

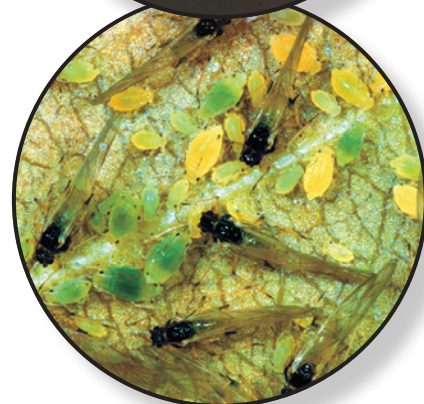


# on Target

Annual review of University  
of Illinois insect management trials

## 2014 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





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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## TABLE OF CONTENTS

### CORN

<b>SECTION 1</b>	Evaluation of products to control corn rootworm larvae ( <i>Diabrotica spp.</i> ) in Illinois, 2014. ....	4
<b>SECTION 2</b>	Evaluation of Bt hybrids and Poncho to control corn rootworm larvae ( <i>Diabrotica spp.</i> ) in Illinois, 2014 .....	13
<b>SECTION 3</b>	Evaluation of soil-applied insecticides to control corn rootworm larvae ( <i>Diabrotica spp.</i> ) in Illinois, 2014 .....	18
<b>SECTION 4</b>	Evaluation of soil-applied insecticides and a Bt hybrid seed-blend to control corn rootworm larvae ( <i>Diabrotica spp.</i> ) in Illinois, 2014 .....	21

### SOYBEAN

<b>SECTION 5</b>	Evaluation of experimental and commercially available foliar-applied insecticides and insecticide/ fungicide combinations to control Japanese beetles ( <i>Popillia japonica</i> ) in soybean in Illinois, 2014 ...	26
<b>SECTION 6</b>	Evaluation of foliar-applied insecticides to control Japanese beetles ( <i>Popillia japonica</i> ) in soybean in Illinois, 2014 .....	28

### APPENDICES

<b>APPENDIX I</b>	References cited in this publication, including the node-injury scale to evaluate root injury by corn rootworms .....	30
<b>APPENDIX II</b>	Trade names and active ingredients of chemical products included in this publication .....	31
<b>APPENDIX III</b>	Temperature and precipitation data .....	32



## CORN

### SECTION 1

## Evaluation of products to control corn rootworm larvae (*Diabrotica* spp.) in Illinois, 2014

Nicholas A. Tinsley, Ronald E. Estes, 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 14 July at Monmouth and Perry and on 23 and 28 July at Urbana and DeKalb, respectively. Root systems were washed and rated for corn rootworm larval injury using the 0 to 3 node-injury scale developed by Oleson et al. (2005) (Appendix I). The percentage of roots with a node-injury rating less than 0.25 (i.e., consistency percentage) was determined for each product at each location.

### Planting, Insecticide Application, and Yield

Trials were planted on 6, 7, 8, and 12 May at Perry, Monmouth, DeKalb, and Urbana, respectively. All trials were planted using a four-row, vacuum style planter constructed by Seed Research Equipment Solutions (SRES). Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. Granular insecticides were applied through modified Noble metering units 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<sub>2</sub> system. All insecticides were applied in front of the firming wheels on the planter. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 26 September at Perry and on 3 and 7 November at DeKalb and Urbana, respectively. Weights were converted to bushels per acre (bu/A) at 15.5% moisture. To ensure

uniform plant densities across all plots, plant populations in the harvested rows were thinned at the V7 growth stage to 36,000 plants per acre. Due to severe lodging, plots were not harvested at Monmouth. Lodging evaluations were performed at this location by determining the percentage of plants lodged (i.e., leaning 45° or less from the soil surface) in the center two rows of each plot.

### Agronomic Information

Agronomic information for all locations is listed in Table 1.1.

### Climatic Conditions

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

### Statistical Analysis

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

### Results and Discussion

**DeKalb**—Mean node-injury ratings, consistency percentages, and yields are presented in Table 1.2. Mean node-injury ratings for the untreated checks (UTCs) ranged from 1.08 to 2.10, indicating that corn rootworm larval feeding was moderate to severe. Mean node-injury ratings for the soil-applied insecticides ranged from 0.02 to 0.83. All soil-applied insecticides had a mean node-injury rating that was significantly lower than for their respective UTC. Of the three soil-applied insecticides we tested that are currently labeled for use in corn, Aztec 2.1G and Force CS provided significantly better root protection than Capture LFR. Mean node-injury ratings for the pyramided rootworm Bt hybrids (i.e., those with two toxins targeting corn rootworm larvae) ranged from 0.01 to 0.28 and were generally lower than for the single-toxin rootworm Bt hybrids (0.69 to 0.92). Mean node-injury ratings for the soil-applied insecticide/rootworm Bt hybrid combination treatments ranged from 0.01 to 0.46. Mean node-injury ratings for the pyramided rootworm Bt hybrids were never significantly improved by adding a soil-applied insecticide. Use of a soil-applied insecticide with the single-toxin rootworm Bt hybrids usually resulted in a significantly lower mean node-injury rating; however, this trend was not observed when Capture LFR was used.



## CORN

**TABLE 1.1** • Agronomic information for efficacy trials of products to control corn rootworm larvae, University of Illinois, 2014

	DeKalb	Monmouth	Perry	Urbana
<b>Planting date</b>	8 May	7 May	6 May	12 May
<b>Root evaluation date</b>	28 July	14 July	14 July	23 July
<b>Harvest date</b>	3 November	—	26 September	7 November
<b>Hybrids</b>	DEKALB DKC61-88 Genuity VT Triple Pro DEKALB DKC61-88RIB Genuity VT Triple Pro RIB Complete <sup>1</sup> DEKALB DKC63-33 Genuity SmartStax DEKALB DKC63-33RIB Genuity SmartStax RIB Complete <sup>2</sup> DEKALB DKC63-35RIB Genuity VT Double Pro RIB Complete Mycogen 2K591 Roundup Ready 2 Mycogen 2K594 SmartStax NK N63H-3111 Agrisure Viptera 3111 NK N65D-3122 Agrisure 3122 E-Z Refuge <sup>2</sup> NK N69Z-GT Agrisure GT T.A. Seeds TA617-18 Agrisure GT	DEKALB DKC61-88 Genuity VT Triple Pro DEKALB DKC61-88RIB Genuity VT Triple Pro RIB Complete <sup>1</sup> DEKALB DKC63-33 Genuity SmartStax DEKALB DKC63-33RIB Genuity SmartStax RIB Complete <sup>2</sup> DEKALB DKC63-35RIB Genuity VT Double Pro RIB Complete NK N63H-3111 Agrisure Viptera 3111 NK N65D-3122 Agrisure 3122 E-Z Refuge <sup>2</sup> NK N69Z-GT Agrisure GT	DEKALB DKC61-88 Genuity VT Triple Pro DEKALB DKC61-88RIB Genuity VT Triple Pro RIB Complete <sup>1</sup> DEKALB DKC63-33 Genuity SmartStax DEKALB DKC63-33RIB Genuity SmartStax RIB Complete <sup>2</sup> DEKALB DKC63-35RIB Genuity VT Double Pro RIB Complete Mycogen 2K591 Roundup Ready 2 Mycogen 2K594 SmartStax NK N65D-3122 Agrisure 3122 E-Z Refuge <sup>2</sup>	DEKALB DKC61-88 Genuity VT Triple Pro DEKALB DKC61-88RIB Genuity VT Triple Pro RIB Complete <sup>1</sup> DEKALB DKC63-33 Genuity SmartStax DEKALB DKC63-33RIB Genuity SmartStax RIB Complete <sup>2</sup> DEKALB DKC63-35RIB Genuity VT Double Pro RIB Complete Mycogen 2K591 Roundup Ready 2 Mycogen 2K594 SmartStax NK N63H-3111 Agrisure Viptera 3111 NK N65D-3122 Agrisure 3122 E-Z Refuge <sup>2</sup> NK N75H-GTA Agrisure GT NK N75H-5122A Agrisure Duracade E-Z Refuge <sup>2</sup> T.A. Seeds TA617-18 Agrisure GT
<b>Row spacing</b>	30 inches	30 inches	30 inches	30 inches
<b>Seeding rate</b>	36,600/acre	36,600/acre	36,600/acre	36,600/acre
<b>Previous crop</b>	Trap crop <sup>3</sup>	Trap crop <sup>3</sup>	Trap crop <sup>3</sup>	Trap crop <sup>3</sup>
<b>Tillage</b>	Fall—none Spring—discovator	Fall—disc plow Spring—field cultivator	Fall—disc-chisel plow Spring—field cultivator	Fall—chisel plow Spring—field cultivator

<sup>1</sup> Contains a 10% refuge-in-the-bag (non-rootworm Bt) seed-blend.

