



CORN

SECTION 3

Evaluation of Bt hybrids, seed-blends, and soil-applied insecticides to control corn rootworm larvae (*Diabrotica spp.*) in Illinois, 2012

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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 Northwestern Illinois Agricultural Research and Demonstration Center near Monmouth (Warren County).

Experimental Design and Methods

The experimental design was a randomized complete block with four replications. The plot size for each treatment was 10 ft (four rows) x 20 ft. For seed-blend treatments, two root clusters were extracted from row one of each plot on 10 and 16 July at Monmouth 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 23 April at both DeKalb and Monmouth. 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. Granular insecticides were applied through modified Noble metering units mounted to each row. Plastic tubes directed the insecticide granules into the seed furrow. Force CS was applied at a spray volume of 5 gallons per acre (gal/A) using a CO₂ system. All insecticides were 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 12 September at Monmouth and on 16 October at DeKalb. 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 had been thinned at the V6 to V7 growth stage to 33,000 plants per acre.

Agronomic Information

Agronomic information is listed in Table 3.1.

TABLE 3.1 • Agronomic information for efficacy trials of Bt hybrids, seed-blends, and soil-applied insecticides to control corn rootworm larvae, University of Illinois, 2012

	DeKalb	Monmouth
Planting date	23 April	23 April
Root evaluation date	16 July	10 July
Harvest date	16 October	12 September
Hybrids	Mycogen 2K591 RR2 Mycogen 2K592 Herculex XTRA Mycogen 2K594 SmartStax	Mycogen 2K591 RR2 Mycogen 2K592 Herculex XTRA Mycogen 2K594 SmartStax
Row spacing	30 inches	30 inches
Seeding rate	36,000/acre	36,000/acre
Previous crop	Trap crop ¹	Trap crop ¹
Tillage	Fall—moldboard plow Spring—mulch finisher	Fall—chisel plow Spring—soil finisher

¹ Late-planted corn and pumpkins.



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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 3.2. The mean node-injury

rating for the untreated check (UTC) was 2.28, indicating that corn rootworm larval feeding was severe. Adding Force CS to the UTC enhanced root protection; however, the mean node-injury rating for this treatment remained relatively high (0.75). Mean node-injury ratings for the remainder of the treatments were low (< 0.25)—this trend excluded the 90% Herculex XTRA/10% UTC seed-blend. The mean consistency percentage for the UTC was 0.0%. Adding Force CS to the UTC failed to significantly improve the mean consistency percentage. Mean consistency percentages were relatively high (≥ 75%) for the remainder of the treatments; again, this trend

TABLE 3.2 • Evaluation of Bt hybrids, seed-blends, and soil-applied insecticides to control corn rootworm larvae, DeKalb, University of Illinois, 2012

Product	Rate ¹	Placement	Mean node-injury rating ²⁻⁶ 16 July	Mean % consistency < 0.25 ^{5,7,8}	Mean yield (bu/A) ^{9,10} 16 Oct
90% Herculex XTRA (Mycogen 2K592 ¹¹) + 10% Mycogen 2K591 ¹¹	—	—	0.43 c	55 c	153.0 abc
95% SmartStax (Mycogen 2K594 ¹¹) + 5% Mycogen 2K591 ¹¹	—	—	0.12 de	87 ab	157.0 abc
Aztec 2.1G + Herculex XTRA (Mycogen 2K592 ¹¹)	6.7	NU furrow ¹³	0.02 e	100 a	159.1 ab
Force CS + 90% Herculex XTRA (Mycogen 2K592 ¹¹) + 10% Mycogen 2K591 ¹¹	0.46	Band	0.10 de	93 ab	141.5 c
Force CS + 95% SmartStax (Mycogen 2K594 ¹¹) + 5% Mycogen 2K591 ¹¹	0.46	Band	0.04 de	99 a	159.2 ab
Force CS + Herculex XTRA (Mycogen 2K592 ¹¹)	0.46	Band	0.05 de	96 ab	164.7 ab
Force CS + Mycogen 2K591 ¹¹	0.46	Band	0.75 b	13 d	59.2 d
Force CS + SmartStax (Mycogen 2K594 ¹¹)	0.46	Band	0.03 e	100 a	167.3 a
Lorsban 15G + Herculex XTRA (Mycogen 2K592 ¹¹)	8	NU furrow ¹³	0.10 de	79 abc	154.4 abc
Herculex XTRA (Mycogen 2K592 ¹¹)	—	—	0.18 d	75 bc	149.7 bc
SmartStax (Mycogen 2K594 ¹¹)	—	—	0.07 de	100 a	159.6 ab
UTC ¹² (Mycogen 2K591 ¹¹)	—	—	2.28 a	0 d	21.9 e

¹ Rates of application for band and furrow placements 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 ($P = 0.10$, PROC MIXED).

