SECTION 4

Evaluation of soil-applied insecticides and a Bt hybrid seed-blend to control corn rootworm larvae (*Diabrotica* spp.) in Illinois, 2014

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Locations

We established three trials at University of Illinois research and education centers near DeKalb (DeKalb County), Monmouth (Warren County), and Urbana (Champaign 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 40 ft. Five randomly selected root systems were extracted from the first row of each plot on 14, 16, and 28 July at Monmouth, Urbana, and DeKalb, respectively. 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 (i.e., consistency percentage) was determined for each product at each location.

Planting, Insecticide Application, and Yield

Trials were planted on 6, 8, and 12 May at Monmouth, DeKalb, and Urbana, respectively. All 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. Liquid insecticides were applied at a spray volume of 5 gallons per acre using a CO_2 system. All insecticides were applied in front of the firming wheels on the planter. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 2 and 7 November at DeKalb and Urbana, 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

TABLE 4.1 • Agronomic information for efficacy trials of soil-applied insecticides and a Bt hybrid seed-blend to control corn rootworm larvae, University of Illinois, 2014

	DeKalb	Monmouth	Urbana
Planting date	8 May	6 May	12 May
Root evaluation date	28 July	14 July	16 July
Harvest date	2 November	—	7 November
Hybrid	DEKALB DKC61-88 Genuity VT Triple Pro DEKALB DKC61-88RIB Genuity VT Triple Pro RIB Complete[1] DEKALB DKC61-86 Roundup Ready 2	DEKALB DKC61-88 Genuity VT Triple Pro DEKALB DKC61-88RIB Genuity VT Triple Pro RIB Complete[1] DEKALB DKC61-86 Roundup Ready 2	DEKALB DKC61-88 Genuity VT Triple Pro DEKALB DKC61-88RIB Genuity VT Triple Pro RIB Complete[1] DEKALB DKC61-86 Roundup Ready 2
Row spacing	30 inches	30 inches	30 inches
Seeding rate	36,600/acre	36,600/acre	36,600/acre
Previous crop	Trap crop[2]	Trap crop[2]	Trap crop[2]
Tillage	Fall—none Spring—discovator	Fall—disc plow Spring—field cultivator	Fall—chisel plow Spring—field cultivator

[1] Contains a 10% refuge-in-the-bag (non-rootworm Bt) seed blend.
[2] Late-planted corn and pumpkins.

V6–V8 growth stage to 36,000 plants per acre. Due to severe lodging, plots were not harvested at Monmouth. Lodging evaluations were performed at this location by determining the percentage of plants lodged (i.e., leaning 45° or less from the soil surface) in the center two rows of each plot.

Agronomic Information

Agronomic information for all locations is listed in Table 4.1.

Climatic Conditions

Temperature and precipitation data for all locations are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 9 (Agricultural Research Manager), revision 9.2014.2 (Copyright© 1982–2014 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

DeKalb—Mean node-injury ratings, consistency percentages, and yields are reported in Table 4.2. The mean node-injury rating for the untreated check (UTC) was 1.03, indicating that corn rootworm larval feeding was moderate. Mean node-injury ratings for all treatments with a soil-applied insecticide (Aztec 2.1G, Capture LFR, or Force 3G) were significantly lower

TABLE 4.2 • Evaluation of soil-applied insecticides and a Bt hybrid seed-blend to control corn rootworm larvae, DeKalb, University of Illinois, 2014

Product	Rate[1]	Placement 8 May	Mean node-injury rating[2–5] 28 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 2 Nov
Aztec 2.1G + Genuity VT Triple Pro (DEKALB DKC61-88[9])	6.7	NU furrow[11]	0.02 b	100 a	198.6 ab
Aztec 2.1G + Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	6.7	NU furrow[11]	0.03 b	100 a	201.0 a
Capture LFR + Starter fertilizer (10-34-0) + Genuity VT Triple Pro (DEKALB DKC61-88[9])	0.49	Furrow	0.14 b	90 a	197.4 ab
Capture LFR + Starter fertilizer (10-34-0) + Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	0.49	Furrow	0.17 b	80 a	200.4 ab
Force 3G + Genuity VT Triple Pro (DEKALB DKC61-88[9])	4	NU furrow[11]	0.03 b	99 a	194.7 abc
Force 3G + Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	4	NU furrow[11]	0.04 b	100 a	197.4 ab
Genuity VT Triple Pro (DEKALB DKC61-88[9])	—	—	0.80 a	25 b	191.4 bc
Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	—	—	0.28 b	75 a	187.4 c
Untreated check (DEKALB DKC61-86[9])	—	—	1.03 a	20 b	164.0 d