<sup>2</sup> Contains a 5% refuge-in-the-bag (non-rootworm Bt) seed-blend.

<sup>3</sup> Late-planted corn and pumpkins.

Mean yields for the soil-applied insecticides ranged from 144.8 to 173.7 bu/A. With the exception of Capture LFR, all soil-applied insecticides had a mean yield that was significantly higher than for their respective UTC. Mean yields for the rootworm Bt hybrids ranged from 155.4 to 203.5 bu/A—no clear trend was evident when comparing mean yields between

single-toxin and pyramided Bt hybrids. Mean yields for the soil-applied insecticide/rootworm Bt hybrid combination treatments ranged from 160.6 to 210.0 bu/A. Adding a soil-applied insecticide to a rootworm Bt hybrid significantly improved mean yield in only 1 of 11 instances (Force CS + SmartStax).

*Continued on page 7*



## CORN

**TABLE 1.2 • Evaluation of products to control corn rootworm larvae, DeKalb, University of Illinois, 2014**

Product	Rate <sup>1</sup>	Placement 8 May	Mean node- injury rating <sup>2-5</sup> 28 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 3 Nov
<b>Soil-applied insecticides</b>					
Aztec 2.1G + T.A. Seeds TA617-18 <sup>9</sup>	6.7	NU furrow <sup>15</sup>	0.03 g	100 a	173.7 de
Belay <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.36	Furrow	0.10 g	90 a	172.7 def
Belay <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.56	Furrow	0.02 g	100 a	165.7 d–g
Belay <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.62	Furrow	0.29 d–g	70 a–d	167.7 def
Belay 50 WDG <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.19	Furrow	0.25 efg	70 a–d	167.1 def
Capture LFR + NK N69Z-GT <sup>11</sup>	0.39	Furrow	0.83 b–e	30 d–g	144.8 i
Force CS + NK N69Z-GT <sup>11</sup>	0.46	Furrow	0.05 g	100 a	170.0 def
<b>Rootworm Bt hybrids</b>					
Agrisure 3122 E-Z Refuge <sup>12</sup> (NK N65D-3122 <sup>11</sup> )	—	—	0.05 g	100 a	165.2 d–h
Agrisure Vipitera 3111 (NK N63H-3111 <sup>11</sup> )	—	—	0.69 b–f	35 c–g	155.4 f–i
Genuity SmartStax (DEKALB DKC63-33 <sup>13</sup> )	—	—	0.01 g	100 a	194.3 abc
Genuity SmartStax RIB Complete <sup>12</sup> (DEKALB DKC63-33RIB <sup>13</sup> )	—	—	0.06 g	95 a	203.5 ab
Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	—	—	0.92 bcd	46 b–f	193.2 abc
Genuity VT Triple Pro RIB Complete <sup>12</sup> (DEKALB DKC61-88RIB <sup>13</sup> )	—	—	0.90 bc	15 fg	197.1 abc
SmartStax (Mycogen 2K594 <sup>14</sup> )	—	—	0.28 d–g	75 abc	180.9 cd
<b>Soil-applied insecticides + rootworm Bt hybrids</b>					
Aztec 2.1G + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	6.7	NU furrow <sup>15</sup>	0.05 g	95 a	195.6 abc
Aztec 4.67G + Genuity VT Triple Pro RIB Complete <sup>12</sup> (DEKALB DKC61-88RIB <sup>13</sup> )	3	SB furrow <sup>16</sup>	0.01 g	100 a	203.6 ab
Belay <sup>10</sup> + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	0.56	Furrow	0.10 g	85 ab	210.0 a
Capture LFR + Agrisure Vipitera 3111 (NK N63H-3111 <sup>11</sup> )	0.39	Furrow	0.28 d–g	80 ab	160.6 e–i
Capture LFR + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	0.49	Furrow	0.46 c–g	60 a–e	189.7 bc
Counter 20G + Agrisure 3122 E-Z Refuge <sup>12</sup> (NK N65D-3122 <sup>11</sup> )	6	NU furrow <sup>15</sup>	0.19 fg	75 abc	172.1 def
Force CS + Agrisure Vipitera 3111 (NK N63H-3111 <sup>11</sup> )	0.46	Furrow	0.04 g	100 a	161.7 e–i
Force CS + Agrisure 3122 E-Z Refuge <sup>12</sup> (NK N65D-3122 <sup>11</sup> )	0.46	Furrow	0.02 g	100 a	173.1 de

Table 1.2 continued on next page



## CORN

**TABLE 1.2 • continued**

Product	Rate <sup>1</sup>	Placement 8 May	Mean node- injury rating <sup>2-5</sup> 28 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 3 Nov
Force CS + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	0.57	Furrow	0.16 fg	75 abc	199.0 ab
Force CS + SmartStax (Mycogen 2K594 <sup>14</sup> )	0.46	Furrow	0.01 g	100 a	205.1 ab
SmartChoice 5G + Genuity SmartStax RIB Complete <sup>12</sup> (DEKALB DKC63-33RIB <sup>13</sup> )	5	SB furrow <sup>16</sup>	0.01 g	100 a	194.8 abc
<b>Untreated checks (UTCs)</b>					
DEKALB DKC63-35RIB <sup>13</sup>	—	—	1.08 b	25 efg	170.2 def
Mycogen 2K591 <sup>14</sup>	—	—	1.09 b	30 d–g	148.8 hi
NK N69Z-GT <sup>11</sup>	—	—	1.81 a	0 g	149.4 ghi
T.A. Seeds TA617-18 <sup>9</sup>	—	—	2.10 a	0 g	145.6 i

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Seed was untreated; no insecticidal or fungicidal seed treatment was used.

<sup>10</sup> Product is not currently labeled for use in corn.

<sup>11</sup> Seed was treated with Cruiser, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>12</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>13</sup> Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>14</sup> Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>15</sup> Applied with modified Noble metering units.

<sup>16</sup> Applied with modified SmartBox metering units.

**Monmouth**—Mean node-injury ratings, consistency percentages, and lodging percentages are presented in Table 1.3. Mean node-injury ratings for the UTCs ranged from 1.34 to 2.18, indicating that corn rootworm larval feeding was moderate to severe. Mean node-injury ratings for the soil-applied insecticides ranged from 0.30 to 1.23. While all soil-applied insecticides had a mean node-injury rating that was significantly lower than for their respective UTC, Aztec 2.1G and Force CS provided significantly better root protection than Capture LFR. Mean node-injury ratings for the pyramided rootworm Bt hybrids (0.14 to 0.47) were significantly lower than for the single-toxin rootworm Bt hybrids (1.07 to 1.83). Mean node-injury ratings for the soil-applied insecticide/rootworm Bt hybrid combination treatments ranged from 0.03 to 1.02. Adding a soil-applied insecticide to the pyramided rootworm Bt hybrids only resulted in a significantly improved mean node-injury rating in one instance (Counter 20G + Agrisure 3122 E-Z Refuge). However, use of a soil-applied

insecticide with the single-toxin rootworm Bt hybrids always resulted in a significantly lower mean node-injury rating.