¹¹ Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.

¹² UTC = untreated check.

¹³ Applied with modified Noble metering units.



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excluded the 90% Herculex XTRA/10% UTC seed-blend. The mean yield for the UTC was 21.9 bu/A. Adding Force CS to the UTC resulted in a significantly greater mean yield. The mean yields for Herculex XTRA, 90% Herculex XTRA/10% UTC, and 95% SmartStax/5% UTC were statistically similar. Adding an insecticide (Aztec 2.1G, Force CS, or Lorsban 15G) to these treatments did not result in significantly improved mean yields.

Monmouth—Mean node-injury ratings, consistency percentages, and yields are reported in Table 3.3. The mean node-injury rating for the UTC was 0.020, indicating that

corn rootworm larval feeding was virtually absent. Mean node-injury ratings for all treatments were exceedingly low (< 0.05). Although some significant differences among treatments were observed, the extremely low mean node-injury ratings suggest that such differences are not biologically significant. The mean consistency percentage for all treatments (including the UTC) was 100.0%—no significant differences were observed. Mean yields for all treatments were very high (172.2–216.6 bu/A). Although some significant differences were observed, the virtual absence of root injury suggests that differences in yield were not caused by corn rootworm larval feeding.

TABLE 3.3 • Evaluation of Bt hybrids, seed-blends, and soil-applied insecticides to control corn rootworm larvae, Monmouth, University of Illinois, 2012

Product	Rate ¹	Placement	Mean node-injury rating ²⁻⁶ 10 July	Mean % consistency < 0.25 ^{5,7,8}	Mean yield (bu/A) ^{9,10} 12 Sep
90% Herculex XTRA (Mycogen 2K592 ¹¹) + 10% Mycogen 2K591 ¹¹	—	—	0.015 abc	100 a	201.5 ab
95% SmartStax (Mycogen 2K594 ¹¹) + 5% Mycogen 2K591 ¹¹	—	—	0.010 bcd	100 a	216.6 a
Aztec 2.1G + Herculex XTRA (Mycogen 2K592 ¹¹)	6.7	NU furrow ¹³	0.000 d	100 a	204.5 ab
Force CS + 90% Herculex XTRA (Mycogen 2K592 ¹¹) + 10% Mycogen 2K591 ¹¹	0.46	Band	0.005 cd	100 a	188.6 bc
Force CS + 95% SmartStax (Mycogen 2K594 ¹¹) + 5% Mycogen 2K591 ¹¹	0.46	Band	0.003 d	100 a	193.5 bc
Force CS + Herculex XTRA (Mycogen 2K592 ¹¹)	0.46	Band	0.005 cd	100 a	188.9 bc
Force CS + Mycogen 2K591 ¹¹	0.46	Band	0.023 a	100 a	180.1 cd
Force CS + SmartStax (Mycogen 2K594 ¹¹)	0.46	Band	0.000 d	100 a	200.2 b
Lorsban 15G + Herculex XTRA (Mycogen 2K592 ¹¹)	8	NU furrow ¹³	0.005 cd	100 a	198.3 b
Herculex XTRA (Mycogen 2K592 ¹¹)	—	—	0.010 bcd	100 a	198.9 b
SmartStax (Mycogen 2K594 ¹¹)	—	—	0.007 bcd	100 a	195.4 bc
UTC ¹² (Mycogen 2K591 ¹¹)	—	—	0.020 ab	100 a	172.2 d

¹ Rates of application for band and furrow placements 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 the 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 ($P = 0.10$, PROC MIXED).

¹¹ Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.

¹² UTC = untreated check.

¹³ Applied with modified Noble metering units.