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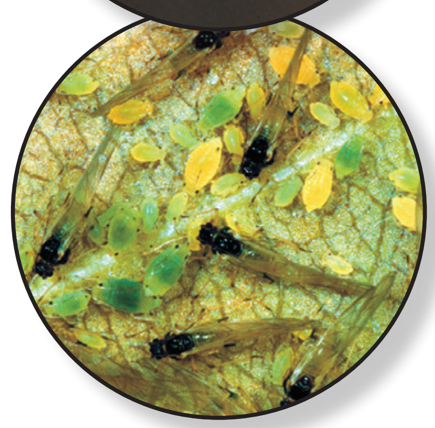
Annual review of University of Illinois insect management trials

2012 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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SECTION 1

Evaluation of products to control corn rootworm larvae (*Diabrotica spp.*) in Illinois, 2012

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 9 July at Urbana, 10 July at Monmouth and Perry, and 16 July at DeKalb. 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 18, 19, 21, and 23 April at Urbana, Perry, Monmouth, and DeKalb, 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. Force CS was 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 12 September at Monmouth and 26 October at DeKalb. Weights were converted to bushels per acre (bu/A) at 15.5% moisture. To ensure uniform plant densities across all plots, plant populations in the harvested rows had been thinned at the V6–V8 growth stage to 33,000 plants per acre at all locations. Due to deleterious drought conditions in 2012, plots at the Perry and Urbana locations were not harvested. Barren stalk assessments were conducted at both locations and over half the plots did not contain harvestable ears. Since the reductions in yield were largely due to hybrid response to drought and not directly correlated to injury caused by rootworm larvae, we opted to not include these data in our analyses.

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 8.4.2 (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 16 July are reported in Table 1.2. Mean node-injury ratings for the untreated checks (UTCs) ranged from 0.54–2.32, indicating that corn rootworm larval feeding was moderate to severe. Garst 84U58 GT (UTC) and Mycogen 2K591 (UTC) had significantly greater amounts of root feeding than the other UTCs. Mean node-injury ratings for the soil-applied insecticides ranged from 0.14–0.81. Aztec 4.67G had significantly lower root damage than Force CS. Mean node-injury ratings for the rootworm Bt hybrids ranged from 0.17–1.78. The mean node-injury rating for Agrisure 3000GT (Garst 84U58 3000GT) was greater than all other rootworm Bt hybrids, and was statistically similar to two of the UTCs (Garst 84U58 GT and Mycogen 2K591). YieldGard VT3P (DKC64-83) also had significantly higher levels of corn rootworm injury than the SmartStax hybrid Stone 6128 RIB. The addition of soil-applied insecticides to rootworm Bt hybrids only resulted in significantly lower mean node-injury ratings for Agrisure 3000GT and YieldGard VT3P. Mean percentage consistency (percentage of roots with a node-injury

TABLE 1.1 • Agronomic information for efficacy trials of products to control corn rootworm larvae, University of Illinois, 2012

	DeKalb	Monmouth	Perry	Urbana
Planting date	23 April	21 April	19 April	18 April
Root evaluation date	16 July	10 July	10 July	9 July
Harvest date	26 Oct	12 Sep	—	—
Hybrids	DKC64-82 RR2 DKC64-83 YieldGard VT3P Garst 84U58 GT Garst 84U58 3122 Agrisure 3122 Garst 84U58 3000GT Agrisure 3000GT Mycogen 2K591 RR2 Mycogen 2K592 Herculex XTRA Mycogen 2K594 SmartStax Stone 6128RIB SmartStax RIB[1] Stone 6N52RR RR2	DKC64-82 RR2 DKC64-83 YieldGard VT3P Garst 84U58 GT Garst 84U58 3122 Agrisure 3122 Garst 84U58 3000GT Agrisure 3000GT Mycogen 2K592 Herculex XTRA Mycogen 2K594 SmartStax Stone 6128RIB SmartStax RIB[1] Stone 6N52RR RR2	DKC64-82 RR2 DKC64-83 YieldGard VT3P Garst 84U58 GT Garst 84U58 3122 Agrisure 3122 Garst 84U58 3000GT Agrisure 3000GT Mycogen 2K592 Herculex XTRA Mycogen 2K594 SmartStax Stone 6128RIB SmartStax RIB[1] Stone 6N52RR RR2	DKC64-82 RR2 DKC64-83 YieldGard VT3P Garst 84U58 GT Garst 84U58 3122 Agrisure 3122 Garst 84U58 3000GT Agrisure 3000GT Mycogen 2K591 RR2 Mycogen 2K592 Herculex XTRA Mycogen 2K594 SmartStax Stone 6128RIB SmartStax RIB[1] Stone 6N52RR RR2
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[2]	Trap crop[2]	Trap crop[2]	Trap crop[2]
Tillage	Fall—moldboard plow Spring—mulch finisher	Fall—chisel plow Spring—soil finisher	Fall—chisel plow Spring—field cultivator	Fall—chisel plow Spring—field cultivator

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

rating < 0.25) ranged from 0–100%. Agrisure 3000GT (with and without Force CS), YieldGard VT3P, and all of the UTCs had mean consistencies of 30% or less. The application of Aztec 2.1G significantly improved consistency percentages for Agrisure 3000GT, and Aztec 2.1G and Force CS improved consistency percentages for YieldGard VT3P.

Mean yields for the UTCs were extremely low and ranged from 16–38 bu/A. Mean yields for the soil-applied insecticides were significantly lower that the rootworm Bt hybrids (with and without the addition of a soil-applied insecticide). Agrisure 3000GT and YieldGard VT3P had significantly lower yields than all other rootworm Bt hybrids. Although there were significant differences in yield, the differences cannot be solely attributed to injury caused by rootworm larvae. Differences in yield were also caused by variable hybrid responses to drought conditions or other agronomic factors.

Monmouth—Mean node-injury ratings and consistency percentages for rootworm injury evaluations on 10 July are reported in Table 1.3. Mean node-injury ratings for the UTCs ranged from 0.02–0.10, indicating that corn rootworm larval feeding was minimal. Mean node-injury ratings for all treatments in the study (including Bt rootworm hybrids, soil applied insecticides, and their combinations) did not exceed 0.06, which represents root scarring, or only the tips of roots injured. Although there were statistical differences among the treatments, the differences are not biologically relevant. Mean percentage consistency ranged from 85–100%. Garst 84U58 GT, with and without the addition of Force CS, had significantly lower mean consistency ratings than all other products in the trial.

Mean yields for the UTCs ranged from 179–192 bu/A. Mean yields for all rootworm Bt hybrids were not statistically

Continued on page 8

TABLE 1.2 • Evaluation of products to control corn rootworm larvae, DeKalb, University of Illinois, 2012

Product	Rate[1]	Placement	Mean node-injury rating[2–5] 16 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 26 Oct
Soil-applied insecticides					
Aztec 4.67G + DKC64-82[9]	3	SB furrow[12]	0.14 e–h	85 ab	35.8 e
Force CS + Garst 84U58 GT[10]	0.46	Band	0.81 cd	35 c–f	36.7 e
Rootworm Bt hybrids					
Agrisure 3000GT (Garst 84U58 3000GT[10])	—	—	1.78 ab	0 f	55.5 d
Agrisure 3122 (Garst 84U58 3122[10])	—	—	0.31 d–h	65 a–d	152.0 a
Herculex XTRA (Mycogen 2K592[10])	—	—	0.43 c–g	41 c–f	144.5 a
SmartStax (Mycogen 2K594[10])	—	—	0.33 d–h	55 b–e	145.4 a
SmartStax RIB (Stone 6128RIB[9])	—	—	0.17 e–h	65 a–d	155.2 a
YieldGard VT3P (DKC64-83[9])	—	—	0.66 cd	20 ef	83.1 c
Soil-applied insecticides + rootworm Bt hybrids					
Aztec 2.1G + Agrisure 3000GT (Garst 84U58 3000GT[10])	6.7	NU furrow[13]	0.08 fgh	100 a	104.2 b
Aztec 2.1G + YieldGard VT3P (DKC64-83[9])	6.7	NU furrow[13]	0.10 fgh	90 ab	89.7 bc
Counter 20G + SmartStax (Mycogen 2K594[10])	6	SB furrow[12]	0.23 e–h	75 abc	146.1 a
Force CS + Agrisure 3000GT (Garst 84U58 3000GT[10])	0.46	Band	0.46 c–f	25 def	97.1 bc
Force CS + Agrisure 3122 (Garst 84U58 3122[10])	0.46	Band	0.03 h	100 a	156.4 a
Force CS + Herculex XTRA (Mycogen 2K592[10])	0.46	Band	0.35 d–h	65 a–d	139.8 a
Force CS + SmartStax (Mycogen 2K594[10])	0.46	Band	0.13 e–h	75 abc	155.1 a
Force CS + YieldGard VT3P (DKC64-83[9])	0.46	Band	0.17 e–h	85 ab	91.3 bc
SmartChoice 5G + Herculex XTRA (Mycogen 2K592[10])	5	SB furrow[12]	0.05 gh	95 ab	146.3 a
Untreated checks (UTCs)					
DKC64-82[9]	—	—	0.54 cde	30 def	38.5 e
Garst 84U58 GT[10]	—	—	1.69 b	5 f	16.8 f
Mycogen 2K591[10]	—	—	2.32 a	0 f	23.2 ef
Stone 6N52RR[11]	—	—	0.88 c	10 f	23.5 ef

[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 treatment 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 ($P = 0.10$, 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] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] Applied with modified SmartBox metering units.
[13] Applied with modified Noble metering units.

