



## CORN

### SECTION 1

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

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### Locations

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

### Experimental Design and Methods

The experimental design was a randomized complete block with four replications. The plot size for each treatment was 10 ft (four rows) x 40 ft. Five randomly selected root systems were extracted from the first row of each plot on 14 July at Monmouth and Perry and on 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 Viptera 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 Viptera 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 Viptera 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

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## 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 Viptera 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 Viptera 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 Viptera 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

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## 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° 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
Rootworm Bt hybrids					
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.