Lodging at this location was extensive—mean lodging percentages for the UTCs ranged from 79 to 89%. Mean lodging percentages for the soil-applied insecticides ranged from 19 to 56% and were significantly lower than for their UTC. Mean lodging percentages for the rootworm Bt hybrids ranged from 55 to 98%. Lodging percentages for these treatments were mostly similar; however, the mean lodging percentage for Genuity SmartStax RIB Complete was significantly lower than for Agrisure 3122 E-Z Refuge, Agrisure Viptera 3111, and Genuity VT Triple Pro. Mean lodging percentages for the soil-applied insecticide/rootworm Bt hybrid combination treatments ranged from 19 to 98%. In roughly half of these treatments (6 of 11 instances), the use of a soil-applied insecticide with the rootworm Bt hybrids resulted in a significantly lower mean lodging percentage.



## CORN

**TABLE 1.3** • Evaluation of products to control corn rootworm larvae, Monmouth, University of Illinois, 2014

Product	Rate <sup>1</sup>	Placement 7 May	Mean node- injury rating <sup>2-5</sup> 14 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean % lodging <sup>4,7</sup> 24 Sep
<b>Soil-applied insecticides</b>					
Aztec 2.1G + NK N69Z-GT <sup>8</sup>	6.7	NU furrow <sup>12</sup>	0.30 e-h	50 b-e	19 d
Capture LFR + NK N69Z-GT <sup>8</sup>	0.39	Furrow	1.23 c	10 f	56 bc
Force CS + NK N69Z-GT <sup>8</sup>	0.46	Furrow	0.57 ef	40 de	50 bcd
<b>Rootworm Bt hybrids</b>					
Agrisure 3122 E-Z Refuge <sup>9</sup> (NK N65D-3122 <sup>8</sup> )	—	—	0.47 efg	50 b-e	94 a
Agrisure Vipera 3111 (NK N63H-3111 <sup>8</sup> )	—	—	1.80 ab	5 f	98 a
Genuity SmartStax (DEKALB DKC63-33 <sup>10</sup> )	—	—	0.14 gh	73 abc	66 ab
Genuity SmartStax RIB Complete <sup>9</sup> (DEKALB DKC63-33RIB <sup>10</sup> )	—	—	0.34 e-h	65 bcd	55 bc
Genuity VT Triple Pro (DEKALB DKC61-88 <sup>10</sup> )	—	—	1.83 a	0 f	96 a
Genuity VT Triple Pro RIB Complete <sup>9</sup> (DEKALB DKC61-88RIB <sup>10</sup> )	—	—	1.07 cd	26 ef	78 ab
<b>Soil-applied insecticides + rootworm Bt hybrids</b>					
Aztec 2.1G + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>10</sup> )	6.7	NU furrow <sup>12</sup>	0.22 fgh	55 b-e	31 cd
Aztec 4.67G + Genuity VT Triple Pro RIB Complete <sup>9</sup> (DEKALB DKC61-88RIB <sup>10</sup> )	3	SB furrow <sup>13</sup>	0.19 fgh	80 ab	19 d
Belay <sup>11</sup> + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>10</sup> )	0.56	Furrow	0.27 e-h	55 b-e	70 ab
Capture LFR + Agrisure Vipera 3111 (NK N63H-3111 <sup>8</sup> )	0.39	Furrow	0.70 de	30 ef	98 a
Capture LFR + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>10</sup> )	0.49	Furrow	1.02 cd	30 ef	80 ab
Counter 20G + Agrisure 3122 E-Z Refuge <sup>9</sup> (NK N65D-3122 <sup>8</sup> )	6	NU furrow <sup>12</sup>	0.06 h	95 a	23 d
Force CS + Agrisure Vipera 3111 (NK N63H-3111 <sup>8</sup> )	0.46	Furrow	0.32 e-h	45 cde	79 ab
Force CS + Agrisure 3122 E-Z Refuge <sup>9</sup> (NK N65D-3122 <sup>8</sup> )	0.46	Furrow	0.07 gh	95 a	28 cd
Force CS + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>10</sup> )	0.57	Furrow	0.31 e-h	45 cde	70 ab
Force CS + Genuity SmartStax (DEKALB DKC63-33 <sup>10</sup> )	0.46	Furrow	0.03 h	100 a	33 cd
SmartChoice 5G + Genuity SmartStax RIB Complete <sup>9</sup> (DEKALB DKC63-33RIB <sup>10</sup> )	5	SB furrow <sup>13</sup>	0.03 h	100 a	20 d
<b>Untreated checks (UTCs)</b>					
DEKALB DKC63-35RIB <sup>10</sup>	—	—	1.34 bc	10 f	79 ab
NK N69Z-GT <sup>8</sup>	—	—	2.18 a	0 f	89 a

Table 1.3 continued on next page



## CORN

**TABLE 1.3 • continued**

- <sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.
- <sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).
- <sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.
- <sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).
- <sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.
- <sup>6</sup> Percentage of roots with a node-injury rating  $< 0.25$ .
- <sup>7</sup> Percentage of plants leaning  $45^\circ$  or less from the soil surface.
- <sup>8</sup> Seed was treated with Cruiser, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.
- <sup>9</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.
- <sup>10</sup> Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.
- <sup>11</sup> Product is not currently labeled for use in corn.
- <sup>12</sup> Applied with modified Noble metering units.
- <sup>13</sup> Applied with modified SmartBox metering units.

**Perry**—Mean node-injury ratings, consistency percentages, and yields are presented in Table 1.4. Mean node-injury ratings for the UTCs ranged from 0.29 to 0.76, indicating that corn rootworm larval feeding was light to moderate. The only stand-alone soil-applied insecticide evaluated at this location was Aztec 2.1G, which provided root protection equal to or better than any other rootworm control product in the trial. Mean node-injury ratings for the rootworm Bt hybrids ranged from 0.01 to 0.22. With the exception of Genuity SmartStax having a significantly lower mean node-injury rating than Genuity VT Triple Pro RIB Complete, all rootworm Bt hybrids had statistically similar mean node-injury ratings. Mean node-injury ratings for the soil-applied insecticide/rootworm Bt hybrid combination treatments ranged from 0.02 to 0.11. Adding a soil-applied insecticide to the rootworm Bt hybrids never resulted in significantly improved root protection.

The stand-alone soil-applied insecticide Aztec 2.1G had a mean yield of 237.0 bu/A, which was equal to or better than any other rootworm control product in the trial. Mean yields for the rootworm Bt hybrids ranged from 197.7 to 241.5 bu/A. Mean yields for Genuity SmartStax, Genuity SmartStax RIB Complete, and SmartStax were significantly greater than for their respective UTCs—near-isoline UTCs were not present for the remaining rootworm Bt hybrids. Mean yields for the soil-applied insecticide/rootworm Bt hybrid combination treatments ranged from 219.4 to 240.2 bu/A. Adding a soil-applied insecticide to the rootworm Bt hybrids never resulted in a significantly greater mean yield.

**Urbana**—Mean node-injury ratings, consistency percentages, and yields are presented in Table 1.5. Mean node-injury ratings

for the UTCs ranged from 1.05 to 1.45, indicating that corn rootworm larval feeding was moderate. Mean node-injury ratings for the soil-applied insecticides ranged from 0.10 to 0.78. All soil-applied insecticides had a mean node-injury rating that was significantly lower than for their respective UTC. The pyramided rootworm Bt hybrids generally had lower mean node-injury ratings when compared with the single-toxin rootworm Bt hybrids (0.01 to 0.45 versus 0.44 to 0.96, respectively); however, this trend was less pronounced than at DeKalb or Monmouth and was not statistically significant in all instances. Agrisure Duracade E-Z Refuge, a new rootworm trait expressing eCry3.1Ab pyramided with mCry3A, had a mean node-injury rating that was statistically similar to those for the other pyramided rootworm Bt hybrids. Mean node-injury ratings for the soil-applied insecticide/rootworm Bt hybrid combination treatments ranged from 0.01 to 0.14. Mean node-injury ratings for the pyramided rootworm Bt hybrids were never significantly improved by adding a soil-applied insecticide. Use of a soil-applied insecticide with the single-toxin rootworm Bt hybrids resulted in a significantly lower mean node-injury rating in two instances: Aztec 4.67G + Genuity VT Triple Pro RIB Complete and Force CS + Agrisure Viptera 3111.

