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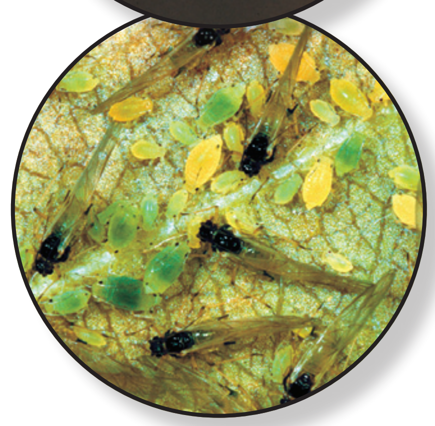
Annual review of University of Illinois insect management trials

2013 Report



Providing accurate and unbiased evaluations of insect control products and management strategies to assist growers in Illinois.

UNIVERSITY OF ILLINOIS EXTENSION

College of Agricultural, Consumer and Environmental Sciences
Department of Crop Sciences

ILLINOIS SOYBEAN ASSOCIATION

Since its inception in 1984, the University of Illinois Insect Management and Insecticide Evaluation Program has provided the producers of Illinois complete and informative evaluations of registered insecticides and new chemical and transgenic tools for the management of insect pests in Illinois. It is our intention to provide scientifically sound efficacy data to aid the producers of Illinois in their insect pest management decision making.

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CORN

SOYBEAN

APPENDICES

SECTION 1

Evaluation of products to control corn rootworm larvae (*Diabrotica* spp.) in Illinois, 2013

Ronald E. Estes, Nicholas A. Tinsley, and Michael E. Gray

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 17, 18, 29, and 30 July at Monmouth, Urbana, Perry, 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 was determined for each product at each location.

Planting, Insecticide Application, and Yield

Trials were planted on 1, 1, 14, and 16 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. Granular insecticides were applied through modified Noble metering units or through modified SmartBox 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. 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 27 September at Monmouth; 8 and 14 October at Perry and Urbana, respectively; and 10 November 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 were thinned at the V6–V8 growth stage to 30,000 plants per acre at Perry and to 32,000 plants per acre at DeKalb, Monmouth, and Urbana.

Agronomic Information

Agronomic information for all locations is listed in Table 1.1.

Climatic Conditions

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

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

DeKalb—Mean node-injury ratings and consistency percentages for rootworm injury evaluations on 30 July are presented in Table 1.2. Mean node-injury ratings for the untreated checks (UTCs) ranged from 0.18–0.47, indicating that corn rootworm larval feeding was low to moderate. Mycogen 2T777 (UTC) and NK N68B-GT (UTC) had significantly greater levels of root damage than all other treatments, including DEKALB DKC62-98 (UTC). Mean node-injury ratings for soil-applied insecticides, rootworm Bt hybrids, and rootworm Bt hybrids plus soil-applied insecticides were very low, ranging from 0.00–0.19. With the exception of Genuity VT Triple Pro, all rootworm control treatments provided statistically similar levels of protection from corn rootworm larval feeding. The mean node-injury rating for Genuity VT Triple Pro was statistically similar to its UTC (DEKALB DKC62-98). Mean percentage consistency (percentage of roots with a node-injury rating < 0.25) ranged from 40–100%. Genuity VT Triple Pro and all of the UTCs had mean consistency ratings of 75% or less. The application of Aztec 4.67G significantly improved the consistency rating for Genuity VT Triple Pro.

Mean yields ranged from 94.9–221.4 bu/A. Adding soil-applied insecticides to DKC62-98 (UTC) resulted in significantly greater yields. The application of Force CS to Genuity SmartStax RIB Complete significantly improved yields when compared with Genuity SmartStax RIB Complete alone. Because the mean-node injury ratings for Genuity

TABLE 1.1 • Agronomic information for efficacy trials of products to control corn rootworm larvae, University of Illinois, 2013

	DeKalb	Monmouth	Perry	Urbana
Planting date	14 May	1 May	1 May	16 May
Root evaluation date	30 July	17 July	29 July	18 July
Harvest date	10 November	27 September	8 October	14 October
Hybrids	DEKALB DKC62-97 Genuity VT Triple Pro DEKALB DKC62-97RIB Genuity VT Triple Pro RIB Complete[1] DEKALB DKC62-98 Genuity VT Double Pro DEKALB DKC63-33RIB Genuity SmartStax RIB Complete[2] Mycogen 2T777 Roundup Ready 2 Mycogen 2T784 SmartStax Mycogen 2T789 Herculex XTRA NK N68B-GT Agrisure GT NK N68B-3122 Agrisure 3122 E-Z Refuge[2]	DEKALB DKC62-97 Genuity VT Triple Pro DEKALB DKC62-97RIB Genuity VT Triple Pro RIB Complete[1] DEKALB DKC62-98 Genuity VT Double Pro DEKALB DKC63-33RIB Genuity SmartStax RIB Complete[2] Mycogen 2T777 Roundup Ready 2 Mycogen 2T784 SmartStax Mycogen 2T789 Herculex XTRA NK N68B-GT Agrisure GT NK N68B-3122 Agrisure 3122 E-Z Refuge[2]	DEKALB DKC62-97 Genuity VT Triple Pro DEKALB DKC62-97RIB Genuity VT Triple Pro RIB Complete[1] DEKALB DKC62-98 Genuity VT Double Pro DEKALB DKC63-33RIB Genuity SmartStax RIB Complete[2] Mycogen 2T777 Roundup Ready 2 Mycogen 2T784 SmartStax Mycogen 2T789 Herculex XTRA NK N68B-GT Agrisure GT NK N68B-3122 Agrisure 3122 E-Z Refuge[2]	DEKALB DKC62-97 Genuity VT Triple Pro DEKALB DKC62-97RIB Genuity VT Triple Pro RIB Complete[1] DEKALB DKC62-98 Genuity VT Double Pro DEKALB DKC63-33RIB Genuity SmartStax RIB Complete[2] Mycogen 2T777 Roundup Ready 2 Mycogen 2T784 SmartStax Mycogen 2T789 Herculex XTRA NK N68B-GT Agrisure GT NK N68B-3122 Agrisure 3122 E-Z Refuge[2]
Row spacing	30 inches	30 inches	30 inches	30 inches
Seeding rate	36,000/acre	36,000/acre	36,000/acre	36,000/acre
Previous crop	Trap crop[3]	Trap crop[3]	Trap crop[3]	Trap crop[3]
Tillage	Fall—chisel plow Spring—discovator	Fall—disc plow Spring—soil finisher	Fall—disc-chisel plow Spring—field cultivator	Fall—chisel plow Spring—field cultivator

[1] Contains a 10% refuge-in-the-bag (non-rootworm Bt) seed-blend.
[2] Contains a 5% refuge-in-the-bag (non-rootworm Bt) seed-blend.
[3] Late-planted corn and pumpkins.

SmartStax RIB Complete with and without Force CS differed only slightly (0.04), it is unlikely that the observed difference in mean yields (21.8 bu/A) can be attributed to increased root protection from the application of Force CS. Each of the UTCs had significantly lower yields than their corresponding rootworm Bt hybrids, in spite of the low to moderate root injury. With the exception of Force CS applied to Genuity SmartStax RIB Complete, the addition of a soil insecticide at planting did not significantly improve yields of the corresponding Bt treatment.

