SECTION 2

Evaluation of Bt hybrids, seed-blends, and Force 3G to control corn rootworm larvae (*Diabrotica* spp.) in Illinois, 2013

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Locations

We established one trial at the Northern Illinois Agronomy Research Center near DeKalb (DeKalb County) and one trial at the Brad Lindskog Farm near Prophetstown (Whiteside County).

Experimental Design and Methods

The experimental design was a randomized complete block with four replications. The plot width for each treatment was 10 ft (four rows)—plot lengths for each treatment were 30 and 40 ft at Prophetstown and DeKalb, respectively. For seed-blend treatments, two root clusters were extracted from row one of each plot on 22 and 30 July at Prophetstown and DeKalb, respectively. Each cluster contained a non-rootworm Bt refuge root system and two adjacent rootworm Bt root systems. For non-seed-blend treatments, six randomly selected root systems were extracted from row one of each plot. Root systems were washed and rated for corn rootworm larval injury using the 0 to 3 node-injury scale developed by Oleson et al. (2005) (Appendix I). The percentage of roots with a node-injury rating less than 0.25 was determined for each product. For seed-blend treatments, a weighted formula (see Appendix I) was used to calculate the mean node-injury rating and consistency percentage.

Planting, Insecticide Application, and Yield

Trials were planted on 13 and 14 May at Prophetstown and DeKalb, respectively. Both trials were planted using a four-row, vacuum style planter constructed by Seed Research Equipment Solutions (SRES). Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. Force 3G was applied through modified Noble metering units mounted to each row. Plastic tubes directed the insecticide granules into the seed furrow. The insecticide was applied in front of the firming wheels on the planter. Twisted drag chains were attached behind each of the row units to improve insecticide incorporation. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 8 and 29 November at Prophetstown and DeKalb, respectively. Weights were converted to bushels per acre (bu/A) at 15.5% moisture. To ensure uniform plant densities across all plots, plant populations in the harvested rows were thinned at the V6–V7 growth stage to 30,000 plants per acre.

TABLE 2.1 • Agronomic information for efficacy trials of Bt hybrids, seed-blends, and Force 3G to control corn rootworm larvae, University of Illinois, 2013

	DeKalb	Prophetstown
Planting date	14 May	13 May
Root evaluation date	30 July	22 July
Harvest date	29 November	8 November
Hybrids	Mycogen 2T777 Roundup Ready 2 Mycogen 2T784 SmartStax Mycogen 2T789 Herculex XTRA	Mycogen 2T777 Roundup Ready 2 Mycogen 2T784 SmartStax Mycogen 2T789 Herculex XTRA
Row spacing	30 inches	30 inches
Seeding rate	36,000/acre	36,000/acre
Previous crop	Trap crop[1]	Trap crop[1]
Tillage	Fall—disc ripper Spring—discovator	Fall—chisel plow Spring—field cultivator

[1] Late-planted corn and pumpkins.

Agronomic Information

Agronomic information is listed in Table 2.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using SAS 9.2 (Copyright© 2002–2008 SAS Institute, Inc., Cary, NC).

Results and Discussion

DeKalb—Mean node-injury ratings, consistency percentages, and yields are reported in Table 2.2. The mean node-injury rating for the untreated check (UTC) was 1.13. Mean node-injury ratings for the remainder of the treatments ranged from 0.01 to 0.18 and were significantly lower than the mean node-injury rating for the UTC. No significant differences among mean node-injury ratings for these treatments were observed. The mean consistency percentage for the UTC was 13%. Mean consistency percentages for the remainder of the treatments ranged from 83 to 100% and were significantly higher than

TABLE 2.2 • Evaluation of Bt hybrids, seed-blends, and Force 3G to control corn rootworm larvae, DeKalb, University of Illinois, 2013

Product	Rate[1]	Placement 14 May	Mean node-injury rating[2–6] 30 July	Mean % consistency < 0.25[5,7,8]	Mean yield (bu/A)[9,10] 29 Nov
90% Herculex XTRA (Mycogen 2T789[11]) + 10% Mycogen 2T777[11]	—	—	0.11 b	90 a	146.0 ab
95% SmartStax (Mycogen 2T784[11]) + 5% Mycogen 2T777[11]	—	—	0.08 b	96 a	123.6 cde
Force 3G + 90% Herculex XTRA (Mycogen 2T789[11]) + 10% Mycogen 2T777[11]	4.04	NU furrow[12]	0.04 b	96 a	149.9 a
Force 3G + 95% SmartStax (Mycogen 2T784[11]) + 5% Mycogen 2T777[11]	4.04	NU furrow[12]	0.03 b	100 a	116.0 de
Force 3G + Herculex XTRA (Mycogen 2T789[11])	4.04	NU furrow[12]	0.03 b	100 a	142.2 abc
Force 3G + Mycogen 2T777[11]	4.04	NU furrow[12]	0.18 b	83 a	122.1 cde
Force 3G + SmartStax (Mycogen 2T789[11])	4.04	NU furrow[12]	0.01 b	100 a	137.1 a–d
Herculex XTRA (Mycogen 2T789[11])	—	—	0.11 b	83 a	125.7 b–e
SmartStax (Mycogen 2T784[11])	—	—	0.04 b	100 a	113.1 e
Untreated check (Mycogen 2T777[11])	—	—	1.13 a	13 b	84.1 f