TABLE 1.3 • Evaluation of products to control corn rootworm larvae, Monmouth, University of Illinois, 2012

Product	Rate[1]	Placement	Mean node-injury rating[2–5] 10 July	Mean % consistency < 0.25[4,6]	Mean yield (bu/A)[7,8] 12 Sep
Soil-applied insecticides					
Aztec 4.67G + DKC64-82[9]	3	SB furrow[12]	0.01 c	100 a	179.2 cde
Force CS + Garst 84U58 GT[10]	0.46	Band	0.06 b	90 b	181.3 cde
Rootworm Bt hybrids					
Agrisure 3000GT (Garst 84U58 3000GT[10])	—	—	0.04 bc	100 a	194.6 bc
Agrisure 3122 (Garst 84U58 3122[10])	—	—	0.00 c	100 a	201.3 ab
Herculex XTRA (Mycogen 2K592[10])	—	—	0.02 bc	100 a	175.7 e
SmartStax RIB (Stone 6128RIB[9])	—	—	0.01 c	100 a	192.3 bcd
YieldGard VT3P (DKC64-83[9])	—	—	0.01 c	100 a	177.5 de
Soil-applied insecticides + rootworm Bt hybrids					
Aztec 2.1G + YieldGard VT3P (DKC64-83[9])	6.7	NU furrow[13]	0.01 c	100 a	179.7 cde
Counter 20G + SmartStax (Mycogen 2K594[10])	6	SB furrow[12]	0.00 c	100 a	194.0 bc
Force CS + Agrisure 3000GT (Garst 84U58 3000GT[10])	0.46	Band	0.02 bc	100 a	212.9 a
Force CS + Agrisure 3122 (Garst 84U58 3122[10])	0.46	Band	0.01 c	100 a	194.1 bc
Force CS + Herculex XTRA (Mycogen 2K592[10])	0.46	Band	0.01 c	100 a	182.4 cde
Force CS + SmartStax (Mycogen 2K594[10])	0.46	Band	0.01 c	100 a	179.0 cde
Force CS + YieldGard VT3P (DKC64-83[9])	0.46	Band	0.01 c	100 a	181.1 cde
SmartChoice 5G + Herculex XTRA (Mycogen 2K592[10])	5	SB furrow[12]	0.00 c	100 a	191.5 bcd
Untreated checks (UTCs)					
DKC64-82[9]	—	—	0.02 bc	100 a	179.2 cde
Garst 84U58 GT[10]	—	—	0.10 a	85 b	192.2 bcd
Stone 6N52RR[11]	—	—	0.03 bc	100 a	187.0 b–e

[1] Rates of application for band and furrow placements are ounces (oz) of product per 1,000 ft of row.
[2] Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
[3] Mean node-injury ratings were derived from five root systems per treatment 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 ($P = 0.10$, 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] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] Applied with modified SmartBox metering units.
[13] Applied with modified Noble metering units.

different from their near-isoline 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.

Perry—Mean node-injury ratings and consistency percentages for rootworm injury evaluations on 10 July are reported in Table 1.4. Mean node-injury ratings for the UTCs ranged from 0.33–1.40, indicating that corn rootworm larval feeding was moderate. The mean node-injury rating for the Garst UTC (Garst 84U58 GT) was significantly higher than all other treatments. Mean node-injury ratings for the rootworm Bt hybrids, soil-applied insecticides, and treatment combinations were statistically similar. Mean percentage consistency among the rootworm control products ranged from 55–100%. As was observed in Monmouth, Garst 84U58 GT (UTC) had significantly lower mean consistency ratings than all other treatments in the trial. The mean consistency rating for Force CS was significantly lower than all soil-applied insecticides and rootworm Bt hybrids.

Urbana—Mean node-injury ratings and consistency percentages for rootworm injury evaluations on 11 July are reported in Table 1.5. Mean node-injury ratings for the UTCs ranged from 1.94–2.10, indicating that corn rootworm larval feeding was moderate to severe. Mean node-injury ratings for the soil-applied insecticides ranged from 0.77–0.98, and were statistically similar to each other. Mean node-injury ratings for the rootworm Bt hybrids ranged from 0.29–1.57. Agrisure 3000GT (Garst 84U58 3000GT) and YieldGard VT3P (DKC64-83) had significantly greater root damage than all other control products and treatment combinations. Agrisure 3000 GT had statistically similar node injury ratings to three of the four UTCs. The addition of soil-applied insecticides to rootworm Bt hybrids resulted in significantly lower mean node-injury ratings for all rootworm Bt hybrids in the study, except for SmartStax (Mycogen 2K594) plus Force CS. Mean percentage consistency ranged from 0–100% for rootworm control products. The following treatments had consistency ratings of 100%: Counter 20 G + SmartStax (Mycogen 2K594), Force CS + Agrisure 3122, Force CS + Herculex XTRA, Force CS + SmartStax (Mycogen 2K594), and Smartchoice 5G + Herculex XTRA. Consistency ratings of the following treatments were not statistically different from the UTCs: Aztec 4.67G, Force CS, Agrisure 3000 GT, Herculex XTRA, YieldGard VT3P, and Aztec 2.1G plus Agrisure 3000GT or YieldGard VT3P.

TABLE 1.4 • Evaluation of products to control corn rootworm larvae, Perry, University of Illinois, 2012

Product	Rate[1]	Placement	Mean node-injury rating[2–5] 10 July	Mean % consistency < 0.25[4,6]
Soil-applied insecticides				
Aztec 4.67G + DKC64-82[7]	3	SB furrow[10]	0.02 c	100 a
Force CS + Garst 84U58 GT[8]	0.46	Band	0.28 bc	55 c
Rootworm Bt hybrids				
Agrisure 3000GT (Garst 84U58 3000GT[8])	—	—	0.10 bc	89 ab
Agrisure 3122 (Garst 84U58 3122[8])	—	—	0.00 c	100 a
Herculex XTRA (Mycogen 2K592[8])	—	—	0.05 bc	95 ab
SmartStax RIB (Stone 6128RIB[7])	—	—	0.00 c	100 a
YieldGard VT3P (DKC64-83[7])	—	—	0.01 c	100 a
Soil-applied insecticides + rootworm Bt hybrids				
Counter 20G + YieldGard VT3P (DKC64-83[7])	6	SB furrow[10]	0.00 c	100 a
Force CS + Agrisure 3000GT (Garst 84U58 3000GT[8])	0.46	Band	0.04 bc	100 a
Force CS + Agrisure 3122 (Garst 84U58 3122[8])	0.46	Band	0.00 c	100 a
Force CS + Herculex XTRA (Mycogen 2K592[8])	0.46	Band	0.01 c	100 a
Force CS + SmartStax (Mycogen 2K594[8])	0.46	Band	0.00 c	100 a
Force CS + YieldGard VT3P (DKC64-83[7])	0.46	Band	0.02 c	100 a
SmartChoice 5G + Herculex XTRA (Mycogen 2K592[8])	5	SB furrow[10]	0.01 c	100 a
Untreated checks (UTCs)				
DKC64-82[7]	—	—	0.35 b	70 bc
Garst 84U58 GT[8]	—	—	1.40 a	25 d
Stone 6N52RR[9]	—	—	0.33 bc	60 c

[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 treatment 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] Seed was treated with Poncho, 0.50 milligrams (mg) of active ingredient (a.i.) per seed.
[8] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[9] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[10] Applied with modified SmartBox metering units.