Monmouth—Mean node-injury ratings and consistency percentages for rootworm injury evaluations on 17 July are presented in Table 1.3. Mean node-injury ratings for the UTCs ranged from 0.42–0.69, indicating that corn rootworm larval feeding was low to moderate. The NK N68B-GT (UTC) had significantly greater levels of root damage than DEKALB DKC62-98 (UTC) and Mycogen 2T777 (UTC). Mean node-injury ratings for soil-applied insecticides, rootworm Bt hybrids, and rootworm Bt hybrids plus soil-applied insecticides were low, ranging from 0.01–0.27. Aztec 2.1G and Force CS

Continued on page 8

TABLE 1.2 • Evaluation of products to control corn rootworm larvae, DeKalb, University of Illinois, 2013

Product	Rate[1]	Placement 14 May	Mean node-injury rating[2–5] 30 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 10 Nov
Soil-applied insecticides					
Aztec 2.1G + DEKALB DKC62-98[9]	6.7	NU furrow[13]	0.03 bcd	100 a	187.0 cde
Capture LFR + DEKALB DKC62-98[9]	0.49	Band	0.09 bcd	90 ab	177.7 d–g
Force CS + DEKALB DKC62-98[9]	0.46	Band	0.08 bcd	93 ab	181.8 c–f
Rootworm Bt hybrids					
Agrisure 3122 E-Z Refuge[10] (NK N68B-3122[11])	—	—	0.03 bcd	95 ab	176.0 d–g
Genuity SmartStax RIB Complete[10] (DEKALB DKC63-33RIB[9])	—	—	0.04 bcd	95 ab	199.6 bc
Genuity VT Triple Pro (DEKALB DKC62-97[9])	—	—	0.19 b	75 b	193.9 bcd
Herculex XTRA (Mycogen 2T789[11])	—	—	0.03 bcd	100 a	160.3 gh
SmartStax (Mycogen 2T784[11])	—	—	0.06 bcd	85 ab	162.0 fgh
Soil-applied insecticides + rootworm Bt hybrids					
Aztec 4.67G + Genuity VT Triple Pro RIB Complete[10] (DEKALB DKC62-97RIB[12])	3	SB furrow[14]	0.02 bcd	100 a	192.0 b–e
Capture LFR + Agrisure 3122 E-Z Refuge[10] (NK N68B-3122[11])	0.49	Band	0.01 d	100 a	171.6 e–h
Capture LFR + Genuity SmartStax RIB Complete[10] (DEKALB DKC63-33RIB[9])	0.49	Band	0.01 d	100 a	209.4 ab
Counter 20G + Agrisure 3122 E-Z Refuge[10] (NK N68B-3122[11])	6	SB furrow[14]	0.01 d	100 a	175.1 d–g
Force CS + Agrisure 3122 E-Z Refuge[10] (NK N68B-3122[11])	0.46	Band	0.00 d	100 a	179.1 c–g
Force CS + Genuity SmartStax RIB Complete[10] (DEKALB DKC63-33RIB[9])	0.46	Band	0.00 d	100 a	221.4 a
SmartChoice 5G + Herculex XTRA (Mycogen 2T789[11])	5	SB furrow[14]	0.01 d	100 a	180.4 c–g
SmartChoice 5G + SmartStax (Mycogen 2T784[11])	5	SB furrow[14]	0.01 d	100 a	162.9 fgh
Untreated checks (UTCs)					
DEKALB DKC62-98[9]	—	—	0.18 bc	75 b	152.7 hi
Mycogen 2T777[11]	—	—	0.47 a	40 c	94.9 j
NK N68B-GT[11]	—	—	0.37 a	55 c	136.9 i

[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] 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, 0.50 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] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[13] Applied with modified Noble metering units.
[14] Applied with modified SmartBox metering units.

TABLE 1.3 • Evaluation of products to control corn rootworm larvae, Monmouth, University of Illinois, 2013

Product	Rate[1]	Placement 1 May	Mean node-injury rating[2–5] 17 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 27 Sep
Soil-applied insecticides					
Aztec 2.1G + DEKALB DKC62-98[9]	6.7	NU furrow[14]	0.11 de	85 abc	188.3 de
Belay[10] + NK N68B-GT[11]	0.62	Furrow	0.27 cd	67 bcd	166.0 gh
Force CS + NK N68B-GT[11]	0.46	Band	0.14 de	80 abc	167.7 gh
Rootworm Bt hybrids					
Agrisure 3122 E-Z Refuge[12] (NK N68B-3122[11])	—	—	0.12 de	90 ab	208.1 ab
Genuity SmartStax RIB Complete[12] (DEKALB DKC63-33RIB[9])	—	—	0.06 e	90 ab	212.6 a
Genuity VT Triple Pro (DEKALB DKC62-97[9])	—	—	0.26 d	65 cd	201.9 abc
Genuity VT Triple Pro RIB Complete[12] (DEKALB DKC62-97RIB[13])	—	—	0.07 e	90 ab	202.0 abc
Herculex XTRA (Mycogen 2T789[11])	—	—	0.07 e	95 a	194.2 cde
SmartStax (Mycogen 2T784[11])	—	—	0.02 e	100 a	175.1 fg
Soil-applied insecticides + rootworm Bt hybrids					
Aztec 4.67G + Genuity VT Triple Pro RIB Complete[12] (DEKALB DKC62-97RIB[13])	3	SB furrow[15]	0.03 e	100 a	198.5 bcd
Capture LFR + Genuity VT Triple Pro RIB Complete[12] (DEKALB DKC62-97RIB[13])	0.49	Band	0.08 e	80 abc	210.3 ab
Counter 20G + Agrisure 3122 E-Z Refuge[12] (NK N68B-3122[11])	6	SB furrow[15]	0.01 e	100 a	207.7 ab
Force CS + Agrisure 3122 E-Z Refuge[12] (NK N68B-3122[11])	0.46	Band	0.02 e	100 a	208.8 ab
SmartChoice 5G + Herculex XTRA (Mycogen 2T789[11])	5	SB furrow[15]	0.02 e	100 a	213.0 a
Untreated checks (UTCs)					
DEKALB DKC62-98[9]	—	—	0.42 bc	45 de	182.7 ef
Mycogen 2T777[11]	—	—	0.48 b	40 e	140.2 i
NK N68B-GT[11]	—	—	0.69 a	35 e	160.8 h

[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] 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, 0.50 milligrams (mg) of active ingredient (a.i.) per seed.
[10] Belay is not currently labeled for use in corn.
[11] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[13] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[14] Applied with modified Noble metering units.
[15] Applied with modified SmartBox metering units.

provided statistically similar levels of root protection as the rootworm Bt hybrids and rootworm Bt hybrids plus a soil-applied insecticide. With the exception of Genuity VT Triple Pro, all rootworm Bt hybrids and rootworm Bt hybrids plus a soil-applied insecticide provided statistically similar levels of protection from corn rootworm larval feeding. The mean node-injury rating for Genuity VT Triple Pro was statistically similar to Agrisure 3122 E-Z Refuge, and all of the soil-applied insecticides. Mean percentage consistency ranged from 35–100%. Belay, Genuity VT Triple Pro, and all of the UTCs had mean consistency ratings of 70% or less. Adding a soil-applied insecticide to a rootworm Bt hybrid never resulted in significantly higher mean consistency ratings.

Mean yields ranged from 140.2–213.0 bu/A. The application of SmartChoice 5G resulted in significantly higher yields for Herculex XTRA. However, the addition of a soil-applied insecticide to rootworm Bt hybrids did not always result in higher yields. With the exception of Herculex XTRA, all rootworm Bt hybrids/soil-applied insecticide combinations had significantly higher yields than soil-applied insecticides applied to non-rootworm Bt hybrids (UTCs).

Perry—Mean node-injury ratings and consistency percentages for rootworm injury evaluations on 29 July are presented in Table 1.4. Mean node-injury ratings for the UTCs ranged from 0.39–0.89, indicating that corn rootworm larval feeding was low to moderate. Mycogen 2T777 (UTC) and NK N68B-GT (UTC) treatments had significantly greater levels of root damage than all other treatments, including DEKALB DKC62-98 (UTC). Mean node-injury ratings for soil-applied insecticides were very low and were statistically similar to the rootworm Bt hybrids and rootworm Bt hybrids plus soil-applied insecticides. The mean node-injury rating for Genuity VT Triple Pro was statistically similar to its UTC (DEKALB DKC62-98). Mean percentage consistency ranged from 30–100%. With the exception of Genuity VT Triple Pro, all soil-applied insecticides, rootworm Bt hybrids, and rootworm Bt hybrids plus soil-applied insecticides had statistically similar percentage consistency ratings. The mean percentage consistency for Genuity VT Triple Pro was statistically similar to its UTC (DEKALB DKC62-98).