Mean yields for all treatments ranged from 171.5 to 212.8 bu/A. Although significant differences among the products evaluated were observed for mean node-injury ratings and consistency percentages, no significant differences in mean yields were observed. Substantial variability in the yield data at this location contributed to our inability to detect differences in mean yields among the treatments.



## CORN

**TABLE 1.4 • Evaluation of products to control corn rootworm larvae, Perry, University of Illinois, 2014**

Product	Rate <sup>1</sup>	Placement 6 May	Mean node- injury rating <sup>2-5</sup> 14 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 26 Sep
<b>Soil-applied insecticides</b>					
Aztec 2.1G + DEKALB DKC63-35RIB <sup>9</sup>	6.7	NU furrow <sup>14</sup>	0.03 cd	100 a	237.0 a
<b>Rootworm Bt hybrids</b>					
Agrisure 3122 E-Z Refuge <sup>10</sup> (NK N65D-3122 <sup>11</sup> )	—	—	0.03 cd	100 a	215.2 c
Genuity SmartStax (DEKALB DKC63-33 <sup>9</sup> )	—	—	0.01 d	100 a	241.5 a
Genuity SmartStax RIB Complete <sup>10</sup> (DEKALB DKC63-33RIB <sup>9</sup> )	—	—	0.03 cd	100 a	238.9 a
Genuity VT Triple Pro (DEKALB DKC61-88 <sup>9</sup> )	—	—	0.14 bcd	85 abc	231.0 ab
Genuity VT Triple Pro RIB Complete <sup>10</sup> (DEKALB DKC61-88RIB <sup>9</sup> )	—	—	0.22 bc	70 bc	221.8 bc
SmartStax (Mycogen 2K594 <sup>12</sup> )	—	—	0.03 cd	100 a	197.7 d
<b>Soil-applied insecticides + rootworm Bt hybrids</b>					
Aztec 2.1G + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>9</sup> )	6.7	NU furrow <sup>14</sup>	0.08 cd	90 abc	225.2 bc
Aztec 4.67G + Genuity VT Triple Pro RIB Complete <sup>10</sup> (DEKALB DKC61-88RIB <sup>9</sup> )	3	SB furrow <sup>15</sup>	0.11 bcd	90 abc	225.4 bc
Belay <sup>13</sup> + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>9</sup> )	0.56	Furrow	0.06 cd	90 abc	237.8 a
Capture LFR + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>9</sup> )	0.49	Furrow	0.10 bcd	85 abc	230.6 ab
Counter 20G + Agrisure 3122 E-Z Refuge <sup>10</sup> (NK N65D-3122 <sup>11</sup> )	6	NU furrow <sup>14</sup>	0.02 d	100 a	219.4 bc
Force CS + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>9</sup> )	0.57	Furrow	0.08 cd	90 abc	237.6 a
SmartChoice 5G + Genuity SmartStax RIB Complete <sup>10</sup> (DEKALB DKC63-33RIB <sup>9</sup> )	5	SB furrow <sup>15</sup>	0.02 d	95 ab	240.2 a
<b>Untreated checks (UTCs)</b>					
DEKALB DKC63-35RIB <sup>9</sup>	—	—	0.29 b	65 c	224.7 bc
Mycogen 2K591 <sup>12</sup>	—	—	0.76 a	40 d	168.6 e

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>10</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>11</sup> Seed was treated with Cruiser, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>12</sup> Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>13</sup> Product is not currently labeled for use in corn.

<sup>14</sup> Applied with modified Noble metering units.

<sup>15</sup> Applied with modified SmartBox metering units.



## CORN

**TABLE 1.5 • Evaluation of products to control corn rootworm larvae, Urbana, University of Illinois, 2014**

Product	Rate <sup>1</sup>	Placement 12 May	Mean node- injury rating <sup>2-5</sup> 23 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 7 Nov
<b>Soil-applied insecticides</b>					
Aztec 2.1G + T.A. Seeds TA617-18 <sup>9</sup>	6.7	NU furrow <sup>15</sup>	0.10 fg	85 a-d	189.4 a
Belay <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.36	Furrow	0.23 fg	70 a-f	181.2 a
Belay <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.56	Furrow	0.20 fg	70 a-f	198.1 a
Belay <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.62	Furrow	0.30 efg	60 a-g	208.2 a
Belay 50 WDG <sup>10</sup> + T.A. Seeds TA617-18 <sup>9</sup>	0.19	Furrow	0.33 efg	55 b-g	209.4 a
Capture LFR + NK N75H-GTA <sup>11</sup>	0.39	Furrow	0.78 b-e	25 gh	196.7 a
Force CS + NK N75H-GTA <sup>11</sup>	0.46	Furrow	0.36 efg	45 d-h	212.8 a
<b>Rootworm Bt hybrids</b>					
Agrisure 3122 E-Z Refuge <sup>12</sup> (NK N65D-3122 <sup>11</sup> )	—	—	0.13 fg	90 abc	206.3 a
Agrisure Duracade E-Z Refuge <sup>12</sup> (NK N75H-5122A <sup>11</sup> )	—	—	0.45 d-g	40 e-h	192.9 a
Agrisure Viptera 3111 (NK N63H-3111 <sup>11</sup> )	—	—	0.56 c-f	50 c-h	202.9 a
Genuity SmartStax (DEKALB DKC63-33 <sup>13</sup> )	—	—	0.01 g	100 a	203.4 a
Genuity SmartStax RIB Complete <sup>12</sup> (DEKALB DKC63-33RIB <sup>13</sup> )	—	—	0.03 g	100 a	203.0 a
Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	—	—	0.44 d-g	55 b-g	203.3 a
Genuity VT Triple Pro RIB Complete <sup>12</sup> (DEKALB DKC61-88RIB <sup>13</sup> )	—	—	0.96 a-d	30 fgh	183.0 a
SmartStax (Mycogen 2K594 <sup>14</sup> )	—	—	0.11 fg	80 a-e	201.3 a
<b>Soil-applied insecticides + rootworm Bt hybrids</b>					
Aztec 2.1G + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	6.7	NU furrow <sup>15</sup>	0.04 g	100 a	201.5 a
Aztec 4.67G + Agrisure Duracade E-Z Refuge <sup>12</sup> (NK N75H-5122A <sup>11</sup> )	3	SB furrow <sup>16</sup>	0.01 g	100 a	196.1 a
Aztec 4.67G + Genuity VT Triple Pro RIB Complete <sup>12</sup> (DEKALB DKC61-88RIB <sup>13</sup> )	3	SB furrow <sup>16</sup>	0.02 g	100 a	202.1 a
Belay <sup>10</sup> + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	0.56	Furrow	0.10 fg	80 a-e	197.1 a
Capture LFR + Agrisure Viptera 3111 (NK N63H-3111 <sup>11</sup> )	0.39	Furrow	0.08 fg	95 ab	206.8 a
Capture LFR + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	0.49	Furrow	0.14 fg	80 a-e	205.0 a
Counter 20G + Agrisure 3122 E-Z Refuge <sup>12</sup> (NK N65D-3122 <sup>11</sup> )	6	NU furrow <sup>15</sup>	0.01 g	100 a	196.8 a
Force CS + Agrisure Viptera 3111 (NK N63H-3111 <sup>11</sup> )	0.46	Furrow	0.04 g	100 a	199.4 a

Table 1.5 continued on next page



## CORN

**TABLE 1.5** • continued

Product	Rate <sup>1</sup>	Placement 12 May	Mean node- injury rating <sup>2-5</sup> 23 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 7 Nov
Force CS + Agrisure Duracade E-Z Refuge <sup>12</sup> (NK N75H-5122A <sup>11</sup> )	0.46	Furrow	0.04 g	95 ab	204.9 a
Force CS + Genuity VT Triple Pro (DEKALB DKC61-88 <sup>13</sup> )	0.57	Furrow	0.03 g	100 a	177.2 a
Force CS + SmartStax (Mycogen 2K594 <sup>14</sup> )	0.46	Furrow	0.01 g	100 a	171.5 a
SmartChoice 5G + Genuity SmartStax RIB Complete <sup>12</sup> (DEKALB DKC63-33RIB <sup>13</sup> )	5	SB furrow <sup>16</sup>	0.01 g	100 a	179.3 a
<b>Untreated checks (UTCs)</b>					
DEKALB DKC63-35RIB <sup>13</sup>	—	—	1.11 abc	24 gh	202.9 a
Mycogen 2K591 <sup>14</sup>	—	—	1.05 abc	25 gh	200.4 a
NK N75H-GTA <sup>11</sup>	—	—	1.45 a	20 gh	195.0 a
T.A. Seeds TA617-18 <sup>9</sup>	—	—	1.37 ab	10 h	204.1 a

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Seed was untreated; no insecticidal or fungicidal seed treatment was used.