TABLE 1.5 • Evaluation of products to control corn rootworm larvae, Urbana, University of Illinois, 2012

Product	Rate[1]	Placement	Mean node-injury rating[2–5] 9 July	Mean % consistency < 0.25[4,6]
Soil-applied insecticides				
Aztec 4.67G + DKC64-82[7]	3	SB furrow[10]	0.77 def	11 ef
Force CS + Garst 84U58 GT[8]	0.46	Band	0.98 d	5 ef
Rootworm Bt hybrids				
Agrisure 3000GT (Garst 84U58 3000GT[8])	—	—	1.57 bc	0 f
Agrisure 3122 (Garst 84U58 3122[8])	—	—	0.41 g	50 bc
Herculex XTRA (Mycogen 2K592[8])	—	—	0.89 de	15 ef
SmartStax (Mycogen 2K594[8])	—	—	0.33 gh	50 bc
SmartStax RIB (Stone 6128RIB[7])	—	—	0.29 ghi	65 b
YieldGard VT3P (DKC64-83[7])	—	—	1.38 c	0 f
Soil-applied insecticides + rootworm Bt hybrids				
Aztec 2.1G + Agrisure 3000GT (Garst 84U58 3000GT[8])	6.7	NU furrow[11]	0.56 efg	25 c–f
Aztec 2.1G + YieldGard VT3P (DKC64-83[7])	6.7	NU furrow[11]	0.50 fg	20 def
Counter 20G + SmartStax (Mycogen 2K594[8])	6	SB furrow[10]	0.03 i	100 a
Force CS + Agrisure 3000GT (Garst 84U58 3000GT[8])	0.46	Band	0.42 g	30 cde
Force CS + Agrisure 3122 (Garst 84U58 3122[8])	0.46	Band	0.04 hi	100 a
Force CS + Herculex XTRA (Mycogen 2K592[8])	0.46	Band	0.02 i	100 a
Force CS + SmartStax (Mycogen 2K594[8])	0.46	Band	0.04 hi	100 a
Force CS + YieldGard VT3P (DKC64-83[7])	0.46	Band	0.40 g	45 bcd
SmartChoice 5G + Herculex XTRA (Mycogen 2K592[8])	5	SB furrow[10]	0.04 hi	100 a
Untreated checks (UTCs)				
DKC64-82[7]	—	—	2.06 ab	0 f
Garst 84U58 GT[8]	—	—	1.94 ab	0 f
Mycogen 2K591[8]	—	—	2.08 ab	0 f
Stone 6N52RR[9]	—	—	2.10 a	0 f

[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 treatment 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] Seed was treated with Poncho, 0.50 milligrams (mg) of active ingredient (a.i.) per seed.
[8] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[9] Seed was treated with Poncho, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[10] Applied with modified SmartBox metering units.
[11] Applied with modified Noble metering units.

SECTION 2

Evaluation of Capture LFR and Optimum AcreMax 1 to control corn rootworm larvae (*Diabrotica spp.*) in Illinois, 2012

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 University of Illinois Agricultural Engineering Farm near 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 at DeKalb and 10 ft (four rows) × 30 ft at Urbana. For seed-blend treatments, one root cluster was extracted from row one of each plot on 12 and 16 July at Urbana and DeKalb, respectively. Each cluster contained a non-rootworm Bt refuge root system and four adjacent rootworm Bt root systems. For the non-seed-blend treatment (the untreated check [UTC]), five 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 mean node-injury ratings and consistency percentages.

Planting, Insecticide Application, and Yield

Trials were planted on 18 and 23 April at Urbana 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. Capture LFR was applied at a spray volume of 5 gallons per acre (gal/A) using a CO_2 system. 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 11 and 16 October at Urbana 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 had been thinned at the V6 to V8 growth stage to 33,000 plants per acre.

Agronomic Information

Agronomic information is listed in Table 2.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

TABLE 2.1 • Agronomic information for efficacy trials of Capture LFR and Optimum AcreMax 1 to control corn rootworm larvae, University of Illinois, 2012

	DeKalb	Urbana
Planting date	23 April	18 April
Root evaluation date	16 July	12 July
Harvest date	16 October	11 October
Hybrids	Pioneer P1162AM1 Optimum AcreMax 1 Pioneer P1162HR Herculex I	Pioneer P1162AM1 Optimum AcreMax 1 Pioneer P1162HR Herculex I
Row spacing	30 inches	30 inches
Seeding rate	36,000/acre	36,000/acre
Previous crop	Trap crop[1]	Trap crop[1]
Tillage	Fall—moldboard plow Spring—mulch finisher	Fall—chisel plow Spring—field cultivator

[1] Late-planted corn and pumpkins.

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 UTC was 2.27, indicating that corn rootworm larval feeding was severe. Mean node injury ratings for Optimum AcreMax 1 (with and without the addition of Capture LFR) were significantly lower than the mean node-injury rating for the UTC. Adding Capture LFR to Optimum AcreMax 1 did not significantly enhance root protection. The mean consistency percentage for the UTC was 0%. Mean consistency percentages for Optimum AcreMax 1 (with and without the addition of Capture LFR) were significantly greater than the mean consistency percentage for the UTC. Adding Capture LFR to Optimum AcreMax 1 did not significantly enhance the mean consistency percentage. The mean yield for the UTC was 37.7 bu/A. Mean yields for Optimum AcreMax 1 (with and without the addition of Capture LFR) were significantly greater than the mean yield for the UTC. Adding Capture LFR to Optimum AcreMax 1 did not result in a significantly greater mean yield.

Urbana—Mean node-injury ratings, consistency percentages, and yields are reported in Table 2.3. The mean node-injury rating for the UTC was 2.50, indicating that corn rootworm larval feeding was severe. Mean node injury ratings for Optimum AcreMax 1 (with and without the addition of Capture LFR) were significantly lower than the mean node-injury rating for the UTC. Adding Capture LFR to Optimum AcreMax 1 did not significantly enhance root protection. The mean consistency percentage for the UTC was 0%. Mean consistency percentages for Optimum AcreMax 1 (with and without the addition of Capture LFR) were significantly greater than the mean consistency percentage for the UTC. Adding Capture LFR to Optimum AcreMax 1 did not significantly enhance the mean consistency percentage. The mean yield for the UTC was 8.0 bu/A. The mean yield for Optimum AcreMax 1 was significantly greater than the mean yield for the UTC. Adding Capture LFR to Optimum AcreMax 1 resulted in a significantly greater mean yield than Optimum AcreMax 1 alone.

TABLE 2.2 • Evaluation of Capture LFR and Optimum AcreMax 1 to control corn rootworm larvae, DeKalb, University of Illinois, 2012

Product	Rate[1]	Placement	Mean node-injury rating[2–6] 16 July	Mean % consistency < 0.25[5,7,8]	Mean yield (bu/A)[9,10] 16 Oct
Capture LFR + Optimum AcreMax 1[11] (Pioneer P1162AM1[12])	0.49	Band	0.09 b	90 a	149.3 a
Optimum AcreMax 1[11] (Pioneer P1162AM1[12])	—	—	0.16 b	88 a	132.7 a
UTC[13] (Pioneer P1162HR[14])	—	—	2.27 a	0 b	37.7 b

[1] Rates of application for Capture LFR 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 the non-seed-blend treatment (the UTC), the mean node-injury rating was derived from five 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 seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean consistency percentages.
[9] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[10] Means followed by the same letter do not differ significantly ($P = 0.10$, PROC MIXED).
[11] This product is a 10% seed-blend (90% rootworm Bt seed, 10% non-rootworm Bt seed).
[12] Rootworm Bt seed for this hybrid was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed; non-rootworm Bt seed for this hybrid was treated with Poncho, 1.25 milligrams (mg) of active ingredient (a.i.) per seed.
[13] UTC = untreated check.
[14] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.

TABLE 2.3 ♦ **Evaluation of Capture LFR and Optimum AcreMax 1 to control corn rootworm larvae, Urbana, University of Illinois, 2012**

Product	Rate[1]	Placement	Mean node-injury rating[2–6] 12 July	Mean % consistency < 0.25[5,7,8]	Mean yield (bu/A)[9,10] 11 Oct
Capture LFR + Optimum AcreMax 1[11] (Pioneer P1162AM1[12])	0.49	Band	0.15 b	83 a	110.0 a
Optimum AcreMax 1[11] (Pioneer P1162AM1[12])	—	—	0.26 b	83 a	57.3 b
UTC[13] (Pioneer P1162HR[14])	—	—	2.50 a	0 b	8.0 c

[1] Rates of application for Capture LFR 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 the non-seed-blend treatment (the UTC), the mean node-injury rating was derived from five root systems per plot in each of four replications.
[4] For seed-blend treatments, a weighted formula (see Appendix I) was used to calculate the 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 seed-blend treatments, a weighted formula (see Appendix I) was used to calculate the mean consistency percentages.
[9] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[10] Means followed by the same letter do not differ significantly (*P* = 0.10, PROC MIXED).
[11] This product is a 10% seed-blend (90% rootworm Bt seed, 10% non-rootworm Bt seed).
[12] Rootworm Bt seed for this hybrid was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed; non-rootworm Bt seed for this hybrid was treated with Poncho, 1.25 milligrams (mg) of active ingredient (a.i.) per seed.
[13] UTC = untreated check.
[14] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.