Mean yields ranged from 168.6–201.1 bu/A. Mean yields from all rootworm hybrids were not significantly different from their UTCs. Adding soil-applied insecticides to the rootworm Bt hybrids never resulted in a significant increase in mean yields. Mean yields for the soil applied insecticides were statistically similar to their respective UTCs.

Urbana—Mean node-injury ratings and consistency percentages for rootworm injury evaluations on 18 July are presented in Table 1.5. Mean node-injury ratings for the UTCs ranged from 0.91–1.80, indicating that corn rootworm larval feeding was moderate to severe. Mycogen 2T777 (UTC) and NK N68B-GT (UTC) had significantly greater levels of root damage than all other treatments, including DEKALB DKC62-98 (UTC). Mean node-injury ratings for soil-applied insecticides ranged from 0.10–0.65 and were statistically similar to each other. Root injury in the Capture LFR treatment was statistically similar to its UTC. Mean node-injury ratings for the rootworm Bt hybrids and rootworm Bt hybrids plus a soil-applied insecticide were statistically similar, ranging from 0.01–0.54. The addition of a soil-applied insecticide to a rootworm Bt hybrid never resulted in significantly greater levels of root protection. Mean percentage consistency ranged from 15–100%. Capture LFR, Genuity SmartStax RIB Complete, Genuity VT Triple Pro, and Genuity VT Triple Pro RIB Complete had statistically similar consistency percentages as their corresponding UTCs.

Mean yields ranged from 153.4–198.4 bu/A. Mycogen 2T777 (UTC) had significantly lower yields than all other treatments and the UTCs. Agrisure 3122 E-Z Refuge, Genuity SmartStax RIB Complete, Herculex XTRA, and SmartStax, had significantly higher yields than their corresponding UTCs. Adding soil-applied insecticides to the rootworm Bt hybrids never resulted in a significant increase in mean yields.

TABLE 1.4 • **Evaluation of products to control corn rootworm larvae, Perry, University of Illinois, 2013**

Product	Rate[1]	Placement 1 May	Mean node-injury rating[2–5] 29 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 8 Oct
Soil-applied insecticides					
Aztec 2.1G + DEKALB DKC62-98[9]	6.7	NU furrow[13]	0.10 cd	85 ab	187.8 a
Force CS + NK N68B-GT[10]	0.46	Band	0.08 cd	90 ab	172.4 a
Rootworm Bt hybrids					
Agrisure 3122 E-Z Refuge[11] (NK N68B-3122[10])	—	—	0.16 cd	80 ab	184.8 a
Genuity SmartStax RIB Complete[11] (DEKALB DKC63-33RIB[9])	—	—	0.06 cd	90 ab	199.0 a
Genuity VT Triple Pro (DEKALB DKC62-97[9])	—	—	0.23 bc	65 bc	193.7 a
Genuity VT Triple Pro RIB Complete[11] (DEKALB DKC62-97RIB[12])	—	—	0.15 cd	90 ab	192.2 a
Herculex XTRA (Mycogen 2T789[10])	—	—	0.07 cd	100 a	188.8 a
SmartStax (Mycogen 2T784[10])	—	—	0.14 cd	73 ab	201.1 a
Soil-applied insecticides + rootworm Bt hybrids					
Aztec 4.67G + Genuity VT Triple Pro RIB Complete[11] (DEKALB DKC62-97RIB[12])	3	SB furrow[14]	0.09 cd	85 ab	196.7 a
Capture LFR + Genuity VT Triple Pro RIB Complete[11] (DEKALB DKC62-97RIB[12])	0.49	Band	0.08 cd	95 a	196.0 a
Counter 20G + Agrisure 3122 E-Z Refuge[11] (NK N68B-3122[10])	6	SB furrow[14]	0.04 cd	95 a	183.9 a
Force CS + Agrisure 3122 E-Z Refuge[11] (NK N68B-3122[10])	0.46	Band	0.02 d	100 a	176.8 a
SmartChoice 5G + Herculex XTRA (Mycogen 2T789[10])	5	SB furrow[14]	0.03 cd	100 a	168.6 a
Untreated checks (UTCs)					
DEKALB DKC62-98[9]	—	—	0.39 b	45 cd	183.3 a
Mycogen 2T777[10]	—	—	0.89 a	45 cd	184.5 a
NK N68B-GT[10]	—	—	0.69 a	30 d	190.2 a

[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] 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, 0.50 milligrams (mg) of active ingredient (a.i.) per seed.
[10] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[11] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[12] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[13] Applied with modified Noble metering units.
[14] Applied with modified SmartBox metering units.

TABLE 1.5 • Evaluation of products to control corn rootworm larvae, Urbana, University of Illinois, 2013

Product	Rate[1]	Placement 16 May	Mean node-injury rating[2–5] 18 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 14 Oct
Soil-applied insecticides					
Aztec 2.1G + DEKALB DKC62-98[9]	6.7	NU furrow[14]	0.10 cd	90 ab	174.7 fg
Belay[10] + NK N68B-GT[11]	0.62	Furrow	0.25 cd	70 a–d	177.7 efg
Capture LFR + DEKALB DKC62-98[9]	0.49	Band	0.65 bc	45 c–f	184.6 a–f
Force CS + DEKALB DKC62-98[9]	0.46	Band	0.15 cd	89 ab	183.5 a–g
Rootworm Bt hybrids					
Agrisure 3122 E-Z Refuge[12] (NK N68B-3122[11])	—	—	0.08 cd	90 ab	195.2 abc
Genuity SmartStax RIB Complete[12] (DEKALB DKC63-33RIB[9])	—	—	0.27 cd	65 a–d	195.4 abc
Genuity VT Triple Pro (DEKALB DKC62-97[9])	—	—	0.39 bcd	55 b–e	181.6 c–g
Genuity VT Triple Pro RIB Complete[12] (DEKALB DKC62-97RIB[13])	—	—	0.54 bcd	45 c–f	182.7 b–g
Herculex XTRA (Mycogen 2T789[11])	—	—	0.09 cd	90 ab	187.3 a–f
SmartStax (Mycogen 2T784[11])	—	—	0.05 cd	95 ab	190.4 a–e
Soil-applied insecticides + rootworm Bt hybrids					
Aztec 4.67G + Genuity VT Triple Pro RIB Complete[12] (DEKALB DKC62-97RIB[13])	3	SB furrow[15]	0.05 cd	100 a	187.5 a–f
Capture LFR + Agrisure 3122 E-Z Refuge[12] (NK N68B-3122[11])	0.49	Band	0.03 d	100 a	195.5 abc
Capture LFR + Genuity SmartStax RIB Complete[12] (DEKALB DKC63-33RIB[9])	0.49	Band	0.01 d	100 a	197.5 ab
Capture LFR + Genuity VT Triple Pro RIB Complete[12] (DEKALB DKC62-97RIB[13])	0.49	Band	0.14 cd	84 abc	190.0 a–e
Counter 20G + Agrisure 3122 E-Z Refuge[12] (NK N68B-3122[11])	6	SB furrow[15]	0.01 d	100 a	192.8 a–d
Force CS + Agrisure 3122 E-Z Refuge[12] (NK N68B-3122[11])	0.46	Band	0.01 d	100 a	195.3 abc
Force CS + Genuity SmartStax RIB Complete[12] (DEKALB DKC63-33RIB[9])	0.46	Band	0.01 d	100 a	198.4 a
Force CS + Genuity VT Triple Pro RIB Complete[12] (DEKALB DKC62-97RIB[13])	0.46	Band	0.03 d	100 a	189.5 a–e
SmartChoice 5G + Herculex XTRA (Mycogen 2T789[11])	5	SB furrow[15]	0.01 d	100 a	191.5 a–e
SmartChoice 5G + SmartStax (Mycogen 2T784[11])	5	SB furrow[15]	0.00 d	100 a	193.2 a–d
Untreated checks (UTCs)					
DEKALB DKC62-98[9]	—	—	0.91 b	35 def	178.7 d–g
Mycogen 2T777[11]	—	—	1.80 a	15 f	153.4 h
NK N68B-GT[11]	—	—	1.76 a	20 ef	170.0 g

Table 1.5 continued on next page

[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] 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, 0.50 milligrams (mg) of active ingredient (a.i.) per seed.
[10] Belay is not currently labeled for use in corn.
[11] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
[13] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[14] Applied with modified Noble metering units.
[15] Applied with modified SmartBox metering units.