[1] Rates of application for soil-applied insecticides 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] Mean node-injury ratings were derived from five root systems per plot in each of four replications.
[4] Means followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[5] Data were analyzed using a square-root transformation; actual means are shown.
[6] Percentage of roots with a node-injury rating < 0.25.
[7] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[8] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[9] Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.
[10] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[11] Applied with modified Noble metering units.

than for Genuity VT Triple Pro or the UTC. For reasons that remain unclear, Genuity VT Triple Pro RIB Complete had a significantly lower mean node-injury rating than its non-RIB counterpart (Genuity VT Triple Pro). Consistency percentages mirrored node-injury ratings, with Genuity VT Triple Pro and the UTC having significantly lower mean consistency percentages than all other treatments.

Mean yield for the UTC (164.0 bu/A) was significantly lower than all other treatments. Aztec 2.1G + Genuity VT Triple Pro RIB Complete (201.0 bu/A) had significantly higher mean yields than Genuity VT Triple Pro (191.4 bu/A), Genuity VT Triple Pro RIB Complete (187.4 bu/A) or the UTC. Mean yields for all soil-applied insecticides were statistically similar, despite the addition of starter fertilizer (10-34-0) to Capture LFR.

Monmouth—Mean node-injury ratings, consistency percentages, and lodging percentages are reported in Table 4.3. The mean node-injury rating for the UTC was 2.32, indicating that corn rootworm larval feeding was severe. Mean node-injury ratings for Genuity VT Triple Pro, Genuity VT Triple Pro RIB Complete, and the UTC were significantly higher than for all other treatments. Aztec 2.1G + Genuity VT Triple Pro, Aztec 2.1G + Genuity VT Triple Pro RIB Complete, and Force 3G + Genuity VT Triple Pro had significantly lower mean node-injury ratings than Force 3G + Genuity VT Triple Pro RIB Complete or either of the treatments with

TABLE 4.3 • Evaluation of soil-applied insecticides and a Bt hybrid seed-blend to control corn rootworm larvae, Monmouth, University of Illinois, 2014

Product	Rate[1]	Placement 6 May	Mean node-injury rating[2–5] 14 July	Mean % consistency < 0.25[4,6]	Mean % lodging[4,7] 24 Sep
Aztec 2.1G + Genuity VT Triple Pro (DEKALB DKC61-88[8])	6.7	NU furrow[10]	0.45 d	30 b	33 c
Aztec 2.1G + Genuity VT Triple Pro RIB Complete[9] (DEKALB DKC61-88RIB[8])	6.7	NU furrow[10]	0.35 d	55 a	29 c
Capture LFR + Starter fertilizer (10-34-0) + Genuity VT Triple Pro (DEKALB DKC61-88[8])	0.49	Furrow	1.09 c	10 bc	86 a
Capture LFR + Starter fertilizer (10-34-0) + Genuity VT Triple Pro RIB Complete[9] (DEKALB DKC61-88RIB[8])	0.49	Furrow	1.08 c	15 bc	80 a
Force 3G + Genuity VT Triple Pro (DEKALB DKC61-88[8])	4	NU furrow[10]	0.39 d	30 b	58 b
Force 3G + Genuity VT Triple Pro RIB Complete[9] (DEKALB DKC61-88RIB[8])	4	NU furrow[10]	0.89 c	5 c	73 ab
Genuity VT Triple Pro (DEKALB DKC61-88[8])	—	—	1.73 b	0 c	85 a
Genuity VT Triple Pro RIB Complete[9] (DEKALB DKC61-88RIB[8])	—	—	1.53 b	1 c	91 a
Untreated check (DEKALB DKC61-86[8])	—	—	2.32 a	0 c	88 a

[1] Rates of application for soil-applied insecticides 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] Mean node-injury ratings were derived from five root systems per plot in each of four replications.
[4] Means followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[5] Data were analyzed using a square-root transformation; actual means are shown.
[6] Percentage of roots with a node-injury rating < 0.25.
[7] Percentage of plants leaning 45° or less from the soil surface.
[8] Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.
[9] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[10] Applied with modified Noble metering units.