SECTION 3

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

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

Experimental Design and Methods

The experimental design was a randomized complete block with four replications. The plot size for each treatment was 10 ft (four rows) x 20 ft. For seed-blend treatments, two root clusters were extracted from row one of each plot on 10 and 16 July at Monmouth and DeKalb, respectively. Each cluster contained a non-rootworm Bt refuge root system and two adjacent rootworm Bt root systems. For non-seed-blend treatments, six randomly selected root systems were extracted from row one of each plot. Root systems were washed and rated for corn rootworm larval injury using the 0 to 3 node-injury scale developed by Oleson et al. (2005) (Appendix I). The percentage of roots with a node-injury rating less than 0.25 was determined for each product. For seed-blend treatments, a weighted formula (see Appendix I) was used to calculate the mean node-injury rating and consistency percentage.

Planting, Insecticide Application, and Yield

Trials were planted on 23 April at both DeKalb and Monmouth. Both trials were planted using a four-row, vacuum style planter constructed by Seed Research Equipment Solutions (SRES). Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. Granular insecticides were applied through modified Noble metering units mounted to each row. Plastic tubes directed the insecticide granules into the seed furrow. Force CS was applied at a spray volume of 5 gallons per acre (gal/A) using a 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 12 September at Monmouth and on 16 October at DeKalb. Weights were converted to bushels per acre (bu/A) at 15.5% moisture. To ensure uniform plant densities across all plots, plant populations in the harvested rows had been thinned at the V6 to V7 growth stage to 33,000 plants per acre.

Agronomic Information

Agronomic information is listed in Table 3.1.

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

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

[1] Late-planted corn and pumpkins.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

Statistical Analysis

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

Results and Discussion

DeKalb—Mean node-injury ratings, consistency percentages, and yields are reported in Table 3.2. The mean node-injury rating for the untreated check (UTC) was 2.28, indicating that corn rootworm larval feeding was severe. Adding Force CS to the UTC enhanced root protection; however, the mean node-injury rating for this treatment remained relatively high (0.75). Mean node-injury ratings for the remainder of the treatments were low (< 0.25)—this trend excluded the 90% Herculex XTRA/10% UTC seed-blend. The mean consistency percentage for the UTC was 0.0%. Adding Force CS to the UTC failed to significantly improve the mean consistency percentage. Mean consistency percentages were relatively high (≥ 75%) for the remainder of the treatments; again, this trend

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

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

[1] Rates of application for band and furrow placements are ounces (oz) of product per 1,000 ft of row.
[2] Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
[3] For non-seed-blend treatments, mean node-injury ratings were derived from six root systems per plot in each of four replications.
[4] For seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean-node injury ratings.
[5] Means followed by the same letter do not differ significantly ($P = 0.05$, PROC MIXED).
[6] Data were analyzed using a square-root transformation; actual means are shown.
[7] Percentage of roots with a node-injury rating < 0.25.
[8] For the seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean consistency percentages.
[9] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[10] Means followed by the same letter do not differ significantly ($P = 0.10$, PROC MIXED).
[11] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] UTC = untreated check.
[13] Applied with modified Noble metering units.

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

Monmouth—Mean node-injury ratings, consistency percentages, and yields are reported in Table 3.3. The mean node-injury rating for the UTC was 0.020, indicating that corn rootworm larval feeding was virtually absent. Mean node-injury ratings for all treatments were exceedingly low (< 0.05). Although some significant differences among treatments were observed, the extremely low mean node-injury ratings suggest that such differences are not biologically significant. The mean consistency percentage for all treatments (including the UTC) was 100.0%—no significant differences were observed. Mean yields for all treatments were very high (172.2–216.6 bu/A). Although some significant differences were observed, the virtual absence of root injury suggests that differences in yield were not caused by corn rootworm larval feeding.

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

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

[1] Rates of application for band and furrow placements are ounces (oz) of product per 1,000 ft of row.
[2] Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
[3] For non-seed-blend treatments, mean node-injury ratings were derived from six root systems per plot in each of four replications.
[4] For seed-blend treatments, a weighted formula (see Appendix I) was used to calculate mean-node injury ratings.
[5] Means followed by the same letter do not differ significantly ($P = 0.05$, PROC MIXED).
[6] Data were analyzed using a square-root transformation; actual means are shown.
[7] Percentage of roots with a node-injury rating < 0.25.
[8] For the seed-blend treatments, a weighted formula (see Appendix I) was used to calculate the mean consistency percentages.
[9] Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.
[10] Means followed by the same letter do not differ significantly ($P = 0.10$, PROC MIXED).
[11] Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
[12] UTC = untreated check.
[13] Applied with modified Noble metering units.

SECTION 4

Evaluation of SmartStax to control corn earworm larvae (*Helicoverpa zea*) in Illinois, 2012

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

Location

We established one trial at the University of Illinois Agricultural Engineering Farm near Urbana (Champaign County).

Experimental Design and Methods

The experimental design was a randomized complete block with four replications. Plot size for each treatment was 10 ft (four rows) x 20 ft. Densities of corn earworm larvae were assessed on 22 August (at the R3 growth stage). Densities were estimated by counting the total number of larvae on 10 ears in each plot. The number of kernels consumed was recorded for each ear that was evaluated.

Planting Information

The trial was planted on 11 June using a four-row, vacuum style planter constructed by Seed Research Equipment Solutions (SRES). The planting date was later than normal to attract late-season flights of corn earworm. Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches.

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 8.4.2 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

The mean number of corn earworm larvae and kernels consumed per ear are reported in Table 4.2.

Moderate densities of corn earworm larvae were present at the time of sampling. The untreated check (UTC) had significantly more corn earworm larvae and kernels consumed per ear than SmartStax plants.

TABLE 4.1 • Agronomic information for efficacy trial of SmartStax to control corn earworm larvae, Urbana, University of Illinois, 2012

Planting date	11 June
Hybrids	Mycogen 2K591 RR2 Mycogen 2K594 SmartStax
Row spacing	30 inches
Seeding rate	36,000/acre
Previous crop	Corn
Tillage	Fall—chisel plow Spring—field cultivator

TABLE 4.2 • Evaluation of SmartStax to control corn earworm larvae, Urbana, University of Illinois, 2012

Product	Mean no. of CEW[1] larvae per ear[2,3]	Mean no. of kernels consumed per ear[3,4,5]
SmartStax (Mycogen 2K594[6])	0.18 b	0.68 b
UTC[7] (Mycogen 2K591[6])	2.58 a	19.73 a

1 CEW = corn earworm.
2 Means were derived from the numbers of larvae on 10 ears per plot in each of four replications.
3 Means followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
4 Data were analyzed using a square root transformation; actual means are shown.
5 Means were derived from the numbers of kernels consumed on 10 ears per plot in each of four replications.
6 Seed treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.
7 UTC = untreated check.

SECTION 5

Evaluation of seed- and foliar-applied insecticides to control foliar-feeding insect pests of soybean in Illinois, 2012

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

Locations

We established one trial at the Adam Yoeckel Farm near Morrison (Whiteside County) and one trial at the University of Illinois Agricultural Engineering Farm near 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 20 ft. Densities of foliar-feeding insect pests were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net at 0, 7, 14, and 21 days after treatment (DAT). Insect pest densities were assessed on 31 July and on 7, 14, and 21 August at Morrison. At Urbana, densities were assessed on 27 July and on 3, 10, and 17 August.

Planting, Insecticide Application, and Yield

The trial was planted on 10 May at Urbana and on 14 May at Morrison, using a four-row, ALMACO constructed planter with John Deere 7300 row units. Precision cone units were used to meter the seeds. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Endigo ZC was applied on 27 July at Urbana and on 31 July at Morrison, using 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 9 and 11 October at Urbana and Morrison, respectively. 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 8.4.2 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Mean densities of foliar-feeding insect pests and yields are reported in Tables 5.2 and 5.3. Although a number of insect

TABLE 5.1 • Agronomic information for efficacy trials of seed- and foliar-applied insecticides to control foliar-feeding insect pests of soybean, University of Illinois, 2012

	Morrison	Urbana
Planting date	14 May	10 May
Harvest date	11 October	9 October
Variety	NK S31-L7	NK S34-N3
Row spacing	30 inches	30 inches
Seeding rate	140,000/acre	140,000/acre
Previous crop	Corn	Corn
Tillage	Fall—vertical tillage Spring—vertical tillage	Fall—chisel plow Spring—field cultivator

pests were recovered in sweep samples, only bean leaf beetle, corn rootworm beetle, and Japanese beetle averages are presented.

