SECTION 2

Evaluation of Bt hybrids and Poncho to control corn rootworm larvae (*Diabrotica* spp.) in Illinois, 2014

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Locations

We established four trials at University of Illinois research and education centers near DeKalb (DeKalb County), Monmouth (Warren County), Perry (Pike 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 July at Monmouth and Perry and on 16 and 28 July at 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, 6, 8, and 12 May at Monmouth, Perry, 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. All seed-applied insecticides (Poncho) were applied by Bayer Crop Sciences. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 26 September at Perry, 29 October at DeKalb, and 7 November at Urbana. 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–V8 growth stage to 32,000 plants per acre. Due to severe lodging, plots were not harvested at Monmouth. Lodging evaluations were performed at this

TABLE 2.1 • Agronomic information for efficacy trials of Bt hybrids and seed-applied insecticides to control corn rootworm larvae, University of Illinois, 2014

	DeKalb	Monmouth	Perry	Urbana
Planting date	8 May	6 May	6 May	12 May
Root evaluation date	28 July	14 July	14 July	16 July
Harvest date	29 October	—	26 September	7 November
Hybrid	KSC[1] 5911 SS RIB Genuity SmartStax RIB Complete[2] KSC[1] 5911 RR2 Roundup Ready 2	KSC[1] 5911 SS RIB Genuity SmartStax RIB Complete[2] KSC[1] 5911 RR2 Roundup Ready 2 MS[1] M-909C-17 Genuity VT Triple Pro RIB Complete[3]	KSC[1] 5911 SS RIB Genuity SmartStax RIB Complete[2] KSC[1] 5911 RR2 Roundup Ready 2	KSC[1] 5911 SS RIB Genuity SmartStax RIB Complete[2] KSC[1] 5911 RR2 Roundup Ready 2 MS[1] M-909C-17 Genuity VT Triple Pro RIB Complete[3]
Row spacing	30 inches	30 inches	30 inches	30 inches
Seeding rate	36,600/acre	36,600/acre	36,600/acre	36,600/acre
Previous crop	Trap crop[4]	Trap crop[4]	Trap crop[4]	Trap crop[4]
Tillage	Fall—none Spring—discovator	Fall—disc plow Spring—field cultivator	Fall—disc-chisel plow Spring—field cultivator	Fall—chisel plow Spring—field cultivator

[1] KSC = Kitchen Seed Company; MS = Merschman Seeds.
[2] Contains a 5% refuge-in-the-bag (non-rootworm Bt) seed-blend.
[3] Contains a 10% refuge-in-the-bag (non-rootworm Bt) seed blend.
[4] Late-planted corn and pumpkins.

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 2.1.

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 2.2. The mean node-injury rating for the untreated check (UTC) was 1.81, indicating that corn rootworm larval feeding was moderate to severe. Mean node-injury ratings for Genuity SmartStax RIB Complete (with or without Poncho) ranged from 0.03 to 0.10 and were significantly lower than for Poncho alone or the UTC. The addition of Poncho (500 and 1250) to Genuity SmartStax RIB Complete did not significantly reduce rootworm larval injury when compared with Genuity SmartStax RIB Complete alone. Mean node-injury ratings for Poncho (500 and 1250) ranged from 0.44 to 0.87 and were significantly lower than for the UTC. Additionally, as the rate of Poncho increased, the amount of protection provided from rootworm larval injury significantly improved. Mean consistency percentages for the Genuity SmartStax RIB Complete treatments and Poncho 1250 ranged from 55 to 100% and were significantly higher than the mean consistency percentage for the UTC (5%).

Mean yields for Poncho 500 (156.0 bu/A) and the UTC (157.1 bu/A) were statistically similar. All other treatments had significantly higher mean yields and were statistically similar to each other.

TABLE 2.2 • Evaluation of Bt hybrids and seed-applied insecticides 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] 29 Oct
Poncho + Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	1250	Seed	0.07 d	85 ab	173.4 a
Poncho + Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	500	Seed	0.03 d	100 a	183.2 a
Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	—	—	0.10 d	90 a	173.3 a
Poncho + KSC[10] 5911 RR2	1250	Seed	0.44 c	55 bc	172.3 a
Poncho + KSC[10] 5911 RR2	500	Seed	0.87 b	30 cd	156.0 b
Untreated check (KSC[10] 5911 RR2)	—	—	1.81 a	5 d	157.1 b

[1] Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.
[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] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[10] Kitchen Seed Company.

Monmouth—Mean node-injury ratings and consistency percentages are reported in Table 2.3. The mean node-injury rating for the UTC was 2.31, indicating that corn rootworm larval feeding was severe. Mean node-injury ratings for Genuity SmartStax RIB Complete + Poncho (500 and 1250) ranged from 0.22 to 0.37 and were significantly lower than for Genuity VT Triple Pro RIB Complete or the UTC. Unlike with Genuity VT Triple Pro RIB Complete, the addition of Poncho (500 and 1250) to Genuity SmartStax RIB Complete did not significantly improve mean node-injury ratings. The mean node-injury rating for Genuity VT Triple Pro RIB Complete was 1.32 and was significantly lower than the UTC. Mean consistency percentages for Genuity SmartStax RIB Complete (with and without Poncho) ranged from 60 to 65% and were significantly higher than the mean consistency percentages for Genuity VT Triple Pro RIB Complete (10%) and the UTC (0%). The addition of Poncho (500 and 1250) to rootworm Bt hybrids did not significantly improve consistency percentages when compared with their untreated counterparts.