SECTION 2

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

Nicholas A. Tinsley, Ronald E. Estes, and Michael E. Gray

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.
[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.

SECTION 3

Evaluation of experimental and commercially available foliar-applied insecticides and insecticide/fungicide combinations to control silk-feeding by corn rootworm beetles (*Diabrotica* spp.) in Illinois, 2013

Nicholas A. Tinsley, Ronald E. Estes, and Michael E. Gray

Location

We established one trial at the Northern Illinois Agronomy Research Center near DeKalb (DeKalb 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. Densities of corn rootworm beetles were determined by counting the number of beetles on each of 10 consecutive plants per plot. After the application of insecticides, densities of corn rootworm beetles were assessed on 15, 22, and 29 August (7, 14, and 21 days after treatment [DAT], respectively).

Planting and Insecticide Application

The trial was planted on 24 May using a four-row, John Deere 7300 planter. Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. Insecticides were applied on 8 August with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides, except those with experimental designations, are listed in Appendix II.

Agronomic Information

Agronomic information is listed in Table 3.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Prior to the application of insecticides on 8 August, there were 0.61 corn rootworm beetles per plant in the trial area. Mean densities of corn rootworm beetles following the application of insecticides are presented in Table 3.2. On 15 August (7 DAT), all insecticide treatments had significantly fewer corn rootworm beetles per plant than both the untreated check (UTC) and the Quilt Xcel fungicide treatment. On both 22 and 29 August (14 and 21 DAT, respectively), no significant differences in mean densities of corn rootworm beetles were observed among the treatments.

TABLE 3.1 • Agronomic information for efficacy trial of experimental and commercially available foliar-applied insecticides and insecticide/fungicide combinations to control silk-feeding by corn rootworm beetles in Illinois, 2013

Planting date	24 May
Variety	DEKALB DKC57-75RIB Genuity SmartStax RIB Complete[1]
Row spacing	30 inches
Seeding rate	36,000/acre
Previous crop	Corn
Tillage	Fall—disc ripper Spring—discovator

[1] Contains a 5% refuge-in-the-bag (non-Bt) seed-blend.

TABLE 3.2 • **Evaluation of experimental and commercially available foliar-applied insecticides and insecticide/fungicide combinations to control silk-feeding by corn rootworm beetles in Illinois, 2013**

Product[1]	**Rate**[2]	**Mean no. corn rootworm beetles per plant**[3,4]		
		15 Aug (7 DAT[5])	**22 Aug (14 DAT[5])**	**29 Aug (21 DAT[5])**
Besiege	9	0.03 c	0.30 a	0.60 a
Cobalt Advanced	32	0.00 c	0.15 a	0.13 a
Cobalt Advanced + Headline SC	32 12	0.03 c	0.10 a	0.40 a
Endigo ZCX[6]	4.5	0.00 c	0.15 a	0.35 a
EXP1	14	0.00 c	0.10 a	0.38 a
Quilt Xcel	14	0.28 b	0.88 a	1.15 a
Warrior II	1.92	0.00 c	0.30 a	0.58 a
Warrior II + Quilt Xcel	1.92 14	0.00 c	0.13 a	0.58 a
Untreated check	—	0.85 a	0.93 a	0.98 a

1 Crop oil concentrate was added to the spray solution for each product (excluding the stand-alone Cobalt Advanced treatment) at a rate of 1%.
2 Rates of application for foliar insecticide/fungicide are ounces (oz) of product per acre.
3 Means were derived from the numbers of beetles on 10 consecutive plants per plot in each of four replications.
4 Means in the same column and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
5 DAT = days after treatment (with insecticide/fungicide).
6 Endigo ZCX is not currently labeled for commercial use.

SECTION 4

Evaluation of experimental and commercially available foliar-applied insecticides to control silk-feeding by corn rootworm beetles (*Diabrotica* spp.) in Illinois, 2013

Nicholas A. Tinsley, Ronald E. Estes, and Michael E. Gray

Location

We established one trial at the Northern Illinois Agronomy Research Center near DeKalb (DeKalb 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. Densities of corn rootworm beetles were determined by counting the number of beetles on each of 10 consecutive plants per plot. After the application of insecticides, densities of corn rootworm beetles were assessed on 15, 22, and 29 August (7, 14, and 21 days after treatment [DAT], respectively).

Planting, Insecticide Application, and Yield

The trial was planted on 24 May using a four-row, John Deere 7300 planter. Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. Insecticides were applied on 8 August with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 29 November. Weights were converted to bushels per acre (bu/A) at 15.5% moisture.

Agronomic Information

Agronomic information is listed in Table 4.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Prior to the application of insecticides on 8 August, there were 0.61 corn rootworm beetles per plant in the trial area. Mean densities of corn rootworm beetles following the application of insecticides are presented in Table 4.2. On all sampling dates, all treatments had significantly fewer corn rootworm beetles per plant than the untreated check (UTC). No significant differences in mean densities of corn rootworm beetles were observed among the insecticide treatments on any sampling date.

Mean yields are presented in Table 4.2. Mean yields ranged from 144.5 to 161.7 bu/A and were statistically similar for all treatments.

TABLE 4.1 • Agronomic information for efficacy trial of experimental and commercially available foliar-applied insecticides to control silk-feeding by corn rootworm beetles in Illinois, 2013

Planting date	24 May
Harvest date	29 November
Hybrid	DEKALB DKC57-75RIB Genuity SmartStax RIB Complete[1]
Row spacing	30 inches
Seeding rate	36,000/acre
Previous crop	Corn
Tillage	Fall—disc ripper Spring—discovator

[1] Contains a 5% refuge-in-the-bag (non-Bt) seed-blend.

TABLE 4.2 • Evaluation of experimental and commercially available foliar-applied insecticides to control silk-feeding by corn rootworm beetles in Illinois, 2013

Product	Rate[1]	Mean no. corn rootworm beetles per plant[2,3]			Mean yield[5,6] (bu/A) 29 Nov
		15 Aug (7 DAT[4])	22 Aug (14 DAT[4])	29 Aug (21 DAT[4])	
Endigo ZCX[7]	4	0.00 b	0.10 b	0.08 b	150.6 a
Hero	6	0.05 b	0.03 b	0.18 b	145.1 a
Warrior II + Lorsban 4E	1.6 8	0.03 b	0.00 b	0.25 b	144.5 a
Untreated check	—	0.95 a	0.98 a	0.85 a	161.7 a

[1] Rates of application for foliar insecticide are ounces (oz) of product per acre.
[2] Means were derived from the numbers of beetles on 10 consecutive plants per plot in each of four replications.
[3] Means in the same column and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[4] DAT = days after treatment (with insecticide).
[5] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[6] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[7] Endigo ZCX is not currently labeled for commercial use.