Morrison—Across all sampling dates, densities of bean leaf beetles and corn rootworm beetles were very low (Table 5.2). In fact, no bean leaf beetle adults were found. No significant differences in mean densities of corn rootworm beetles were observed. Densities of Japanese beetles were higher than densities of bean leaf beetles and corn rootworm beetles. The application of Endigo ZC significantly reduced Japanese beetle densities on the 7 August sampling date (7 DAT). Japanese beetle densities on the 14 and 21 August sampling dates (14 and 21 DAT) were statistically similar across all treatments.

Mean yields ranged from 60.7 to 64.0 bu/A. Only slight numerical differences in mean yield were observed; there were no statistically significant differences.

Urbana—Across all sampling dates, densities of Japanese beetle were very low (Table 5.3). No significant differences in mean densities of Japanese beetle were observed for any sampling date. Although densities of corn rootworm beetles were numerically higher, there also were no significant differences in mean densities across treatments for any of the sampling dates. Bean leaf beetle densities were significantly greater in the ApronMaxx treatment on 17 August (21 DAT); however, the differences were not biologically important.

Mean yields ranged from 60.1 to 62.8 bu/A. Only slight numerical differences in mean yield were observed; there were no statistically significant differences among the four treatments.

TABLE 5.2 • Evaluation of seed- and foliar-applied insecticides to control foliar-feeding insect pests of soybean, Morrison, University of Illinois, 2012

Product	Rate[1]	Mean no. corn rootworm beetles per 20 sweeps[2,3]				Mean no. Japanese beetles per 20 sweeps[2,3]				Mean yield (bu/A)[5,6] 11 Oct
		31 July (0 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	31 July (0 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	
ApronMaxx	0.0094	0.50 a	0.25 a	2.00 a	1.25 a	11.50 a	10.50 a	6.25 a	3.00 a	60.7 a
CruiserMaxx	0.0907	0.25 a	0.00 a	0.00 a	1.00 a	8.75 a	8.75 a	2.00 a	2.50 a	63.4 a
ApronMaxx + Endigo ZC	0.0094 3.5	0.50 a	0.00 a	0.00 a	0.75 a	5.25 a	0.50 b	1.75 a	2.00 a	63.9 a
CruiserMaxx + Endigo ZC	0.0907 3.5	0.50 a	0.00 a	0.05 a	0.75 a	7.50 a	1.50 b	2.33 a	2.25 a	64.0 a

1 Rates of application for ApronMaxx and CruiserMaxx are milligrams (mg) active ingredient (a.i.) per seed; rates of application for Endigo ZC are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects per 20 sweeps in each plot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).

TABLE 5.3 • **Evaluation of seed- and foliar-applied insecticides to control foliar-feeding insect pests of soybean, Urbana, University of Illinois, 2012**

Product	Rate[1]	Mean no. bean leaf beetles per 20 sweeps[2,3]				Mean no. corn rootworm beetles per 20 sweeps[2,3]			
		27 July (0 DAT[4])	3 Aug (7 DAT[4])	10 Aug (14 DAT[4])	17 Aug (21 DAT[4])	27 July (0 DAT[4])	3 Aug (7 DAT[4])	10 Aug (14 DAT[4])	17 Aug (21 DAT[4])
ApronMaxx	0.0094	3.50 a	1.75 a	1.00 a	1.25 a	5.75 a	5.00 a	4.50 a	10.75 a
CruiserMaxx	0.0907	2.75 a	1.50 a	1.00 a	0.25 b	6.25 a	3.00 a	2.50 a	8.75 a
ApronMaxx + Endigo ZC	0.0094 3.50	1.00 a	0.25 a	0.00 a	0.00 b	5.00 a	1.00 a	1.25 a	1.50 a
CruiserMaxx + Endigo ZC	0.0907 3.50	2.00 a	0.00 a	0.25 a	0.00 b	7.50 a	1.25 a	1.00 a	3.50 a

1 Rates of application for ApronMaxx and CruiserMaxx are milligrams (mg) active ingredient (a.i.) per seed; rates of application for Endigo ZC are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects per 20 sweeps in each plot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly (*P* = 0.1, Duncan's New Multiple Range Test).

TABLE 5.3 (CONTINUED) • **Evaluation of seed- and foliar-applied insecticides to control foliar-feeding insect pests of soybean, Urbana, University of Illinois, 2012**

Product	Rate[1]	Mean no. Japanese beetles per 20 sweeps[2,3]				Mean yield (bu/A)[5,6] 9 Oct
		27 July (0 DAT[4])	3 Aug (7 DAT[4])	10 Aug (14 DAT[4])	17 Aug (21 DAT[4])	
ApronMaxx	0.0094	0.50 a	0.00 a	0.00 a	0.25 a	62.8 a
CruiserMaxx	0.0907	0.50 a	0.00 a	0.00 a	0.25 a	60.1 a
ApronMaxx + Endigo ZC	0.0094 3.5	0.50 a	0.00 a	0.00 a	0.25 a	62.4 a
CruiserMaxx + Endigo ZC	0.0907 3.5	0.00 a	0.00 a	0.00 a	0.50 a	60.1 a

1 Rates of application for ApronMaxx and CruiserMaxx are milligrams (mg) active ingredient (a.i.) per seed; rates of application for Endigo ZC are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects per 20 sweeps in each plot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly (*P* = 0.1, Duncan's New Multiple Range Test).

SECTION 6

Evaluation of seed-applied insecticides to control late season foliar-feeding insect pests of soybean in Illinois, 2012

Ronald E. Estes, Nicholas A. Tinsley, 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. Plant emergence was estimated by counting the number of plants in 20 feet of row per plot at the V2 growth stage on 6 June. Mean plant heights were determined by measuring three randomly selected plants per plot at the V3 growth stage on 21 June. Densities of late season foliar-feeding insect pests were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net on 31 July.

Planting, Insecticide Application, and Yield

The trial was planted on 14 May using a four-row, ALMACO constructed planter with John Deere 7300 row units. Precision cone units were used to meter the seeds. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 11 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 8.4.2 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

Mean plant stand counts, plant heights, densities of foliar-feeding insect pests, and yields are reported in Table 6.2. Although a number of insect pests were recovered in sweep samples, only bean leaf beetle, corn rootworm beetle, and Japanese beetle averages are presented.

Mean plant stand counts and plant heights were statistically similar across all treatments. Across all sampling dates, densities of bean leaf beetles and corn rootworm beetles were very low. No significant differences in mean densities of bean leaf beetles or corn rootworm beetles were observed. There were relatively large densities of Japanese beetle, which the insecticidal seed treatments had little effect on. Mean Japanese beetle densities were statistically similar across all treatments.

Mean yields ranged from 62.7 to 64.6 bu/A. Only slight numerical differences in mean yield were observed; there were no statistically significant differences.

TABLE 6.1 • Agronomic information for efficacy trial of seed-applied insecticides to control late season foliar-feeding insect pests of soybean, Morrison, University of Illinois, 2012

Planting date	14 May
Variety	Stine 29RB22
Row spacing	30 inches
Seeding rate	140,000/acre
Previous crop	Corn
Tillage	Fall—vertical tillage Spring—vertical tillage

TABLE 6.2 • **Evaluation of seed-applied insecticides to control late season foliar-feeding insect pests of soybean, Morrison, University of Illinois, 2012**

Product	Rate[1]	Mean no. plants per 20 row-feet[2,3] 6 June	Mean plant height (in)[3,4] 21 June	Mean no. insects per 20 sweeps, 31 July[3,5]			Mean yield (bu/A)[6,7] 11 Oct
				Bean leaf beetles	Corn rootworm beetles	Japanese beetles	
Cruiser	50	126 a	13.67 a	0.25 a	0.00 a	10.75 a	62.7 a
Gaucho	62.5	126 a	12.92 a	0.00 a	0.25 a	15.50 a	63.4 a
Gaucho + Poncho VOTiVO	62.5 0.13	125 a	13.08 a	0.00 a	0.00 a	9.25 a	64.6 a
Poncho VOTiVO	0.13	120 a	13.25 a	0.00 a	0.50 a	11.75 a	63.6 a
UTC[8]	—	124 a	13.04 a	0.00 a	0.50 a	13.25 a	63.6 a

[1] Rates of application for Cruiser and Gaucho are grams (g) active ingredient (a.i.) per 100 kilograms (kg) seed; rates of application for Poncho VOTiVO are milligrams (mg) active ingredient (a.i.) per seed.
[2] Means were derived by counting the number of plants in 20 ft of row in each plot in each of four replications.
[3] Means followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[4] Means were derived by measuring the height of three randomly selected plants in each plot in each of four replications.
[5] Means were derived from the numbers of insects per 20 sweeps in each plot in each of four replications.
[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).
[8] UTC = untreated check.

SECTION 7

Evaluation of aphid-resistant soybean lines and Warrior II to control leaf-feeding insect pests of soybean in Illinois, 2012

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 Adam Yoeckel Farm near Morrison (Whiteside County). Funding for these experiments was provided by the Illinois Soybean Association.