<sup>10</sup> Product is not currently labeled for use in corn.

<sup>11</sup> Seed was treated with Cruiser, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>12</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>13</sup> Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>14</sup> Seed was treated with Cruiser, 0.25 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>15</sup> Applied with modified Noble metering units.

<sup>16</sup> Applied with modified SmartBox metering units.



## CORN

### SECTION 2

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

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 14 July at Monmouth and Perry and on 16 and 28 July at Urbana and DeKalb, respectively. Root systems were washed and rated for corn rootworm larval injury using the 0 to 3 node-injury

scale developed by Oleson et al. (2005) (Appendix I). The percentage of roots with a node-injury rating less than 0.25 (i.e., consistency percentage) was determined for each product at each location.

### Planting, Insecticide Application, and Yield

Trials were planted on 6, 6, 8, and 12 May at Monmouth, Perry, DeKalb, and Urbana, respectively. All trials were planted using a four-row, vacuum style planter constructed by Seed Research Equipment Solutions (SRES). Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. All seed-applied insecticides (Poncho) were applied by Bayer Crop Sciences. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 26 September at Perry, 29 October at DeKalb, and 7 November at Urbana. Weights were converted to bushels per acre (bu/A) at 15.5% moisture. To ensure uniform plant densities across all plots, plant populations in the harvested rows were thinned at the V6–V8 growth stage to 32,000 plants per acre. Due to severe lodging, plots were not harvested at Monmouth. Lodging evaluations were performed at this

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

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

<sup>1</sup> KSC = Kitchen Seed Company; MS = Merschman Seeds.

<sup>2</sup> Contains a 5% refuge-in-the-bag (non-rootworm Bt) seed-blend.

<sup>3</sup> Contains a 10% refuge-in-the-bag (non-rootworm Bt) seed blend.

<sup>4</sup> Late-planted corn and pumpkins.



## CORN

location by determining the percentage of plants lodged (i.e., leaning 45° or less from the soil surface) in the center two rows of each plot.

### Agronomic Information

Agronomic information for all locations is listed in Table 2.1.

### Climatic Conditions

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

### Statistical Analysis

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

### Results and Discussion

**DeKalb**—Mean node-injury ratings, consistency percentages, and yields are reported in Table 2.2. The mean node-injury

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

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

**TABLE 2.2 • Evaluation of Bt hybrids and seed-applied insecticides to control corn rootworm larvae, DeKalb, University of Illinois, 2014**

Product	Rate <sup>1</sup>	Placement 8 May	Mean node- injury rating <sup>2-5</sup> 28 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 29 Oct
Poncho + Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	1250	Seed	0.07 d	85 ab	173.4 a
Poncho + Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	500	Seed	0.03 d	100 a	183.2 a
Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	—	—	0.10 d	90 a	173.3 a
Poncho + KSC <sup>10</sup> 5911 RR2	1250	Seed	0.44 c	55 bc	172.3 a
Poncho + KSC <sup>10</sup> 5911 RR2	500	Seed	0.87 b	30 cd	156.0 b
Untreated check (KSC <sup>10</sup> 5911 RR2)	—	—	1.81 a	5 d	157.1 b

<sup>1</sup> Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>10</sup> Kitchen Seed Company.



## CORN

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

hybrids did not significantly improve consistency percentages when compared with their untreated counterparts.

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

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

**TABLE 2.3 • Evaluation of Bt hybrids and seed-applied insecticides to control corn rootworm larvae, Monmouth, University of Illinois, 2014**

Product	Rate <sup>1</sup>	Placement 6 May	Mean node- injury rating <sup>2-5</sup> 14 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean % lodging <sup>4,7</sup> 24 Sep
Poncho + Genuity SmartStax RIB Complete <sup>8</sup> (KSC <sup>9</sup> 5911 SS RIB)	1250	Seed	0.22 c	65 a	36 b
Poncho + Genuity SmartStax RIB Complete <sup>8</sup> (KSC <sup>9</sup> 5911 SS RIB)	500	Seed	0.37 c	60 ab	40 b
Genuity SmartStax RIB Complete <sup>8</sup> (KSC <sup>9</sup> 5911 SS RIB)	—	—	0.44 c	60 ab	36 b
Poncho + Genuity VT Triple Pro RIB Complete <sup>8</sup> (MS <sup>9</sup> M-909C-17)	1250	Seed	0.70 c	25 abc	94 a
Poncho + Genuity VT Triple Pro RIB Complete <sup>8</sup> (MS <sup>9</sup> M-909C-17)	500	Seed	0.69 c	15 bc	94 a
Genuity VT Triple Pro RIB Complete <sup>8</sup> (MS <sup>9</sup> M-909C-17)	—	—	1.32 b	10 c	98 a
Untreated check (KSC <sup>9</sup> 5911 RR2)	—	—	2.31 a	0 c	93 a

<sup>1</sup> Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Percentage of plants leaning 45° or less from the soil surface.

<sup>8</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>9</sup> KSC = Kitchen Seed Company; MS = Merschman Seeds.



## CORN

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

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

**Urbana**—Mean node-injury ratings, consistency percentages, and yields are reported in Table 2.5. The mean node-injury rating for the UTC was 2.17, indicating that corn rootworm larval feeding was severe. Mean node-injury ratings for Genuity

SmartStax RIB Complete (with or without Poncho) ranged from 0.19 to 0.56 and were significantly lower than for Genuity VT Triple Pro RIB Complete + Poncho 500 (1.55) and the UTC. Mean consistency percentages ranged from 0 to 80%. Genuity SmartStax RIB Complete (with or without Poncho) had significantly higher mean consistency percentages than Genuity VT Triple Pro RIB Complete + Poncho 500 (0%), and the UTC (5%).

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

**TABLE 2.4 • Evaluation of Bt hybrids and seed-applied insecticides to control corn rootworm larvae, Perry, University of Illinois, 2014**

Product	Rate <sup>1</sup>	Placement 6 May	Mean node- injury rating <sup>2-5</sup> 14 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 26 Sep
Poncho + Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	1250	Seed	0.02 b	100 a	179.3 b
Poncho + Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	500	Seed	0.06 b	90 a	192.0 ab
Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	—	—	0.08 b	95 a	200.9 a
Poncho + KSC <sup>10</sup> 5911 RR2	1250	Seed	0.10 b	95 a	199.0 a
Poncho + KSC <sup>10</sup> 5911 RR2	500	Seed	0.21 b	75 ab	195.4 a
Untreated check (KSC <sup>10</sup> 5911 RR2)	—	—	0.96 a	50 b	178.6 b

<sup>1</sup> Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>10</sup> Kitchen Seed Company.