SECTION 5

Evaluation of foliar-applied insecticides and insecticide/fungicide combinations to control insect pests of soybean in Illinois, 2013

Ronald E. Estes, Nicholas A. Tinsley, and Michael E. Gray

Location

We established one trial at the Northern Illinois Agronomy Research Center near DeKalb (DeKalb County). Funding for this experiment was provided by the Illinois Soybean Association.

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. Densities of foliar feeding insects were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. Densities of soybean aphids were determined by counting the total number of aphids on three plants in each plot. The mean number of corn rootworm beetles per 20 sweeps was assessed on 8, 15, 22, and 29 August (0, 7, 14, and 21 days after treatment [DAT], respectively). Populations of soybean aphids were not present until late August; because of this, aphid densities were not evaluated until 22 August (14 DAT).

Planting, Insecticide Application, and Yield

The trial was planted on 11 June using a four-row, John Deere 7300 planter. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Insecticides were applied on 8 August with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 29 October. Weights were converted to bushels per acre (bu/A) at 13% moisture.

Agronomic Information

Agronomic information is listed in Table 5.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Very few insect pests were present in the trial area prior to the application of insecticides on 8 August. Detectable densities of soybean aphids appeared approximately 2 weeks after the application of insecticides. Mean densities of corn rootworm and soybean aphid following the application of insecticides are presented in Table 5.2.

Mean densities of corn rootworm beetles were very low at the 8, 15, and 22 August sampling dates (0, 7, and 14 DAT); although significant differences among treatments were observed, the low pest densities had no biological significance. On 29 August (21 DAT), Folicur, Stratego YLD, and Quilt Xcel had significantly more corn rootworm beetles per 20 sweeps than any of the insecticide treatments (with or without a fungicide/insecticide combination)—all insecticides had statistically similar densities of corn rootworm beetles. Mean densities of soybean aphid were virtually undetectable at the 8 and 15 August sampling dates (0 and 7 DAT). On 22 August (14 DAT), Folicur had significantly more soybean

TABLE 5.1 • Agronomic information for efficacy trial of foliar-applied insecticides and insecticide/fungicide combinations to control insect pests of soybean, DeKalb, University of Illinois, 2013

Planting date	11 June
Harvest date	29 October
Variety	NK S31-L7
Row spacing	30 inches
Seeding rate	150,000/acre
Previous crop	Corn
Tillage	Fall—disc ripper Spring—discovator

aphids per plant than any other treatment. On 29 August (21 DAT), Quilt Xcel had significantly more soybean aphids per plant than any other treatment, including the untreated check (UTC), except the Folicur and Quilt Excel treatments. Although not documented formally, the increased densities of soybean aphids in plots treated with only fungicide could be attributed to the elimination of entomopathogens by the fungicide applications.

Mean yields are presented in Table 5.2. No significant differences in mean yields were observed; none of the insecticide, fungicide, or combination treatments yielded significantly more than the UTC.

TABLE 5.2 • Evaluation of foliar-applied insecticides and insecticide/fungicide combinations to control insect pests of soybean, DeKalb, University of Illinois, 2013

Product	Rate[1]	Mean no. corn rootworm beetles per 20 sweeps[2,3]				Mean no. soybean aphids per plant[3,4]		Mean yield[6,7] (bu/A) 29 Oct
		8 Aug (0 DAT[5])	15 Aug (7 DAT[5])	22 Aug (14 DAT[5])	29 Aug (21 DAT[5])	22 Aug (14 DAT[5])	29 Aug (21 DAT[5])	
Baythroid XL	2.8	0.5 a	0.5 abc	2.0 a–d	19.8 d	33.7 b	4.3 b	61.8 a
Folicur	4	0.3 a	0.8 abc	5.0 abc	66.3 ab	329.8 a	171.3 ab	61.0 a
Baythroid XL + Folicur	2.8 4	0.5 a	0.0 c	2.0 a–d	30.3 cd	29.4 b	9.0 b	58.3 a
Leverage 360	2.8	0.0 a	0.3 bc	0.0 d	25.5 cd	34.3 b	3.4 b	59.0 a
Stratego YLD	4	1.0 a	1.8 abc	5.3 ab	77.5 a	134.9 b	141.8 ab	59.8 a
Leverage 360 +Stratego YLD	2.8 4	1.0 a	0.3 bc	2.5 a–d	29.5 cd	16.5 b	3.9 b	58.8 a
Mustang Maxx	4	0.8 a	0.3 bc	0.8 cd	26.0 cd	47.3 b	1.9 b	57.2 a
Headline	6	0.8 a	1.8 abc	4.3 a–d	47.3 bcd	93.3 b	15.9 b	59.0 a
Mustang Maxx + Headline	4 6	1.0 a	0.8 abc	2.0 a–d	22.0 d	54.8 b	18.9 b	62.6 a
Warrior II	1.6	1.8 a	0.3 bc	1.0 bcd	28.0 cd	6.9 b	0.1 b	54.8 a
Quilt Xcel	10.5	1.8 a	2.3 a	4.5 abc	62.7 ab	113.4 b	334.0 a	60.5 a
Warrior II + Quilt Xcel	1.6 10.5	1.3 a	0.5 abc	1.8 a–d	23.5 d	3.0 b	0.8 b	61.8 a
Untreated check	—	0.8 a	2.0 ab	5.8 a	54.3 abc	74.9 b	59.1 b	58.0 a

1 Rates of application for foliar insecticide/fungicide are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects per 20 sweeps per plot in each of four replications.
3 Means in the same column and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
4 Means were derived from the numbers of soybean aphids on three plants in each plot of four replications.
5 DAT = days after treatment (with insecticide/fungicide).
6 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
7 Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).

SECTION 6

Evaluation of Warrior II and Warrior II + Quilt Xcel to control insect pests of soybean in Illinois, 2013

Ronald E. Estes, Nicholas A. Tinsley, and Michael E. Gray

Location

We established one trial at the Northern Illinois Agronomy Research Center near DeKalb (DeKalb County). Funding for this experiment was provided by the Illinois Soybean Association.

Experimental Design and Methods

The experimental design was a randomized complete block with four replications. The plot size for each treatment was 20 ft (eight rows) x 100 ft. Densities of foliar feeding insects were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. Densities of soybean aphids were determined by counting the total number of aphids on three plants in each plot. The mean number of corn rootworm beetles per 20 sweeps was assessed on 8, 15, 22 and 29 August (0, 7, 14, and 21 days after treatment [DAT], respectively). Populations of soybean aphids were not present until late August; because of this, aphid densities were not evaluated until 22 August (14 DAT).

Planting, Insecticide Application, and Yield

The trial was planted on 11 June using a four-row, John Deere 7300 planter. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Insecticides were applied on 8 August with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 29 October. Weights were converted to bushels per acre (bu/A) at 13% moisture.

Agronomic Information

Agronomic information is listed in Table 6.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Very few insect pests were present in the trial area prior to the application of insecticides on 8 August. Detectable densities of soybean aphids appeared approximately 2weeks after the application of insecticides. Mean densities of corn rootworm and soybean aphid following the application of insecticides are presented in Table 6.2.

Mean densities of corn rootworm beetles were very low at the 8, 15, and 22 August sampling dates (0, 7, and 14 DAT); no significant differences among treatments were observed on these dates. On 29 August (21 DAT), Quilt Xcel and the untreated check (UTC) had significantly more corn rootworm beetles per 20 sweeps than the Warrior II + Quilt

TABLE 6.1 • Agronomic information for efficacy trial of Warrior II and Warrior II + Quilt Xcel to control insect pests of soybean, DeKalb, University of Illinois, 2013

Planting date	11 June
Harvest date	29 October
Variety	NK S31-L7
Row spacing	30 inches
Seeding rate	150,000/acre
Previous crop	Corn
Tillage	Fall—disc ripper Spring—discovator

Xcel combination treatment. Mean densities of soybean aphid were virtually undetectable at the 8 and 15 August sampling dates (0 and 7 DAT). On 22 August (14 DAT), the UTC had significantly more soybean aphids per plant than any other treatment. No significant difference in aphid densities were found on 29 August (21 DAT).