Experimental Design and Methods

The experimental design was a split-plot, randomized complete block with four replications. The plot size for each treatment was 20 ft (eight rows) x 20 ft. One half (four rows) of each plot was treated with a foliar-applied insecticide for yield comparisons. The remaining half was not treated with an insecticide. Three experimental soybean lines were provided from the soybean breeding program at the University of Illinois—two lines contained resistance to soybean aphids. The resistant lines LD05-16657a and LD08-12441a contained the *Rag1* and *Rag2* resistance genes (their susceptible near-isoline was LD02-4485). *These genes do not provide protection against feeding by any of the other insect pests we assessed during this trial.*

Although these trials were designed to assess the efficacy of the treatments for managing soybean aphids, this insect was never detected during the field season. Densities of other insect pests were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. After the application of Warrior II, densities of insect pests were assessed on 7, 14, and 21 August (7, 14, and 21 days after treatment [DAT], respectively).

Planting, Insecticide Application, and Yield

Trials were planted on 14 and 15 May at Morrison and DeKalb, respectively. Both trials were planted using a four-row, ALMACO constructed planter with John Deere 7300 row units. Precision cone units were used to meter the seeds. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Warrior II was applied on 31 July at both locations 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 subplot on 11 and 12 October at Morrison and DeKalb, respectively. 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.

TABLE 7.1 • Agronomic information for efficacy trials of aphid-resistant soybean lines and Warrior II to control leaf-feeding insect pests of soybean, University of Illinois, 2012

	DeKalb	Morrison
Planting date	15 May	14 May
Harvest date	12 October	11 October
Soybean lines	LD02-4485 LD05-16657a LD08-12441a	LD02-4485 LD05-16657a LD08-12441a
Row spacing	30 inches	30 inches
Seeding rate	140,000/acre	140,000/acre
Previous crop	Corn	Corn
Tillage	Fall—moldboard plow Spring—mulch finisher	Fall—vertical tillage Spring—vertical tillage

Statistical Analysis

Data were analyzed using ARM 8 (Agricultural Research Manager), revision 8.4.2 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

DeKalb—Prior to the application of Warrior II on 31 July, there were 0.7, 9.8, 0.2, 0.0, and 0.1 bean leaf beetles, corn rootworm beetles, grasshoppers, Japanese beetles, and stink bugs per 20 sweeps, respectively. Mean densities of these insects following the application of Warrior II are presented in Table 7.2.

Mean densities of bean leaf beetles, grasshoppers, Japanese beetles, and stink bugs were very low across all sampling dates. Some significant differences among treatments were observed on 21 August (21 DAT) for mean densities of bean leaf beetles and grasshoppers, but the extremely low densities of these insects suggest that such differences are not biologically meaningful. On 7 August (7 DAT), two of the soybean lines treated with Warrior II (LD02-4485 and LD05-16657a) had significantly fewer corn rootworm beetles per 20 sweeps than their untreated counterparts. However, no significant differences in mean densities of corn rootworm beetles were observed among treatments on 14 or 21 August (14 and 21 DAT, respectively).

Mean yields are presented in Table 7.2. Mean yields were statistically similar for all treatments and ranged from 49.4 to 53.3 bu/A.

TABLE 7.2 • Evaluation of aphid-resistant soybean lines and Warrior II to control leaf-feeding insect pests of soybean, DeKalb, University of Illinois, 2012

Product	Resistance to soybean aphids	Rate[1]	Mean no. bean leaf beetles per 20 sweeps[2,3]			Mean no. corn rootworm beetles per 20 sweeps[2,3]			Mean no. grasshoppers per 20 sweeps[2,3]		
			7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])
LD02-4485	No	—	0.0 a	0.3 a	0.3 b	14.5 a	21.0 a	22.3 a	0.3 a	0.0 a	0.0 b
LD05-16657a	Yes[7]	—	0.0 a	1.0 a	0.0 b	21.3 a	27.3 a	31.3 a	0.3 a	0.0 a	0.0 b
LD08-12441a	Yes[8]	—	0.0 a	0.3 a	1.0 a	13.3 ab	22.5 a	20.3 a	0.0 a	0.3 a	0.3 a
LD02-4485 + Warrior II	No —	— 1.6	0.0 a	0.0 a	0.0 b	3.8 b	18.8 a	26.8 a	0.0 a	0.5 a	0.0 b
LD05-16657a + Warrior II	Yes[7] —	— 1.6	0.0 a	0.0 a	0.3 b	3.0 b	15.0 a	24.0 a	0.0 a	0.5 a	0.0 b
LD08-12441a + Warrior II	Yes[8] —	— 1.6	0.0 a	0.3 a	0.5 ab	2.8 b	15.5 a	17.8 a	0.0 a	0.0 a	0.3 a

1 Rates of application for Warrior II are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly (*P* = 0.1, Duncan's New Multiple Range Test).
7 Soybean aphid resistance was conferred by the *Rag1* gene.
8 Soybean aphid resistance was conferred by the *Rag2* gene.

TABLE 7.2 (CONTINUED) • Evaluation of aphid-resistant soybean lines and Warrior II to control leaf-feeding insect pests of soybean, DeKalb, University of Illinois, 2012

Product	Resistance to soybean aphids	Rate[1]	Mean no. Japanese beetles per 20 sweeps[2,3]			Mean no. stink bugs per 20 sweeps[2,3]			Mean yield (bu/A)[5,6] 12 Oct
			7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	
LD02-4485	No	—	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a	0.0 a	52.5 a
LD05-16657a	Yes[7]	—	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	49.7 a
LD08-12441a	Yes[8]	—	0.0 a	0.0 a	0.0 a	0.3 a	0.0 a	0.0 a	49.4 a
LD02-4485 + Warrior II	No —	— 1.6	0.0 a	0.0 a	0.0 a	0.3 a	0.3 a	0.0 a	53.3 a
LD05-16657a + Warrior II	Yes[7] —	— 1.6	0.0 a	0.0 a	0.0 a	0.0 a	0.5 a	0.0 a	49.4 a
LD08-12441a + Warrior II	Yes[8] —	— 1.6	0.0 a	0.3 a	0.0 a	0.3 a	0.8 a	0.3 a	51.6 a

1 Rates of application for Warrior II are ounces (oz) of product per acre.
2 Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
7 Soybean aphid resistance was conferred by the *Rag1* gene.
8 Soybean aphid resistance was conferred by the *Rag2* gene.

Morrison—Densities of corn rootworm beetles, grasshoppers, Japanese beetles, and stink bugs were not assessed prior to the application of Warrior II on 31 July. Mean densities of these insects following the application of Warrior II are presented in Table 7.3.

Mean densities of corn rootworm beetles, grasshoppers, and stink bugs were very low across all sampling dates; no significant differences among treatments were observed for these insects. On 7 August (7 DAT), all of the soybean lines treated with Warrior II had significantly fewer Japanese beetles per 20 sweeps than their untreated counterparts. However, no significant differences in mean densities of Japanese beetles were observed on 14 or 21 August (14 and 21 DAT, respectively).

Mean yields are presented in Table 7.3. Although some significant differences in mean yields were observed, none of the soybean lines treated with Warrior II yielded significantly more than their untreated counterparts.

TABLE 7.3 • Evaluation of aphid-resistant soybean lines and Warrior II to control leaf-feeding insect pests of soybean, Morrison, University of Illinois, 2012

Product	Resistance to soybean aphids	Rate[1]	Mean no. corn rootworm beetles per 20 sweeps[2,3]			Mean no. grasshoppers per 20 sweeps[2,3]		
			7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])
LD02-4485	No	—	0.3 a	0.8 a	0.5 a	0.3 a	0.5 a	0.3 a
LD05-16657a	Yes[7]	—	0.5 a	0.0 a	0.5 a	0.0 a	0.3 a	0.3 a
LD08-12441a	Yes[8]	—	0.3 a	0.5 a	0.8 a	0.3 a	0.3 a	0.0 a
LD02-4485 + Warrior II	No —	— 1.6	0.0 a	0.0 a	1.0 a	0.0 a	0.5 a	0.3 a
LD05-16657a + Warrior II	Yes[7] —	— 1.6	0.3 a	0.0 a	0.8 a	0.0 a	0.3 a	0.3 a
LD08-12441a + Warrior II	Yes[8] —	— 1.6	0.0 a	0.0 a	1.0 a	0.3 a	0.0 a	0.3 a

[1] Rates of application for Warrior II are ounces (oz) of product per acre.
[2] Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
[3] Means for the same date 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] Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
[6] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[7] Soybean aphid resistance was conferred by the *Rag1* gene.
[8] Soybean aphid resistance was conferred by the *Rag2* gene.

