absence of any Bt trait targeting corn rootworm; Mycogen HXX = Mycogen brand Herculex XTRA (Mycogen 2K592); Mycogen non-RW Bt = Mycogen brand RR2 (Mycogen 2K591); Mycogen Smartstax = Mycogen Smartstax (Mycogen 2K594); DeKalb VT3 = YieldGard VT Triple (DKC59-88); DeKalb non-RW Bt = DeKalb brand RR Isoline (DKC 59-89); Pioneer OAM1 = Pioneer refuge in a bag (P0461 AMX-R); Pioneer non-RW Bt = Pioneer Herculex 1 (P0987HR); Pioneer HXX = Pioneer Herculex XTRA (P0987XR); Agrisure non-RW Bt = Syngenta (Golden Harvest brand) glyphosate tolerant hybrid (Agrisure H-8211 GT); Agrisure 3000GT = Syngenta (Golden Harvest brand) rootworm hybrid (Agrisure H-8211 3000GT).

[3]Insecticide listed as ounces a.i. per 1,000 row-feet.

[4]In-Furrow & T-Band = insecticide applied at planting time; SB = SmartBox application at planting time.

[5]Chemical and check means based on 8 observations (2 roots/2 rows × 4 replications).

[6]Iowa State Node-Injury scale (0-3). Number of full or partial nodes completely eaten.

[7]Means sharing a common letter do not differ significantly.

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

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

[10]This mean based on 16 observations (2 roots/2 rows × 8 replications).

Table 2. Comparison of corn rootworm management for stand count, Nashua, IA.[1]

Treatment[2]	Form.	Rate[3]	Placement[4]	Stand Count[5,6]
Mycogen Smartstax	-------	-------	-------	37.00a
DeKalb VT3 + Capture LFR	1.5FL	0.09	In-Furrow	36.25a
Pioneer non-RW Bt + Aztec	4.67G	0.14	SB/In-Furrow	36.00a
DeKalb VT3	-------	-------	-------	36.00a[7]
DeKalb non-RW Bt	-------	-------	-------	36.00a
Pioneer HXX + SmartChoice	5G	0.25	SB/In-Furrow	36.00a
Pioneer non-RW Bt + Force	250CS	0.12	T-Band	35.75a
DeKalb VT3 + Aztec	2.1G	0.14	In-Furrow	35.50ab
Pioneer non-RW Bt	-------	-------	-------	35.50ab
Mycogen HXX	-------	-------	-------	35.50ab
Pioneer OAM1	-------	-------	-------	35.00ab
Agrisure non-RW Bt	-------	-------	-------	35.00ab
Mycogen non-RW Bt	-------	-------	-------	34.75ab
Pioneer OAM1 + Capture LFR	1.5FL	0.09	In-Furrow	34.50ab
Pioneer HXX	-------	-------	-------	34.50ab
Pioneer OAM1 + Force	3G	0.12	T-Band	34.50ab
Pioneer non-RW Bt + Lorsban	15G	0.18	In-Furrow	34.25ab
Agrisure 3000GT + Counter	20G	0.90	SB/In-Furrow	33.00ab
Agrisure 3000GT	-------	-------	-------	31.50 b

[1]Planted May 11, 2012; evaluated June 1, 2012.

[2]Non-RW Bt = an absence of any Bt trait targeting corn rootworm; Mycogen HXX = Mycogen brand Herculex XTRA (Mycogen 2K592); Mycogen non-RW Bt = Mycogen brand RR2 (Mycogen 2K591); Mycogen Smartstax = Mycogen Smartstax (Mycogen 2K594); DeKalb VT3 = YieldGard VT Triple (DKC59-88); DeKalb non-RW Bt = DeKalb brand RR Isoline (DKC 59-89); Pioneer OAM1 = Pioneer refuge in a bag (P0461 AMX-R); Pioneer non-RW Bt = Pioneer Herculex 1 (P0987HR); Pioneer HXX = Pioneer Herculex XTRA (P0987XR); Agrisure non-RW Bt = Syngenta (Golden Harvest brand) glyphosate tolerant hybrid (Agrisure H-8211 GT); Agrisure 3000GT = Syngenta (Golden Harvest brand) rootworm hybrid (Agrisure H-8211 3000GT).