## CORN

**TABLE 2.5** • Evaluation of Bt hybrids and seed-applied insecticides to control corn rootworm larvae, Urbana, University of Illinois, 2014

Product	Rate <sup>1</sup>	Placement 12 May	Mean node- injury rating <sup>2-5</sup> 16 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 7 Nov
Poncho + Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	1250	Seed	0.19 e	80 a	187.9 a
Poncho + Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	500	Seed	0.33 de	60 ab	179.6 a
Genuity SmartStax RIB Complete <sup>9</sup> (KSC <sup>10</sup> 5911 SS RIB)	—	—	0.56 cde	50 ab	180.2 a
Poncho + Genuity VT Triple Pro RIB Complete <sup>9</sup> (MS <sup>10</sup> M-909C-17)	1250	Seed	0.81 cd	25 bc	177.1 a
Poncho + Genuity VT Triple Pro RIB Complete <sup>9</sup> (MS <sup>10</sup> M-909C-17)	500	Seed	1.55 ab	0 c	172.2 a
Genuity VT Triple Pro RIB Complete <sup>9</sup> (MS <sup>10</sup> M-909C-17)	—	—	1.01 bc	25 bc	152.4 b
Untreated check (KSC <sup>10</sup> 5911 RR2)	—	—	2.17 a	5 c	139.9 b

<sup>1</sup> Rates of application for seed-applied insecticides are milligrams (mg) of active ingredient (a.i.) per 1,000 seeds.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>10</sup> KSC = Kitchen Seed Company; MS = Merschman Seeds.



## CORN

### SECTION 3

## Evaluation of soil-applied insecticides to control corn rootworm larvae (*Diabrotica* spp.) in Illinois, 2014

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 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. Six randomly selected root systems were extracted from the first row of each plot on 17 and 28 July at Urbana and DeKalb, respectively. Root systems were washed and rated for corn rootworm larval injury using the 0 to 3 node-injury scale developed by Oleson et al. (2005) (Appendix I). The percentage of roots with a node-injury rating less than 0.25 (i.e., consistency percentage) was determined for each product at each location.

### Planting, Insecticide Application, and Yield

Trials were planted on 8 and 21 May at DeKalb and Urbana, 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. Granular insecticides were applied through modified Noble metering units mounted to each row. Plastic tubes directed the insecticide granules into the seed furrow. Liquid insecticides were applied at a spray volume of 5 gallons per acre using a CO<sub>2</sub> system. All insecticides were applied in front of the firming wheels on the planter. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 23 October at Urbana and on 2 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 V7 growth stage to 37,000 plants per acre.

### Agronomic Information

Agronomic information for all locations is listed in Table 3.1.

**TABLE 3.1** • Agronomic information for efficacy trials of soil-applied insecticides to control corn rootworm larvae, University of Illinois, 2014

	DeKalb	Urbana
<b>Planting date</b>	8 May	21 May
<b>Root evaluation date</b>	28 July	17 July
<b>Harvest date</b>	2 November	23 October
<b>Hybrid</b>	DEKALB DKC63-35RIB <sup>1</sup> Genuity VT Double Pro RIB Complete	DEKALB DKC63-35RIB <sup>1</sup> Genuity VT Double Pro RIB Complete
<b>Row spacing</b>	30 inches	30 inches
<b>Seeding rate</b>	38,500/acre	38,500/acre
<b>Previous crop</b>	Trap crop <sup>2</sup>	Trap crop <sup>2</sup>
<b>Tillage</b>	Fall—none Spring—discovator	Fall—chisel plow Spring—field cultivator

<sup>1</sup> Seed was treated with Cruiser, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>2</sup> Late-planted corn and pumpkins.



## CORN

### Climatic Conditions

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

### Statistical Analysis

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

### Results and Discussion

**DeKalb**—Mean node-injury ratings, consistency percentages, and yields are reported in Table 3.2. The mean node-injury rating for the untreated check (UTC) was 0.75, indicating that corn rootworm larval feeding was moderate. Mean node-injury

ratings for the soil-applied insecticides ranged from 0.05 to 0.08 and were significantly lower than the mean node-injury rating for the UTC. Mean consistency percentages for the soil-applied insecticides ranged from 92 to 100% and were significantly higher than the mean consistency percentage for the UTC (22%). Despite the significant improvement in root protection afforded by the various soil-applied insecticides, no significant differences in mean yields were observed among the treatments.

**Urbana**—Mean node-injury ratings, consistency percentages, and yields are reported in Table 3.3. The mean node-injury rating for the UTC was 0.83. Despite this moderate level of corn rootworm larval feeding, no significant differences in mean node-injury ratings, consistency percentages, or yields were observed among the treatments (including the UTC).

**TABLE 3.2** • Evaluation of soil-applied insecticides to control corn rootworm larvae, DeKalb, University of Illinois, 2014

Product	Rate <sup>1</sup>	Placement 8 May	Mean node- injury rating <sup>2–5</sup> 28 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 2 Nov
Aztec 2.1G	6.7	NU furrow <sup>9</sup>	0.06 b	96 a	187.7 a
Capture LFR	0.49	Furrow	0.05 b	100 a	181.4 a
Force 3G	4	NU furrow <sup>9</sup>	0.07 b	96 a	189.3 a
Force 3G	5	NU furrow <sup>9</sup>	0.08 b	92 a	189.3 a
Force CS	0.46	Furrow	0.05 b	100 a	186.5 a
Force CS	0.57	Furrow	0.06 b	92 a	184.2 a
Untreated check	—	—	0.75 a	22 b	175.5 a

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from six root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Applied with modified Noble metering units.



## CORN

**TABLE 3.3** • Evaluation of soil-applied insecticides to control corn rootworm larvae, Urbana, University of Illinois, 2014

Product	Rate <sup>1</sup>	Placement 21 May	Mean node- injury rating <sup>2-5</sup> 17 July	Mean % consistency < 0.25 <sup>4,6</sup>	Mean yield (bu/A) <sup>7,8</sup> 23 Oct
Aztec 2.1G	6.7	NU furrow <sup>9</sup>	0.04 a	100 a	166.3 a
Capture LFR	0.49	Furrow	0.07 a	92 a	162.1 a
Force 3G	4	NU furrow <sup>9</sup>	0.04 a	96 a	157.6 a
Force 3G	5	NU furrow <sup>9</sup>	0.13 a	83 a	166.0 a
Force CS	0.46	Furrow	0.39 a	83 a	147.0 a
Force CS	0.57	Furrow	0.22 a	71 a	158.6 a
Untreated check	—	—	0.83 a	46 a	160.6 a

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from six root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Applied with modified Noble metering units.



## CORN

### SECTION 4

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

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

### Locations

We established three trials at University of Illinois research and education centers near DeKalb (DeKalb County), Monmouth (Warren County), and Urbana (Champaign County).

### Experimental Design and Methods

The experimental design was a randomized complete block with four replications. The plot size for each treatment was 10 ft (four rows) x 40 ft. Five randomly selected root systems were extracted from the first row of each plot on 14, 16, and 28 July at Monmouth, Urbana, and DeKalb, respectively. Root systems were washed and rated for corn rootworm larval injury using the 0 to 3 node-injury scale developed by Oleson et al.

(2005) (Appendix I). The percentage of roots with a node-injury rating less than 0.25 (i.e., consistency percentage) was determined for each product at each location.

### Planting, Insecticide Application, and Yield

Trials were planted on 6, 8, and 12 May at Monmouth, DeKalb, and Urbana, respectively. All trials were planted using a four-row, vacuum style planter constructed by Seed Research Equipment Solutions (SRES). Seeds were planted in 30-inch rows at an approximate depth of 1.75 inches. Granular insecticides were applied through modified Noble metering units mounted to each row. Plastic tubes directed the insecticide granules into the seed furrow. Liquid insecticides were applied at a spray volume of 5 gallons per acre using a CO<sub>2</sub> system. All insecticides were applied in front of the firming wheels on the planter. Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 2 and 7 November at DeKalb and Urbana, respectively. Weights were converted to bushels per acre (bu/A) at 15.5% moisture. To ensure uniform plant densities across all plots, plant populations in the harvested rows were thinned at the

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

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

<sup>1</sup> Contains a 10% refuge-in-the-bag (non-rootworm Bt) seed blend.

<sup>2</sup> Late-planted corn and pumpkins.



## CORN

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

### Agronomic Information

Agronomic information for all locations is listed in Table 4.1.

### Climatic Conditions

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

### Statistical Analysis

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

### Results and Discussion

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

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

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

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>10</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>11</sup> Applied with modified Noble metering units.



## CORN

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

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

despite the addition of starter fertilizer (10-34-0) to Capture LFR.