TABLE 7.3 (CONTINUED) • Evaluation of aphid-resistant soybean lines and Warrior II to control leaf-feeding insect pests of soybean, Morrison, University of Illinois, 2012

Product	Resistance to soybean aphids	Rate[1]	Mean no. Japanese beetles per 20 sweeps[2,3]			Mean no. stink bugs per 20 sweeps[2,3]			Mean yield (bu/A)[5,6] 11 Oct
			7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	
LD02-4485	No	—	18.8 a	7.3 a	2.8 a	0.3 a	0.5 a	0.8 a	47.7 bc
LD05-16657a	Yes[7]	—	14.8 a	2.0 a	3.3 a	0.0 a	0.0 a	0.0 a	44.3 d
LD08-12441a	Yes[8]	—	17.3 a	3.3 a	2.8 a	0.3 a	0.0 a	0.0 a	51.6 a
LD02-4485 + Warrior II	No —	— 1.6	2.0 b	2.5 a	3.5 a	0.0 a	0.0 a	0.0 a	50.0 ab
LD05-16657a + Warrior II	Yes[7] —	— 1.6	2.3 b	3.3 a	3.8 a	0.0 a	0.0 a	0.3 a	45.8 cd
LD08-12441a + Warrior II	Yes[8] —	— 1.6	2.0 b	0.8 a	3.0 a	0.0 a	0.0 a	0.0 a	51.9 a

[1] Rates of application for Warrior II are ounces (oz) of product per acre.
[2] Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
[3] Means for the same date 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] Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
[6] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[7] Soybean aphid resistance was conferred by the *Rag1* gene.
[8] Soybean aphid resistance was conferred by the *Rag2* gene.

SECTION 8

Evaluation of foliar-applied insecticides to control leaf-feeding insect pests of soybean in Illinois, 2012

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 Adam Yoeckel Farm near Morrison (Whiteside County). Funding for these experiments 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 insect pests were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. After the application of insecticides, densities of insect pests were assessed on 7, 14, and 21 August (7, 14, and 21 days after treatment [DAT], respectively).

Planting, Insecticide Application, and Yield

Trials were planted on 14 and 15 May at Morrison and DeKalb, respectively. Both trials were planted using a four-row, ALMACO constructed planter with John Deere 7300 row units. Precision cone units were used to meter the seeds. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Insecticides were applied on 31 July at both locations 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 subplot on 11 and 12 October at Morrison and DeKalb, respectively. 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 8.4.2 (Copyright© 1982–2012 Gylling Data Management, Inc., Brookings, SD).

Results and Discussion

DeKalb—Prior to the application of insecticides on 31 July, there were 0.6, 8.4, 0.4, 0.1, and 0.1 bean leaf beetles, corn

TABLE 8.1 • Agronomic information for efficacy trials of foliar-applied insecticides to control leaf-feeding insect pests of soybean, University of Illinois, 2012

	DeKalb	Morrison
Planting date	15 May	14 May
Harvest date	12 October	11 October
Variety	NK S31-L7	NK S31-L7
Row spacing	30 inches	30 inches
Seeding rate	140,000/acre	140,000/acre
Previous crop	Corn	Corn
Tillage	Fall—moldboard plow Spring—mulch finisher	Fall—vertical tillage Spring—vertical tillage

rootworm beetles, grasshoppers, Japanese beetles, and stink bugs per 20 sweeps, respectively. Mean densities of these insects following the application of insecticides are presented in Table 8.2.

Mean densities of bean leaf beetles, grasshoppers, Japanese beetles, and stink bugs were very low across all sampling dates; no significant differences among treatments were observed for these insects. On 7 August (7 DAT), all insecticide treatments had significantly fewer corn rootworm beetles per 20 sweeps than the untreated check (UTC)—no significant differences among the insecticide treatments were observed on this or the remaining two sampling dates.

Mean yields are presented in Table 8.2. Although some significant differences in mean yields were observed, none of the insecticide treatments yielded significantly more than the UTC.

Morrison—Prior to the application of insecticides on 31 July, there were 0.2, 0.2, 12.2, and 0.0 corn rootworm beetles, grasshoppers, Japanese beetles, and stink bugs per 20 sweeps, respectively. Mean densities of these insects following the application of insecticides are presented in Table 8.3.

Mean densities of corn rootworm beetles, grasshoppers, and stink bugs were very low across all sampling dates; no significant differences among treatments were observed for these insects. On 7 August (7 DAT), all insecticide treatments had significantly fewer Japanese beetles per 20 sweeps than the UTC. Cobalt had significantly more Japanese beetles than all other insecticide treatments excluding the low rate of Declare. On 14 August (14 DAT), all insecticide treatments had significantly fewer Japanese beetles per 20 sweeps than the UTC. In addition, on 14 August (14 DAT), the lowest mean densities of Japanese beetles were observed for Mustang Max and the high rate of Declare, although these mean densities were not significantly different than those for Baythroid XL, Hero, and Leverage 360. No significant differences among treatments were observed for mean densities of Japanese beetles on 21 August (21 DAT).

Mean yields are presented in Table 8.3. Mean yields were statistically similar for all treatments.

TABLE 8.2 • Evaluation of foliar-applied insecticides to control leaf-feeding insect pests of soybean, DeKalb, University of Illinois, 2012

Product	Rate[1]	Mean no. bean leaf beetles per 20 sweeps[2,3]			Mean no. corn rootworm beetles per 20 sweeps[2,3]			Mean no. grasshoppers per 20 sweeps[2,3]		
		7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])
Baythroid XL	2.8	0.0 a	0.3 a	0.0 a	2.0 b	7.5 a	7.5 a	0.0 a	0.0 a	0.0 a
Cobalt	13	0.0 a	0.0 a	0.0 a	5.0 b	8.5 a	12.0 a	0.5 a	0.5 a	0.3 a
Declare	1.02	0.0 a	0.0 a	0.3 a	2.0 b	13.8 a	6.8 a	0.3 a	0.0 a	0.0 a
Declare	1.28	0.0 a	0.0 a	0.0 a	3.3 b	12.5 a	7.8 a	0.3 a	0.8 a	0.5 a
Declare + Dimethoate	1.02 4	0.0 a	0.0 a	0.0 a	2.3 b	13.0 a	9.5 a	0.3 a	0.3 a	0.5 a
Hero	5	0.0 a	0.0 a	0.0 a	2.8 b	11.3 a	6.5 a	0.0 a	0.0 a	0.8 a
Leverage 360	2.8	0.0 a	0.3 a	0.0 a	2.5 b	8.3 a	8.3 a	0.0 a	0.3 a	0.0 a
Mustang Max	4	0.0 a	0.0 a	0.0 a	2.0 b	8.3 a	4.3 a	0.3 a	0.0 a	0.5 a
Warrior II	1.54	0.0 a	0.3 a	0.0 a	0.8 b	13.3 a	7.0 a	0.0 a	0.3 a	0.8 a
UTC[7]	—	0.3 a	0.5 a	0.0 a	15.0 a	11.5 a	7.3 a	0.3 a	0.5 a	0.3 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 in each plot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
7 UTC = untreated check.

TABLE 8.2 (CONTINUED) • Evaluation of foliar-applied insecticides to control leaf-feeding insect pests of soybean, DeKalb, University of Illinois, 2012

Product	Rate[1]	Mean no. Japanese beetles per 20 sweeps[2,3]			Mean no. stink bugs per 20 sweeps[2,3]			Mean yield (bu/A)[5,6] 12 Oct
		7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	
Baythroid XL	2.8	0.0 a	0.0 a	0.0 a	0.0 a	0.5 a	0.0 a	63.8 ab
Cobalt	13	0.0 a	0.3 a	0.0 a	0.0 a	0.3 a	1.0 a	63.6 ab
Declare	1.02	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a	0.5 a	63.9 ab
Declare	1.28	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a	62.8 b
Declare + Dimethoate	1.02 4	0.3 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	61.9 bc
Hero	5	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a	58.9 c
Leverage 360	2.8	0.0 a	0.3 a	0.0 a	0.0 a	0.3 a	0.0 a	61.0 bc
Mustang Max	4	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a	0.5 a	62.3 b
Warrior II	1.54	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a	0.5 a	66.5 a
UTC[7]	—	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	63.2 ab

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 in each plot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
7 UTC = untreated check.