Lodging at this location was extensive—mean lodging percentages for Genuity VT Triple Pro RIB Complete (with and without Poncho) and the UTC ranged from 93 to 98%. Mean lodging percentages for Genuity SmartStax RIB Complete (with and without Poncho) ranged from 36 to 40% and were significantly lower than for the remaining treatments.

Perry—Mean node-injury ratings, consistency percentages, and yields are reported in Table 2.4. The mean node-injury rating for the UTC was 0.96, indicating that corn rootworm larval feeding was low to moderate. All treatments in the study had statistically similar mean node-injury ratings and performed significantly better than the UTC. Mean consistency percentages ranged from 50 to 100%. Mean consistency percentages for Genuity SmartStax RIB Complete (with and

TABLE 2.3 • Evaluation of Bt hybrids and seed-applied insecticides 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
Poncho + Genuity SmartStax RIB Complete[8] (KSC[9] 5911 SS RIB)	1250	Seed	0.22 c	65 a	36 b
Poncho + Genuity SmartStax RIB Complete[8] (KSC[9] 5911 SS RIB)	500	Seed	0.37 c	60 ab	40 b
Genuity SmartStax RIB Complete[8] (KSC[9] 5911 SS RIB)	—	—	0.44 c	60 ab	36 b
Poncho + Genuity VT Triple Pro RIB Complete[8] (MS[9] M-909C-17)	1250	Seed	0.70 c	25 abc	94 a
Poncho + Genuity VT Triple Pro RIB Complete[8] (MS[9] M-909C-17)	500	Seed	0.69 c	15 bc	94 a
Genuity VT Triple Pro RIB Complete[8] (MS[9] M-909C-17)	—	—	1.32 b	10 c	98 a
Untreated check (KSC[9] 5911 RR2)	—	—	2.31 a	0 c	93 a

[1] Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.
[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] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[9] KSC = Kitchen Seed Company; MS = Merschman Seeds.

without Poncho) and Poncho 1250 were significantly higher than the mean consistency percentage for the UTC (50%).

Mean yields for Genuity SmartStax RIB Complete (200.9 bu/A), Poncho 1250 (199.0 bu/A), and Poncho 500 (195.4 bu/A) were significantly greater than for Genuity SmartStax RIB Complete + Poncho 1250 (179.3 bu/A) and the UTC (178.6 bu/A).

Urbana—Mean node-injury ratings, consistency percentages, and yields are reported in Table 2.5. The mean node-injury rating for the UTC was 2.17, indicating that corn rootworm larval feeding was severe. Mean node-injury ratings for Genuity SmartStax RIB Complete (with or without Poncho) ranged from 0.19 to 0.56 and were significantly lower than for Genuity VT Triple Pro RIB Complete + Poncho 500 (1.55) and the UTC. Mean consistency percentages ranged from 0 to 80%. Genuity SmartStax RIB Complete (with or without Poncho) had significantly higher mean consistency percentages than Genuity VT Triple Pro RIB Complete + Poncho 500 (0%), and the UTC (5%).

Mean yields for Genuity VT Triple Pro RIB Complete (152.4 bu/A) and the UTC (139.9 bu/A) were statistically similar. All other treatments had significantly higher mean yields and were statistically similar to each other.

TABLE 2.4 • Evaluation of Bt hybrids and seed-applied insecticides to control corn rootworm larvae, Perry, 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 yield (bu/A)[7,8] 26 Sep
Poncho + Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	1250	Seed	0.02 b	100 a	179.3 b
Poncho + Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	500	Seed	0.06 b	90 a	192.0 ab
Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	—	—	0.08 b	95 a	200.9 a
Poncho + KSC[10] 5911 RR2	1250	Seed	0.10 b	95 a	199.0 a
Poncho + KSC[10] 5911 RR2	500	Seed	0.21 b	75 ab	195.4 a
Untreated check (KSC[10] 5911 RR2)	—	—	0.96 a	50 b	178.6 b

[1] Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.
[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] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[10] Kitchen Seed Company.

TABLE 2.5 • Evaluation of Bt hybrids and seed-applied insecticides 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
Poncho + Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	1250	Seed	0.19 e	80 a	187.9 a
Poncho + Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	500	Seed	0.33 de	60 ab	179.6 a
Genuity SmartStax RIB Complete[9] (KSC[10] 5911 SS RIB)	—	—	0.56 cde	50 ab	180.2 a
Poncho + Genuity VT Triple Pro RIB Complete[9] (MS[10] M-909C-17)	1250	Seed	0.81 cd	25 bc	177.1 a
Poncho + Genuity VT Triple Pro RIB Complete[9] (MS[10] M-909C-17)	500	Seed	1.55 ab	0 c	172.2 a
Genuity VT Triple Pro RIB Complete[9] (MS[10] M-909C-17)	—	—	1.01 bc	25 bc	152.4 b
Untreated check (KSC[10] 5911 RR2)	—	—	2.17 a	5 c	139.9 b

[1] Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.
[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] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[10] KSC = Kitchen Seed Company; MS = Merschman Seeds.