[1] Rates of application for Force 3G are ounces (oz) of product per 1,000 ft of row.
[2] Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
[3] For non-seed-blend treatments, mean node-injury ratings were derived from six root systems per plot in each of four replications.
[4] For seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean-node injury ratings.
[5] Means followed by the same letter do not differ significantly ($P = 0.05$, PROC MIXED).
[6] Data were analyzed using a square-root transformation; actual means are shown.
[7] Percentage of roots with a node-injury rating < 0.25.
[8] For the seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean consistency percentages.
[9] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[10] Means followed by the same letter do not differ significantly ($P = 0.1$, PROC MIXED).
[11] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] Applied with modified Noble metering units.

the mean consistency percentage for the UTC. No significant differences among mean consistency percentages for these treatments were observed. The mean yield for the UTC was 84.1 bu/A and was significantly lower than the mean yields for all of the products evaluated. Mean yields for the Herculex and SmartStax seed-blend treatments were statistically similar to those for the Herculex and SmartStax pure-stand treatments. The addition of Force 3G to the Bt products resulted in a statistically greater mean yield for the SmartStax pure-stand treatment, but not for the other Bt products.

Prophetstown—Mean node-injury ratings, consistency percentages, and yields are reported in Table 2.3. The mean node-injury rating for the UTC was 0.61. Mean node-injury ratings for the remainder of the treatments ranged from 0.01 to 0.15 and were significantly lower than the mean node-injury rating for the UTC. No significant differences among mean node-injury ratings for these treatments were observed. The mean consistency percentage for the UTC was 59%. Mean consistency percentages for the remainder of the treatments ranged from 88 to 100% and were significantly higher than the mean consistency percentage for the UTC. No significant differences among mean consistency percentages for these treatments were observed. The mean yield for the UTC was 175.3 bu/A. Of the products evaluated, only the SmartStax and Force 3G treatments failed to yield significantly more than the UTC. Mean yields for the Herculex and SmartStax seed-blend treatments were statistically similar to those for the Herculex and SmartStax pure-stand treatments. The addition of Force 3G to any of the Bt products evaluated did not result in a statistically greater mean yield.

TABLE 2.3 • Evaluation of Bt hybrids, seed-blends, and Force 3G to control corn rootworm larvae, Prophetstown, University of Illinois, 2013

Product	Rate[1]	Placement 13 May	Mean node-injury rating[2–6] 22 July	Mean % consistency < 0.25[5,7,8]	Mean yield (bu/A)[9,10] 8 Nov
90% Herculex XTRA (Mycogen 2T789[11]) + 10% Mycogen 2T777[11]	—	—	0.15 b	93 a	215.1 ab
95% SmartStax (Mycogen 2T784[11]) + 5% Mycogen 2T777[11]	—	—	0.04 b	98 a	209.8 ab
Force 3G + 90% Herculex XTRA (Mycogen 2T789[11]) + 10% Mycogen 2T777[11]	4.04	NU furrow[12]	0.02 b	100 a	217.4 ab
Force 3G + 95% SmartStax (Mycogen 2T784[11]) + 5% Mycogen 2T777[11]	4.04	NU furrow[12]	0.02 b	100 a	202.7 ab
Force 3G + Herculex XTRA (Mycogen 2T789[11])	4.04	NU furrow[12]	0.01 b	100 a	217.7 ab
Force 3G + Mycogen 2T777[11]	4.04	NU furrow[12]	0.14 b	88 a	190.0 bc
Force 3G + SmartStax (Mycogen 2T789[11])	4.04	NU furrow[12]	0.02 b	100 a	212.7 ab
Herculex XTRA (Mycogen 2T789[11])	—	—	0.03 b	100 a	230.5 a
SmartStax (Mycogen 2T784[11])	—	—	0.04 b	96 a	197.4 bc
Untreated check (Mycogen 2T777[11])	—	—	0.61 a	59 b	175.3 c

[1] Rates of application for Force 3G are ounces (oz) of product per 1,000 ft of row.
[2] Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
[3] For non-seed-blend treatments, mean node-injury ratings were derived from six root systems per plot in each of four replications.
[4] For seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean-node injury ratings.
[5] Means followed by the same letter do not differ significantly ($P = 0.05$, PROC MIXED).
[6] Data were analyzed using a square-root transformation; actual means are shown.
[7] Percentage of roots with a node-injury rating < 0.25.
[8] For the seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean consistency percentages.
[9] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
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