Mean yields are presented in Table 6.2. No significant differences in mean yields were observed; none of the insecticide, fungicide, or combination treatments yielded significantly more than the UTC.

TABLE 6.2 • **Evaluation of Warrior II and Warrior II + Quilt Xcel to control insect pests of soybean, DeKalb, University of Illinois, 2013**

Product	Rate[1]	Mean no. corn rootworm beetles per 20 sweeps[2,3]				Mean no. soybean aphids per plant[3,4]		Mean yield[6,7] (bu/A) 29 Oct
		8 Aug (0 DAT[5])	15 Aug (7 DAT[5])	22 Aug (14 DAT[5])	29 Aug (21 DAT[5])	22 Aug (14 DAT[5])	29 Aug (21 DAT[5])	
Warrior II	1.6	1.3 a	0.7 a	0.3 a	38.3 ab	2.0 b	0.6 a	57.4 a
Quilt Xcel	10.5	0.3 a	2.0 a	7.7 a	84.7 a	49.6 b	52.0 a	58.5 a
Warrior II + Quilt Xcel	1.6 10.5	1.0 a	0.0 a	1.0 a	27.0 b	3.4 b	3.6 a	59.5 a
Untreated check	—	0.3 a	7.0 a	11.3 a	86.0 a	152.9 a	98.6 a	55.4 a

1 Rates of application for foliar insecticide/fungicide are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects in 20 sweeps per plot in each of three replications.
3 Means in the same column and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
4 Means were derived from the numbers of soybean aphids on three plants in each plot of three replications.
5 DAT = days after treatment (with insecticide/fungicide).
6 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
7 Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).

SECTION 7

Evaluation of foliar-applied insecticides to control insect pests of soybean in Illinois, 2013

Ronald E. Estes, Nicholas A. Tinsley, and Michael E. Gray

Location

We established one trial at the Northern Illinois Agronomy Research Center near DeKalb (DeKalb County). Funding for this experiment was provided by the Illinois Soybean Association.

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. Densities of foliar feeding insects were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. Densities of soybean aphids were determined by counting the total number of aphids on three plants in each plot. The mean number of corn rootworm beetles per 20 sweeps was assessed on 8, 15, 22 and 29 August (0, 7, 14, and 21 days after treatment [DAT], respectively). Populations of soybean aphids were not present until late August; because of this, aphid densities were not evaluated until 22 August (14 DAT).

Planting, Insecticide Application, and Yield

The trial was planted on 11 June using a four-row, John Deere 7300 planter. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Insecticides were applied on 8 August with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 29 October. Weights were converted to bushels per acre (bu/A) at 13% moisture.

Agronomic Information

Agronomic information is listed in Table 7.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Very few insect pests were present in the trial area prior to the application of insecticides on 8 August. Detectable densities of soybean aphids appeared approximately 2 weeks after the application of insecticides, although densities remained low throughout the sampling period. Mean densities of corn rootworm and soybean aphid following the application of insecticides are presented in Table 7.2.

Mean densities of corn rootworm beetles were very low at the 8, 15, and 22 August sampling dates (0, 7, and 14 DAT); although significant differences among treatments were observed, the low pest densities had no biological significance.

TABLE 7.1 • Agronomic information for efficacy trial of foliar-applied insecticides to control insect pests of soybean, DeKalb, University of Illinois, 2013

Planting date	11 June
Harvest date	29 October
Variety	NK S31-L7
Row spacing	30 inches
Seeding rate	150,000/acre
Previous crop	Corn
Tillage	Fall—disc ripper Spring—discovator

On 29 August (21 DAT), Cobalt, Declare (1.02 oz/A), and Mustang Maxx had statistically similar densities of corn rootworm beetles per 20 sweeps as the UTC, with densities in each of these treatments significantly greater than Baythroid XL. Soybean aphids were undetectable at the 8 and 15 August sampling dates (0 and 7 DAT). Aphid densities remained low on 22 and 29 August (14 and 21 DAT), and all insecticide treatments had significantly fewer aphids than the UTC. No significant differences in aphid numbers among the insecticide treatments were observed.

Mean yields are presented in Table 7.2. No significant differences in mean yields were observed; none of the insecticide treatments yielded significantly more than the UTC.

TABLE 7.2 • Evaluation of foliar-applied insecticides to control insect pests of soybean, DeKalb, University of Illinois, 2013

Product	Rate[1]	Mean no. corn rootworm beetles per 20 sweeps[2,3]				Mean no. soybean aphids per plant[3,4]		Mean yield[6,7] (bu/A) 29 Oct
		8 Aug (0 DAT[5])	15 Aug (7 DAT[5])	22 Aug (14 DAT[5])	29 Aug (21 DAT[5])	22 Aug (14 DAT[5])	29 Aug (21 DAT[5])	
Baythroid XL	2.8	0.3 a	0.0 b	0.3 b	5.8 d	1.3 b	0.8 b	57.7 a
Cobalt	13	0.8 a	0.0 b	1.0 b	21.0 ab	10.0 b	3.5 b	56.3 a
Declare	1.02	0.5 a	0.0 b	1.5 b	16.3 abc	2.9 b	0.0 b	54.7 a
Declare	1.28	1.5 a	0.0 b	0.8 b	12.8 bcd	0.3 b	0.0 b	59.9 a
Declare + Dimethoate 4E	1.02 4	1.3 a	0.5 b	0.3 b	10.0 cd	0.4 b	3.9 b	56.5 a
Hero	5	1.3 a	0.3 b	1.3 b	12.5 bcd	3.7 b	1.6 b	58.3 a
Leverage 360	2.8	1.8 a	0.3 b	0.5 b	13.5 bcd	4.9 b	0.3 b	64.1 a
Mustang Maxx	4	0.3 a	0.3 b	1.0 b	16.0 abc	1.8 b	1.9 b	58.8 a
Warrior II	1.6	0.8 a	0.0 b	0.3 b	12.0 bcd	2.5 b	0.0 b	56.8 a
Untreated check	—	0.5 a	2.5 a	2.8 a	23.3 a	75.4 a	41.6 a	56.3 a

1 Rates of application for foliar insecticide are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects per 20 sweeps per plot in each of four replications.
3 Means in the same column and followed by the same letter do not differ significantly (*P* = 0.05, Duncan's New Multiple Range Test).
4 Means were derived from the numbers of soybean aphids on three plants in each plot of four replications.
5 DAT = days after treatment (with insecticide).
6 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
7 Means followed by the same letter do not differ significantly (*P* = 0.1, Duncan's New Multiple Range Test).

SECTION 8

Evaluation of foliar-applied insecticides to control Japanese beetles (*Popillia japonica*) in soybean in Illinois, 2013

Nicholas A. Tinsley, Ronald E. Estes, and Michael E. Gray

Location

We established one trial at the Adam Yoeckel Farm near Morrison (Whiteside 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. Densities of Japanese beetles were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. Densities of Japanese beetles were assessed on 25 July and on 1, 8, and 15 August (0, 7, 14, and 21 days after treatment [DAT], respectively).

Planting, Insecticide Application, and Yield

The trial was planted on 20 May using a 16-row Case IH Model 1250 planter. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Insecticides were applied on 25 July with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 2 October. Weights were converted to bushels per acre (bu/A) at 13% moisture.