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

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

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

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Percentage of plants leaning 45° or less from the soil surface.

<sup>8</sup> Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>9</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>10</sup> Applied with modified Noble metering units.



## CORN

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

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

VT Triple Pro and Genuity VT Triple Pro RIB Complete (both with and without Capture LFR), as well as the UTC.

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

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

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

<sup>1</sup> Rates of application for soil-applied insecticides are ounces (oz) of product per 1,000 ft of row.

<sup>2</sup> Mean node-injury ratings are based on the 0 to 3 node-injury scale (Oleson et al. 2005, Appendix I).

<sup>3</sup> Mean node-injury ratings were derived from five root systems per plot in each of four replications.

<sup>4</sup> Means followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> Data were analyzed using a square-root transformation; actual means are shown.

<sup>6</sup> Percentage of roots with a node-injury rating < 0.25.

<sup>7</sup> Corn was harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 15.5% moisture.

<sup>8</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>9</sup> Seed was treated with Poncho, 0.5 milligrams (mg) of active ingredient (a.i.) per seed.

<sup>10</sup> Because root systems were evaluated at random, mean root ratings for these seed-blend products may include refuge (non-Bt) root systems.

<sup>11</sup> Applied with modified Noble metering units.



## CORN

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

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



## SOYBEANS

### SECTION 5

#### Evaluation of experimental and commercially available foliar-applied insecticides and insecticide/fungicide combinations to control Japanese beetles (*Popillia japonica*) in soybean in Illinois, 2014

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. After the application of products, densities were assessed on 21 and 28 August (7 and 14 days after treatment [DAT], respectively) and on 4 September (21 DAT).

##### Planting, Insecticide Application, and Yield

The trial was planted on 23 May using a 16-row, Case IH Model 1240 Early Riser planter. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Products were applied on 14 August with a CO<sub>2</sub> backpack sprayer and a four-row boom. TeeJet T'TJ60-11002 spray tips were calibrated to deliver a volume of 15 gallons per acre (gal/A). Active ingredients for all insecticides and fungicides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each plot on 10 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 9 (Agricultural Research Manager), revision 9.2014.2 (Copyright© 1982–2014 Gylling Data Management, Inc., Brookings, SD).

##### Results and Discussion

Prior to the application of products on 14 August, there was an average of 3.3 Japanese beetles per 20 sweeps in the trial area. Mean densities of Japanese beetles following the application of products are presented in Table 5.2.

On 21 August (7 DAT), all products (excluding Transform WG) had a significantly lower mean number of Japanese beetles per 20 sweeps than the untreated check (UTC). Similarly, on 28 August (14 DAT), most products (excluding Transform WG and Quilt Xcel) continued to have a significantly lower mean number of Japanese beetles per 20 sweeps than the UTC. By 4 September (21 DAT), mean numbers of Japanese beetles per 20 sweeps were low for all treatments, including the UTC—no significant differences among the treatments were observed.

Mean yields are presented in Table 5.2. Mean yields were statistically similar for all treatments and ranged from 63.3 to 72.4 bu/A.

**TABLE 5.1 • Agronomic information for efficacy trial of experimental and commercially available foliar-applied insecticides and insecticide/fungicide combinations to control Japanese beetles in soybean, Morrison, University of Illinois, 2014**

Planting date	23 May
Harvest date	10 October
Variety	Burrus 28V2
Row spacing	30 inches
Seeding rate	155,000/acre
Previous crop	Corn
Tillage	Fall—vertical tillage



## SOYBEANS

**TABLE 5.2** • Evaluation of experimental and commercially available foliar-applied insecticides and insecticide/fungicide combinations to control Japanese beetles in soybean, Morrison, University of Illinois, 2014

Product <sup>1</sup>	Rate <sup>2</sup>	Mean no. Japanese beetles per 20 sweeps <sup>3,4</sup>			Mean yield <sup>6,7</sup> (bu/A) 10 Oct
		21 Aug (7 DAT <sup>5</sup> )	28 Aug (14 DAT <sup>5</sup> )	4 Sep (21 DAT <sup>5</sup> )	
Besiege	8.9	0.8 c	1.8 cd	0.0 a	66.2 a
Cobalt Advanced	26	1.5 bc	0.3 d	0.3 a	68.0 a
Cobalt Advanced + Headline	26 12.4	0.5 c	0.8 d	0.8 a	68.8 a
Endigo ZCX <sup>8</sup>	4.5	0.3 c	0.8 d	0.5 a	65.1 a
Quilt Xcel	14	5.8 b	11.3 a	2.0 a	66.7 a
Quindigo <sup>8</sup>	14	0.5 c	0.5 d	0.3 a	68.9 a
Transform WG	1	12.0 a	6.0 bc	1.0 a	63.3 a
Warrior II	1.92	0.5 c	1.8 cd	0.0 a	72.4 a
Warrior II + Assail 30SG	1.92 1.67	1.5 bc	3.0 cd	1.0 a	69.1 a
Warrior II + Quilt Xcel	1.92 14	0.5 c	0.0 d	0.5 a	67.1 a
Untreated check	—	11.8 a	9.8 ab	1.0 a	66.4 a

<sup>1</sup> Crop oil concentrate was added to the spray solution for each product (excluding the Cobalt Advanced and Cobalt Advanced + Headline treatments) at a rate of 1% v/v.

<sup>2</sup> Rates of application for foliar insecticides/fungicides are ounces (oz) of product per acre.

<sup>3</sup> Means were derived from the numbers of insects per 20 sweeps per plot in each of four replications.

<sup>4</sup> Means in the same column and followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> DAT = days after treatment (with insecticide/fungicide).

<sup>6</sup> Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.

<sup>7</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).

<sup>8</sup> Product is not currently labeled for commercial use.



## SOYBEANS

### SECTION 6

## Evaluation of foliar-applied insecticides to control Japanese beetles (*Popillia japonica*) in soybean in Illinois, 2014

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. Densities of Japanese beetles were determined by taking 20 sweeps per plot with a 15-inch diameter sweep net. After the application of insecticides, densities were assessed on 21 and 28 August (7 and 14 days after treatment [DAT], respectively) and on 4 and 11 September (21 and 28 DAT, respectively).

### Planting, Insecticide Application, and Yield

The trial was planted on 23 May using a 16-row, Case IH Model 1240 Early Riser planter. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Insecticides were applied on 14 August with a CO<sub>2</sub> backpack sprayer and a four-row boom. TeeJet T<sup>T</sup>J60-11002 spray tips were calibrated to deliver a volume of 15 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 20 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 9 (Agricultural Research Manager), revision 9.2014.2 (Copyright© 1982–2014 Gylling Data Management, Inc., Brookings, SD).

### Results and Discussion

Prior to the application of products on 14 August, there was an average of 3.3 Japanese beetles per 20 sweeps in the trial area. Mean densities of Japanese beetles following the application of products are presented in Table 6.2.

On 21 and 28 August (7 and 14 DAT, respectively), all products had a significantly lower mean number of Japanese beetles per 20 sweeps than the untreated check (UTC). By 4 September (21 DAT), mean numbers of Japanese beetles per 20 sweeps were low for all treatments, including the UTC, and were statistically similar. This trend continued on 11 September (28 DAT).

Mean yields are presented in Table 6.2. Mean yields were statistically similar for all treatments and ranged from 63.2 to 69.9 bu/A.