[3]Insecticide listed as ounces a.i. per 1,000 row-feet.

[4]In-Furrow & T-Band = insecticide applied at planting time; SB = SmartBox application at planting time.

[5]Means based on 8 observations (2-row treatment × 17.5 row-feet/treatment × 4 replications).

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

[7]This mean based on 16 observations (2-row treatment × 17.5 row-feet/treatment × 8 replications)

Table 3. Comparison of rootworm management for yield, Nashua, IA.[1]

Treatment[2]	Form.	Rate[3]	Placement[4]	Bushels/ Acre[5,6,7]
Pioneer HXX + SmartChoice	5G	0.25	SB/In-Furrow	158a
Mycogen Smartstax	-------	-------	-------	133ab
Pioneer HXX	-------	-------	-------	119abc
Pioneer OAM1 + Capture LFR	1.5FL	0.09	In-Furrow	109abcd
Mycogen HXX	-------	-------	-------	103 bcde
DeKalb VT3 + Capture LFR	1.5FL	0.09	In-Furrow	99 bcdef
DeKalb VT3 + Aztec	2.1G	0.14	In-Furrow	85 bcdef
Pioneer non-RW Bt + Lorsban	15G	0.18	In-Furrow	82 cdef
Pioneer OAM1	-------	-------	-------	79 cdef
Agrisure 3000GT + Counter	20G	0.90	SB/In-Furrow	72 cdef
DeKalb VT3	-------	-------	-------	69 def[8]
Pioneer non-RW Bt + Aztec	4.67G	0.14	SB/In-Furrow	69 def
Pioneer OAM1 + Force	3G	0.12	T-Band	57 efg
Pioneer non-RW Bt + Force	250CS	0.12	T-Band	53 fgh
DeKalb non-RW Bt	-------	-------	-------	53 fgh
Mycogen non-RW Bt	-------	-------	-------	33 gh
Agrisure 3000GT	-------	-------	-------	29 gh
Pioneer non-RW Bt	-------	-------	-------	28 gh
Agrisure non-RW Bt	-------	-------	-------	24 h

[1]Planted May 11, 2012; machine harvested October 4, 2012.

[2]Non-RW Bt = an absence of any Bt trait targeting corn rootworm; Mycogen HXX = Mycogen brand Herculex XTRA (Mycogen 2K592); Mycogen non-RW Bt = Mycogen brand RR2 (Mycogen 2K591); Mycogen Smartstax = Mycogen Smartstax (Mycogen 2K594); DeKalb VT3 = YieldGard VT Triple (DKC59-88); DeKalb non-RW Bt = DeKalb brand RR Isoline (DKC 59-89); Pioneer OAM1 = Pioneer refuge in a bag (P0461 AMX-R); Pioneer non-RW Bt = Pioneer Herculex 1 (P0987HR); Pioneer HXX = Pioneer Herculex XTRA (P0987XR); Agrisure non-RW Bt = Syngenta (Golden Harvest brand) glyphosate tolerant hybrid (Agrisure H-8211 GT); Agrisure 3000GT = Syngenta (Golden Harvest brand) rootworm hybrid (Agrisure H-8211 3000GT).

[3]Insecticide listed as ounces a.i. per 1,000 row-feet.

[4]In-Furrow & T-Band = insecticide applied at planting time; SB = SmartBox application at planting time.

[5]Means based on 4 observations (2-row treatment × 68 row-feet/treatment × 4 replications).

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

[7]Yields converted to15% moisture.

[8]This mean based on 8 observations (2-row treatment × 68 row-feet/treatment × 8 replications).