Agronomic Information

Agronomic information is listed in Table 8.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Mean densities of Japanese beetles are presented in Table 8.2. On 25 July (0 DAT), mean beetle densities were substantial (19.7 Japanese beetles per 20 sweeps when averaged across all treatments). On 1 August (7 DAT), all treatments had significantly fewer Japanese beetles per 20 sweeps than the untreated check (UTC). On 8 August (14 DAT), only Fanfare 2EC, Hero, Leverage 360, and SkyRaider at 3 oz/A had significantly fewer Japanese beetles per 20 sweeps than the UTC. A similar trend was observed on 15 August (21 DAT), although SkyRaider at 6 oz/A had significantly fewer Japanese beetles per 20 sweeps than the UTC as well.

Mean yields are presented in Table 8.2. No significant differences in mean yields were observed.

TABLE 8.1 • Agronomic information for efficacy trial of foliar-applied insecticides to control Japanese beetles in soybean, Morrison, University of Illinois, 2013

Planting date	20 May
Harvest date	2 October
Variety	Pioneer 92Y51
Row spacing	30 inches
Seeding rate	150,000/acre
Previous crop	Corn
Tillage	Fall—vertical tillage Spring—vertical tillage

TABLE 8.2 • **Evaluation of foliar-applied insecticides to control Japanese beetles in soybean, Morrison, University of Illinois, 2013**

Product[1]	Rate[2]	Mean no. Japanese beetles per 20 sweeps[3,4]				Mean yield[6,7] (bu/A) 2 Oct
		25 July (0 DAT[5])	1 Aug (7 DAT[5])	8 Aug (14 DAT[5])	15 Aug (21 DAT[5])	
Brigadier	3.05	12.0 a	5.5 b	38.3 a	14.3 abc	61.5 a
Brigadier	6.1	17.8 a	3.8 b	13.8 bc	15.3 abc	61.6 a
Cobalt Advanced	18	17.5 a	5.8 b	20.5 abc	13.3 abc	62.3 a
Endigo ZC	4.5	24.0 a	2.3 b	27.3 ab	11.3 abc	64.3 a
Fanfare 2EC	6.4	16.0 a	0.8 b	3.5 c	6.8 c	61.9 a
Hero	5.12	24.5 a	1.3 b	3.3 c	9.0 bc	60.2 a
Leverage 360	2.8	29.5 a	1.8 b	1.8 c	7.8 c	62.1 a
Silencer	3.2	18.3 a	5.5 b	31.5 ab	12.0 abc	62.0 a
SkyRaider	3	12.8 a	2.5 b	4.3 c	6.8 c	63.2 a
SkyRaider	6	25.8 a	3.0 b	14.0 bc	10.5 bc	63.1 a
Warrior II	1.6	20.3 a	7.8 b	27.0 ab	17.3 ab	64.3 a
Untreated check	—	17.3 a	32.5 a	24.3 ab	19.8 a	61.7 a

[1] Non-ionic surfactant was added to the spray solution for each product at a rate of 0.25%.
[2] Rates of application for foliar insecticide are ounces (oz) of product per acre.
[3] Means were derived from the numbers of beetles in 20 sweeps per plot in each of four replications.
[4] Means in the same column and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[5] DAT = days after treatment (with insecticide).
[6] Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
[7] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).

SECTION 9

Evaluation of experimental and commercially available foliar-applied insecticides to control Japanese beetles (*Popillia japonica*) in soybean in Illinois, 2013

Nicholas A. Tinsley, Ronald E. Estes, and Michael E. Gray

Location

We established one trial at the Adam Yoeckel Farm near Morrison (Whiteside 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. Densities of Japanese beetles were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. Densities of Japanese beetles were assessed on 25 July and on 1, 8, and 15 August (0, 7, 14, and 21 days after treatment [DAT], respectively). Defoliation was determined by estimating the percentage defoliation for five randomly selected leaflets per plot on 15 August (21 DAT).

Planting and Insecticide Application

The trial was planted on 20 May using a 16-row Case IH Model 1250 planter. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Insecticides were applied on 25 July with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides, except those with experimental designations, are listed in Appendix II.

Agronomic Information

Agronomic information is listed in Table 9.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.5.0 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Mean densities of Japanese beetles are presented in Table 9.2. On 25 July (0 DAT), mean beetle densities were substantial (18.9 Japanese beetles per 20 sweeps when averaged across all treatments). On 1 August (7 DAT), all insecticide treatments had significantly fewer Japanese beetles per 20 sweeps than both the untreated check (UTC) and Quilt Xcel fungicide treatment. On 8 August (14 DAT), Besiege, Cobalt Advanced, Cobalt Advanced + Headline SC, and Warrior II + Quilt Xcel had significantly fewer Japanese beetles per 20 sweeps than Quilt Xcel. On 15 August (21 DAT), Besiege, Cobalt Advanced, Quilt Xcel, and Warrior II + Quilt Xcel had significantly fewer Japanese beetles per 20 sweeps than the UTC. It is unclear why the Quilt Xcel fungicide treatment had such a low mean density of Japanese beetles on 15 August.

Mean defoliation percentages are presented in Table 9.2. No significant differences in mean defoliation percentages were observed.

TABLE 9.1 • Agronomic information for efficacy trial of experimental and commercially available foliar-applied insecticides to control Japanese beetles in soybean, Morrison, University of Illinois, 2013

Planting date	20 May
Variety	Pioneer 92Y51
Row spacing	30 inches
Seeding rate	150,000/acre
Previous crop	Corn
Tillage	Fall—vertical tillage Spring—vertical tillage

TABLE 9.2 • **Evaluation of experimental and commercially available foliar-applied insecticides to control Japanese beetles in soybean, Morrison, University of Illinois, 2013**

Product[1]	Rate[2]	Mean no. Japanese beetles per 20 sweeps[3,4]				Mean % defoliation[4,6] 15 Aug (21 DAT[5])
		25 July (0 DAT[5])	1 Aug (7 DAT[5])	8 Aug (14 DAT[5])	15 Aug (21 DAT[5])	
Besiege	9	18.5 a	2.3 b	1.8 b	4.8 c	5.5 a
Cobalt Advanced	26	18.0 a	1.5 b	3.5 b	11.8 bc	7.5 a
Cobalt Advanced + Headline SC	26 12	15.8 a	1.3 b	3.0 b	7.0 abc	4.1 a
Endigo ZCX[7]	4.5	17.5 a	3.0 b	10.3 ab	14.5 ab	5.7 a
EXP1	14	17.3 a	1.3 b	10.3 ab	11.3 abc	5.4 a
Quilt Xcel	14	19.3 a	15.0 a	20.8 a	5.5 c	5.3 a
Warrior II	1.92	19.3 a	2.0 b	10.3 ab	10.8 abc	8.2 a
Warrior II + Quilt Xcel	1.92 14	20.5 a	1.5 b	5.0 b	6.0 c	5.7 a
Untreated check	—	23.8 a	20.0 a	11.8 ab	16.5 a	9.4 a

[1] Crop oil concentrate was added to the spray solution for each product (excluding the stand-alone Cobalt Advanced treatment) at a rate of 1%.
[2] Rates of application for foliar insecticide/fungicide are ounces (oz) of product per acre.
[3] Means were derived from the numbers of insects in 20 sweeps per plot in each of four replications.
[4] Means in the same column and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[5] DAT = days after treatment (with insecticide/fungicide).
[6] Means were estimated by determining the percentage defoliation for five randomly selected leaflets per plot in each of four replications.
[7] Endigo ZCX is not currently labeled for commercial use.

APPENDIX I

References cited

Hills, T. M., and D. C. Peters. 1971. A method of evaluating postplanting insecticide treatments for control of western corn rootworm larvae. Journal of Economic Entomology 64: 764–765.

Oleson, J. D., Y. L. Park, T. M. Nowatzki, and J. J. Tollefson. 2005. Node-injury scale to evaluate root injury by corn rootworms (Coleoptera: Chrysomelidae). Journal of Economic Entomology 98: 1–8.