TABLE 8.3 • **Evaluation of foliar-applied insecticides to control leaf-feeding insect pests of soybean, Morrison, University of Illinois, 2012**

Product	Rate[1]	Mean no. corn rootworm beetles per 20 sweeps[2,3]			Mean no. grasshoppers per 20 sweeps[2,3]		
		7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])
Baythroid XL	2.8	0.3 a	0.5 a	5.0 a	0.3 a	0.3 a	0.0 a
Cobalt	13	0.3 a	0.8 a	2.5 a	0.0 a	0.0 a	0.3 a
Declare	1.02	0.5 a	0.3 a	2.5 a	0.0 a	0.3 a	0.0 a
Declare	1.28	0.3 a	0.5 a	2.0 a	0.0 a	0.3 a	0.3 a
Declare + Dimethoate	1.02 4	0.3 a	1.3 a	4.0 a	0.3 a	0.3 a	0.3 a
Hero	5	0.3 a	0.0 a	1.5 a	0.0 a	0.0 a	0.0 a
Leverage 360	2.8	0.5 a	0.5 a	2.5 a	0.0 a	0.0 a	0.3 a
Mustang Max	4	0.3 a	2.0 a	2.5 a	0.0 a	0.3 a	0.0 a
Warrior II	1.54	0.3 a	0.8 a	2.8 a	0.3 a	0.0 a	0.0 a
UTC[7]	—	1.0 a	1.3 a	1.8 a	0.0 a	0.3 a	0.3 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 in each plot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly (*P* = 0.1, Duncan's New Multiple Range Test).
7 UTC = untreated check.

TABLE 8.3 (CONTINUED) • **Evaluation of foliar-applied insecticides to control leaf-feeding insect pests of soybean, Morrison, University of Illinois, 2012**

Product	Rate[1]	Mean no. Japanese beetles per 20 sweeps[2,3]			Mean no. stink bugs per 20 sweeps[2,3]			Mean yield (bu/A)[5,6] 11 Oct
		7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	7 Aug (7 DAT[4])	14 Aug (14 DAT[4])	21 Aug (21 DAT[4])	
Baythroid XL	2.8	0.5 c	1.5 bcd	1.3 a	0.0 a	0.3 a	0.0 a	59.1 a
Cobalt	13	6.8 b	3.0 bc	4.8 a	0.3 a	0.0 a	0.0 a	55.5 a
Declare	1.02	3.8 bc	3.5 bc	3.8 a	0.0 a	0.3 a	0.3 a	57.7 a
Declare	1.28	2.0 c	0.5 d	4.8 a	0.0 a	0.0 a	0.0 a	55.5 a
Declare + Dimethoate	1.02 4	2.8 c	3.8 b	4.8 a	0.0 a	0.0 a	0.3 a	57.9 a
Hero	5	0.8 c	1.3 cd	1.8 a	0.0 a	0.0 a	0.0 a	54.6 a
Leverage 360	2.8	1.0 c	1.3 cd	2.8 a	0.0 a	0.0 a	0.0 a	55.8 a
Mustang Max	4	0.0 c	0.5 d	4.3 a	0.0 a	0.0 a	0.0 a	54.0 a
Warrior II	1.54	2.5 c	3.5 bc	4.3 a	0.0 a	0.3 a	0.0 a	57.0 a
UTC[7]	—	11.3 a	6.0 a	5.3 a	0.0 a	0.5 a	0.3 a	55.8 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 in each plot in each of four replications.
3 Means for the same date 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 Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.
6 Means followed by the same letter do not differ significantly (*P* = 0.1, Duncan's New Multiple Range Test).
7 UTC = untreated check.

APPENDIX I • References cited in this publication, including the node-injury scale to evaluate root injury by corn rootworms

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, one root cluster was extracted from row one of each plot. Each cluster contained a non-rootworm Bt refuge root system (denoted below as root system R) and four adjacent Bt root systems (denoted as root systems A1, A2, A3, and A4). Spatially, root system A1 is nearest to the refuge root system and root system A4 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, A2, A3, or A4.

$$NIR_W = 10\%(NIR_R) + 20\%(NIR_{A1}) + 20\%(NIR_{A2}) + 20\%(NIR_{A3}) + 30\%(NIR_{A4})$$

where:

NIR_W = the overall weighted node-injury rating

NIR_R = the node-injury rating for root system R

NIR_{A1} = the node-injury rating for root system A1

NIR_{A2} = the node-injury rating for root system A2

NIR_{A3} = the node-injury rating for root system A3

NIR_{A4} = the node-injury rating for root system A4

Weighted formula used for determining root injury for seed-blend treatments, Section 3

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 • Trade names and active ingredients of chemical products included in this publication

Product name	Active ingredient(s)
ApronMaxx	mefenoxam[1] + fludioxonil[1]
Aztec 2.1G	tebupirimphos + cyfluthrin
Aztec 4.67G	tebupirimphos + cyfluthrin
Baythroid XL	beta-cyfluthrin
Capture LFR	bifenthrin
Cobalt	chlorpyrifos + gamma-cyhalothrin
Counter 20G	terbufos
Cruiser	thiamethoxam
CruiserMaxx[1]	thiamethoxam + mefenoxam[1] + fludioxonil[1]
Declare	gamma-cyhalothrin
Dimethoate	dimethoate
Endigo ZC	lambda-cyhalothrin + thiamethoxam
Force CS	tefluthrin
Gaucho	imidacloprid
Hero	zeta-cypermethrin + bifenthrin
Leverage 360	imidacloprid + beta-cyfluthrin
Lorsban 15G	chlorpyrifos
Mustang Max	zeta-cypermethrin
Poncho	clothianidin
Poncho VOTiVO[1]	clothianidin + *Bacillus firmus* I-1582[1]
SmartChoice 5G	chlorethoxyfos + bifenthrin
Warrior II	lambda-cyhalothrin

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

APPENDIX III • Temperature and precipitation data

2012 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)		
	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference
April	49.0	49.1	–0.1	178	178	—	2.44	3.48	–1.04
May	64.0	59.4	+4.6	644	534	+110	2.98	4.90	–1.92
June	70.0	69.5	+0.5	1,242	1,115	+127	0.81	4.40	–3.59
July	76.5	73.3	+3.2	2,014	1,828	+186	2.27	3.78	–1.51
August	68.6	71.3	–2.7	2,588	2,485	+103	2.56	4.31	–1.75
September	60.2	64.2	–4.0	2,999	2,939	+60	1.44	3.28	–1.84
October	48.4	51.8	–3.4	3,175	3,155	+20	3.04	2.73	+0.31

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

2012 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)		
	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference
April	53.2	51.3	+1.9	248	210	+38	1.91	3.74	–1.83
May	66.8	61.6	+5.2	779	617	+162	3.79	5.00	–1.21
June	71.0	70.5	+0.5	1,396	1,230	+166	2.95	5.19	–2.24
July	78.6	74.0	+4.6	2,214	1,959	+255	0.09	2.39	–2.30
August	71.6	72.5	–0.9	2,863	2,651	+212	3.31	3.55	–0.24
September	62.8	65.1	–2.3	3,312	3,136	+176	1.59	3.46	–1.87
October	52.2	53.1	–0.9	3,581	3,384	+197	3.60	2.50	+1.10

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

2012 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)		
	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference
April	49.4	50.5	–1.1	177	212	–35	3.77	3.82	–0.05
May	63.6	60.7	+2.9	640	608	+32	3.13	4.03	–0.90
June	68.9	70.0	–1.1	1,208	1,201	+7	2.13	4.72	–2.59
July	78.4	73.9	+4.5	2,008	1,915	+93	0.48	4.09	–3.61
August	69.6	71.6	–2.0	2,601	2,576	+25	4.28	4.38	–0.10
September	61.5	64.0	–2.5	3,035	3,036	–1	1.17	3.07	–1.90
October	49.9	51.9	–2.0	3,232	3,274	–42	2.48	2.75	–0.27

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

2012 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)		
	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference
April	55.6	53.7	+1.9	300	260	+40	5.39	3.71	+1.68
May	67.6	63.1	+4.5	864	712	+152	1.01	3.83	–2.82
June	71.6	72.0	–0.4	1,487	1,360	+127	1.55	5.36	–3.81
July	82.0	76.1	+5.9	2,320	2,129	+191	0.95	3.71	–2.76
August	73.6	74.3	–0.7	2,988	2,851	+137	0.73	3.19	–2.46
September	64.1	66.5	–2.4	3,473	3,370	+103	7.41	3.47	+3.94
October	54.5	54.5	—	3,765	3,654	+111	4.24	3.25	+0.99

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

2012 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)		
	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference	2012	15-year average (1997–2011)	Difference
April	52.7	53.2	–0.5	257	246	+11	2.59	3.53	–0.94
May	67.4	62.8	+4.6	806	683	+123	2.47	4.41	–1.94
June	70.5	72.0	–1.5	1,408	1,334	+74	1.63	4.48	–2.85
July	78.6	75.2	+3.4	2,210	2,094	+116	0.59	4.50	–3.91
August	70.7	73.8	–3.1	2,830	2,817	+13	3.92	3.76	+0.16
September	62.8	67.1	–4.3	3,279	3,341	–62	6.01	3.15	+2.86
October	51.3	54.7	–3.4	3,475	3,609	–134	5.46	3.19	+2.27

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