**TABLE 6.1 • Agronomic information for efficacy trial of foliar-applied insecticides to control Japanese beetles in soybean, Morrison, University of Illinois, 2014**

Planting date	23 May
Harvest date	20 October
Variety	Burrus 28V2
Row spacing	30 inches
Seeding rate	155,000/acre
Previous crop	Corn
Tillage	Fall—vertical tillage



## SOYBEANS

**TABLE 6.2** • Evaluation of foliar-applied insecticides to control Japanese beetles in soybean, Morrison, University of Illinois, 2014

Product <sup>1</sup>	Rate <sup>2</sup>	Mean no. Japanese beetles per 20 sweeps <sup>3,4</sup>				Mean yield <sup>6,7</sup> (bu/A) 20 Oct
		21 Aug (7 DAT <sup>5</sup> )	28 Aug (14 DAT <sup>5</sup> )	4 Sep (21 DAT <sup>5</sup> )	11 Sep (28 DAT <sup>5</sup> )	
Brigadier	3.05	0.0 b	1.8 b	0.8 a	0.5 a	66.2 a
Brigadier	6.1	0.0 b	1.3 b	0.8 a	0.3 a	66.0 a
Cobalt Advanced	18	0.3 b	2.5 b	2.0 a	0.3 a	66.2 a
Endigo ZC	4.5	0.0 b	0.0 b	0.8 a	0.5 a	63.3 a
Hero	5.12	0.3 b	0.0 b	0.0 a	0.8 a	63.2 a
Leverage 360	2.8	0.3 b	1.3 b	0.5 a	0.3 a	69.9 a
Skyraider	3	0.8 b	1.5 b	0.5 a	0.0 a	66.2 a
Skyraider	4	0.0 b	0.3 b	0.3 a	0.0 a	66.6 a
Skyraider	6	0.0 b	1.8 b	0.5 a	0.3 a	67.6 a
Untreated check	—	6.8 a	8.3 a	2.8 a	0.3 a	64.0 a

<sup>1</sup> Non-ionic surfactant was added to the spray solution for each product at a rate of 0.25% v/v.

<sup>2</sup> Rates of application for foliar insecticides are ounces (oz) of product per acre.

<sup>3</sup> Means were derived from the numbers of insects per 20 sweeps per plot in each of four replications.

<sup>4</sup> Means in the same column and followed by the same letter do not differ significantly ( $P = 0.05$ , Duncan's New Multiple Range Test).

<sup>5</sup> DAT = days after treatment (with insecticide).

<sup>6</sup> Soybeans were harvested from the center two rows of each plot and converted to bushels per acre (bu/A) at 13% moisture.

<sup>7</sup> Means followed by the same letter do not differ significantly ( $P = 0.1$ , Duncan's New Multiple Range Test).



## 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 = 1 ½ 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>.



## APPENDIX II

Product name	Active ingredient(s)
Assail 30SG	acetamiprid
Aztec 2.1G	tebupirimphos + cyfluthrin
Aztec 4.67G	tebupirimphos + cyfluthrin
Belay	clothianidin
Belay 50 WDG	clothianidin
Besiege	lambda-cyhalothrin + chlorantraniliprole
Brigadier	bifenthrin + imidacloprid
Capture LFR	bifenthrin
Cobalt Advanced	chlorpyrifos + lambda-cyhalothrin
Counter 20G	terbufos
Cruiser	thiamethoxam
Endigo ZC	lambda-cyhalothrin + thiamethoxam
Endigo ZCX <sup>1</sup>	lambda-cyhalothrin + thiamethoxam
Force 3G	tefluthrin
Force CS	tefluthrin
Headline	pyraclostrobin <sup>2</sup>
Hero	zeta-cypermethrin + bifenthrin
Leverage 360	imidacloprid + beta-cyfluthrin
Poncho	clothianidin
Quilt Xcel	azoxystrobin <sup>2</sup> + propiconazole <sup>2</sup>
Quindigo <sup>1</sup>	lambda-cyhalothrin + thiamethoxam + azoxystrobin <sup>2</sup> + propiconazole <sup>2</sup>
Skyraider	bifenthrin + imidacloprid
SmartChoice 5G	chlorethoxyfos + bifenthrin
Transform WG	sulfoxaflor
Warrior II	lambda-cyhalothrin

<sup>1</sup>Product is not currently labeled for commercial use.

<sup>2</sup>Denotes an active ingredient that does not target insects.



## APPENDIX III

### 2014 and Historical Monthly Weather Data<sup>1</sup> for DeKalb, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference
April	47.1	49.5	–2.4	156	186	–30	2.75	3.56	–0.81
May	59.5	60.1	–0.6	530	560	–30	3.01	4.76	–1.75
June	70.4	69.7	+0.7	1,146	1,147	–1	8.74	4.28	+4.46
July	68.3	73.6	–5.3	1,721	1,864	–143	3.66	3.87	–0.21
August	71.2	71.2	—	2,384	2,518	–134	5.19	4.12	+1.07
September	62.7	64.1	–1.4	2,820	2,973	–153	3.14	3.14	—
October	48.6	51.4	–2.8	2,970	3,184	–214	2.36	2.58	–0.22

<sup>1</sup> Data were compiled by the Midwestern Regional Climate Center.

### 2014 and Historical Monthly Weather Data<sup>1</sup> for Monmouth, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference
April	49.1	51.6	–2.5	197	215	–18	4.79	3.88	+0.91
May	61.9	62.0	–0.1	624	634	–10	2.22	4.99	–2.77
June	71.6	70.5	+1.1	1,276	1,249	+27	8.69	4.81	+3.88
July	68.5	74.3	–5.8	1,858	1,983	–125	2.76	2.37	+0.39
August	71.6	72.5	–0.9	2,529	2,672	–143	3.70	2.89	+0.81
September	62.9	64.8	–1.9	2,964	3,149	–185	6.14	3.14	+3.00
October	51.7	52.9	–1.2	3,163	3,396	–233	2.85	2.20	+0.65

<sup>1</sup> Data were compiled by the Midwestern Regional Climate Center.



## 2014 and Historical Monthly Weather Data<sup>1</sup> for Morrison, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference
April	47.4	50.4	–3.0	174	210	–36	3.03	4.11	–1.08
May	59.6	60.9	–1.3	551	611	–60	3.38	4.04	–0.66
June	69.6	69.7	–0.1	1,151	1,198	–47	7.94	4.45	+3.49
July	68.0	73.9	–5.9	1,714	1,912	–198	2.52	3.92	–1.40
August	71.5	71.4	+0.1	2,385	2,566	–181	4.35	4.18	+0.17
September	61.9	63.8	–1.9	2,797	3,025	–228	4.45	2.86	+1.59
October	51.0	51.6	–0.6	2,994	3,259	–265	1.56	2.47	–0.91

<sup>1</sup> Data were compiled by the Midwestern Regional Climate Center.

## 2014 and Historical Monthly Weather Data<sup>1</sup> for Perry, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference
April	54.5	54.0	+0.5	277	267	+10	4.52	3.97	+0.55
May	65.3	63.6	+1.7	785	729	+56	3.16	4.05	–0.89
June	73.7	72.1	+1.6	1,492	1,379	+113	8.12	4.95	+3.17
July	71.1	76.3	–5.2	2,144	2,148	–4	2.52	3.71	–1.19
August	74.9	74.2	+0.7	2,902	2,865	+37	7.62	2.91	+4.71
September	64.9	66.2	–1.3	3,382	3,377	+5	6.68	3.83	+2.85
October	56.0	54.4	+1.6	3,651	3,659	–8	3.94	3.36	+0.58

<sup>1</sup> Data were compiled by the Midwestern Regional Climate Center.



## 2014 and Historical Monthly Weather Data<sup>1</sup> for Urbana, Illinois

Month	Mean temperature (°F)			Cumulative modified growing degree days (base 50°F, ceiling 86°F)			Total precipitation (in)		
	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference	2014	15-year average (1999–2013)	Difference
April	52.7	53.4	–0.7	230	251	–21	3.94	3.79	+0.15
May	63.9	63.3	+0.6	709	701	+8	4.38	3.99	+0.39
June	73.0	72.1	+0.9	1,398	1,352	+46	8.21	4.27	+3.94
July	69.8	75.4	–5.6	2,017	2,112	–95	8.70	4.31	+4.39
August	73.4	73.7	–0.3	2,735	2,829	–94	1.52	3.45	–1.93
September	64.6	66.8	–2.2	3,196	3,345	–149	3.44	3.21	+0.23
October	54.1	54.3	–0.2	3,437	3,608	–171	3.42	3.47	–0.05

<sup>1</sup> Data were compiled by the Midwestern Regional Climate Center.