Node-injury scale (from Oleson et al. 2005)

0.0 No feeding damage

1.0 One node (circle of roots), or the equivalent of an entire node, pruned back to within approximately 3.8 cm (1.5 in) of the stalk (or soil line if roots originate from above ground nodes)

2.0 Two complete nodes pruned

3.0 Three or more complete nodes pruned (highest rating that can be given)

Damage in between complete nodes pruned is noted as the percentage of the node missing, e.g., 1.50 = 1½ nodes pruned.

For a complete explanation of the node-injury scale and a comparison with the Iowa State University 1-to-6 root rating scale (Hills and Peters 1971), visit the "Interactive Node-Injury Scale" Web site, http://www.ent.iastate.edu/pest/rootworm/nodeinjury/nodeinjury.html.

Weighted formula used for determining root injury for seed-blend treatments, Section 2

For seed-blend treatments, two root clusters were extracted from row one of each plot. Each cluster contained a non-rootworm Bt refuge root system (denoted below as root system R) and two adjacent Bt root systems (denoted as root systems A1 and A2). Spatially, root system A1 is nearest to the refuge root system and root system A2 is farthest. The formula described below assigns weights to the individual root ratings based on the proportion of root systems in the plot that can be identified as either R, A1, or A2.

$$NIR_W = P_1(NIR_R) + P_2(NIR_{A1}) + P_3(NIR_{A2})$$

where:

NIR_W = the overall weighted node-injury rating

P_1 = the proportion of root systems that can be identified as R

NIR_R = the mean node-injury rating for root system R from both clusters

P_2 = the proportion of root systems that can be identified as A1

NIR_{A1} = the mean node-injury rating for root system A1 from both clusters

P_3 = the proportion of root systems that can be identified as A2

NIR_{A2} = the mean node-injury rating for root system A2 from both clusters

For 10% seed-blend treatments, P_1 = 10%, P_2 = 20%, and P_3 = 70%.

For 5% seed-blend treatments, P_1 = 5%, P_2 = 10%, and P_3 = 85%.

APPENDIX II

Product name	Active ingredient(s)
Aztec 2.1G	tebupirimphos + cyfluthrin
Aztec 4.67G	tebupirimphos + cyfluthrin
Baythroid XL	beta-cyfluthrin
Belay	clothianidin
Besiege	lambda-cyhalothrin + chlorantraniliprole
Brigadier	bifenthrin + imidacloprid
Capture LFR	bifenthrin
Cobalt	chlorpyrifos + gamma-cyhalothrin
Cobalt Advanced	chlorpyrifos + lambda-cyhalothrin
Counter 20G	terbufos
Cruiser	thiamethoxam
Declare	gamma-cyhalothrin
Dimethoate 4E	dimethoate
Endigo ZC	lambda-cyhalothrin + thiamethoxam
Endigo ZCX	lambda-cyhalothrin + thiamethoxam
Fanfare 2EC	bifenthrin
Folicur	tebuconazole[1]
Force 3G	tefluthrin
Force CS	tefluthrin
Headline	pyraclostrobin[1]
Headline SC	pyraclostrobin[1]
Hero	zeta-cypermethrin + bifenthrin
Leverage 360	imidacloprid + beta-cyfluthrin
Lorsban 4E	chlorpyrifos
Mustang Maxx	zeta-cypermethrin
Poncho	clothianidin
Quilt Xcel	azoxystrobin[1] + propiconazole[1]
Silencer	lambda-cyhalothrin
SkyRaider	bifenthrin + imidacloprid
SmartChoice 5G	chlorethoxyfos + bifenthrin
Stratego YLD	prothioconazole[1] + trifloxystrobin[1]
Warrior II	lambda-cyhalothrin

[1]Denotes an active ingredient that does not target insects.

APPENDIX III

2013 and Historical Monthly Weather Data[1] for DeKalb, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference
April	50.6	49.4	+1.2	203	182	+21	6.41	3.53	+2.88
May	65.1	60.1	+5.0	701	554	+147	3.72	4.83	–1.11
June	71.9	69.5	+2.4	1,348	1,136	+212	4.43	4.26	+0.17
July	72.6	73.6	–1.0	2,038	1,855	+183	5.03	3.80	+1.23
August	72.6	71.3	+1.3	2,731	2,513	+218	4.19	4.19	—
September	69.0	64.0	+5.0	3,299	2,966	+333	0.57	3.25	–2.68
October	51.5	51.5	—	3,515	3,177	+338	2.40	2.00	+0.40

[1] Data were compiled by the Midwestern Regional Climate Center.

2013 and Historical Monthly Weather Data[1] for Monmouth, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference
April	46.7	51.8	–5.1	150	217	–67	6.54	3.74	+2.80
May	62.1	62.3	–0.2	576	641	–65	4.84	4.99	–0.15
June	69.9	70.5	–0.6	1,171	1,255	–84	1.23	5.14	–3.91
July	72.3	74.4	–2.1	1,850	1,993	–143	1.81	2.30	–0.49
August	72.2	72.6	–0.4	2,525	2,687	–162	0.13	3.14	–3.01
September	67.3	64.9	+2.4	3,052	3,168	–116	0.79	3.38	–2.59
October	52.4	53.0	–0.6	3,317	3,414	–97	2.43	2.58	–0.15

[1] Data were compiled by the Midwestern Regional Climate Center.

2013 and Historical Monthly Weather Data[1] for Morrison, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference
April	44.6	50.8	–6.2	121	213	–92	8.72	3.93	+4.79
May	60.2	61.3	–1.1	512	621	–109	3.51	3.95	–0.44
June	67.0	69.9	–2.9	1,036	1,211	–175	4.33	4.64	–0.31
July	69.7	74.2	–4.5	1,645	1,932	–287	1.95	3.94	–1.99
August	70.6	71.6	–1.0	2,274	2,592	–318	1.15	4.43	–3.28
September	68.3	63.8	+4.5	2,826	3,050	–224	2.00	3.01	–1.01
October	51.4	51.8	–0.4	3,086	3,283	–197	1.99	2.81	–0.82

[1] Data were compiled by the Midwestern Regional Climate Center.

2013 and Historical Monthly Weather Data[1] for Perry, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference
April	49.8	54.2	–4.4	178	269	–91	5.70	3.90	+1.80
May	63.5	63.8	–0.3	640	736	–96	10.50	3.68	+6.82
June	71.9	72.1	–0.2	1,283	1,385	–102	3.39	5.34	–1.95
July	73.0	76.5	–3.5	1,975	2,160	–185	3.74	3.73	+0.01
August	72.8	74.4	–1.6	2,659	2,882	–223	0.12	3.04	–2.92
September	68.3	66.3	+2.0	3,211	3,399	–188	4.18	3.81	+0.37
October	54.7	54.5	+0.2	3,506	3,681	–175	3.38	3.39	–0.01

[1] Data were compiled by the Midwestern Regional Climate Center.

2013 and Historical Monthly Weather Data[1] for Urbana, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference	2013	15-year average (1998–2012)	Difference
April	50.2	53.5	–3.3	187	252	–65	7.05	3.63	+3.42
May	64.2	63.5	+0.7	671	705	–34	3.74	4.26	–0.52
June	71.3	72.0	–0.7	1,306	1,355	–49	6.27	4.43	+1.84
July	72.5	75.5	–3.0	1,992	2,120	–128	3.53	4.35	–0.82
August	73.1	73.8	–0.7	2,694	2,842	–148	0.36	3.55	–3.19
September	69.4	66.9	+2.5	3,248	3,364	–116	0.50	3.32	–2.82
October	54.7	54.5	+0.2	3,541	3,627	–86	3.57	3.43	+0.14

[1] Data were compiled by the Midwestern Regional Climate Center.