Capture LFR. Mean consistency percentages for Genuity VT Triple Pro, Genuity VT Triple Pro RIB Complete, Force 3G + Genuity VT Triple Pro RIB Complete, and the UTC were extremely low (5% or less). Aztec 2.1G + Genuity VT Triple Pro RIB Complete had a significantly higher mean consistency percentage (55%) than all other treatments.

Lodging at this location was extensive—mean lodging percentages for Genuity VT Triple Pro and Genuity VT Triple Pro RIB Complete (both with and without Capture LFR), as well as the UTC, were all equal to or greater than 80%. Mean lodging percentages for treatments with Aztec 2.1G ranged from 29 to 33% and were significantly lower than for all other treatments. Force 3G + Genuity VT Triple Pro had a significantly lower mean lodging percentage than Genuity VT Triple Pro and Genuity VT Triple Pro RIB Complete (both with and without Capture LFR), as well as the UTC.

Urbana—Mean node-injury ratings, consistency percentages, and yields are reported in Table 4.4. The mean node-injury rating for the UTC was 1.44, indicating that corn rootworm larval feeding was moderate to severe. Mean node-injury ratings for Genuity VT Triple Pro, Genuity VT Triple Pro RIB Complete, and the UTC were greater than 1.00 and were all statistically similar. Aztec 2.1G + Genuity VT Triple Pro, Aztec 2.1G + Genuity VT Triple Pro RIB Complete, and Force 3G + Genuity VT Triple Pro RIB Complete had significantly lower mean node-injury ratings than Capture LFR + Genuity VT Triple Pro RIB Complete. Mean consistency percentages for Genuity VT Triple Pro and Genuity VT

TABLE 4.4 • Evaluation of soil-applied insecticides and a Bt hybrid seed-blend to control corn rootworm larvae, Urbana, University of Illinois, 2014

Product	Rate[1]	Placement 12 May	Mean node-injury rating[2–5] 16 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 7 Nov
Aztec 2.1G + Genuity VT Triple Pro (DEKALB DKC61-88[9])	6.7	NU furrow[11]	0.11 d	90 a	186.0 ab
Aztec 2.1G + Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	6.7	NU furrow[11]	0.34 d	50 b	188.8 ab
Capture LFR + Starter fertilizer (10-34-0) + Genuity VT Triple Pro (DEKALB DKC61-88[9])	0.49	Furrow	0.52 cd	40 bc	193.9 ab
Capture LFR + Starter fertilizer (10-34-0) + Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	0.49	Furrow	0.91 bc	10 cd	179.4 bc
Force 3G + Genuity VT Triple Pro (DEKALB DKC61-88[9])	4	NU furrow[11]	0.56 cd	43 bc	201.3 a
Force 3G + Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	4	NU furrow[11]	0.28 d	60 ab	187.9 ab
Genuity VT Triple Pro (DEKALB DKC61-88[9])	—	—	1.51 a	5 cd	159.6 d
Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC61-88RIB[9])	—	—	1.15 ab	0 d	154.1 d
Untreated check (DEKALB DKC61-86[9])	—	—	1.44 ab	10 cd	167.8 cd

[1] Rates of application for soil-applied insecticides 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] Mean node-injury ratings were derived from five root systems per plot in each of four replications.
[4] Means followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[5] Data were analyzed using a square-root transformation; actual means are shown.
[6] Percentage of roots with a node-injury rating < 0.25.
[7] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[8] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[9] Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.
[10] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[11] Applied with modified Noble metering units.

Triple Pro RIB Complete were extremely low (5% or less). Aztec 2.1G + Genuity VT Triple Pro had a significantly higher mean consistency percentage than all other treatments except Force 3G + Genuity VT Triple Pro RIB Complete. Aztec 2.1G + Genuity VT Triple Pro RIB Complete had a significantly higher mean consistency percentage than Capture LFR + Genuity VT Triple Pro RIB Complete, Genuity VT Triple Pro, Genuity VT Triple Pro RIB Complete, or the UTC.

Mean yields for Genuity VT Triple Pro (159.6 bu/A) and Genuity VT Triple Pro RIB Complete (154.1 bu/A) were significantly lower than for all other treatments, except the UTC (167.8 bu/A). Force 3G + Genuity VT Triple Pro (201.3 bu/A) had a significantly higher mean yield than Capture LFR + Genuity VT Triple Pro RIB Complete; all other soil-applied insecticides had statistically similar mean yields.