SECTION 7

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

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Locations

We established one trial at the Northern Illinois Agronomy Research Center near DeKalb (DeKalb County) and one trial at the Adam Yoeckel Farm near Morrison (Whiteside County). Funding for these experiments was provided by the Illinois Soybean Association.

Experimental Design and Methods

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

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

Planting, Insecticide Application, and Yield

Trials were planted on 14 and 15 May at Morrison and DeKalb, respectively. Both trials were planted using a four-row, ALMACO constructed planter with John Deere 7300 row units. Precision cone units were used to meter the seeds. Seeds were planted in 30-inch rows at an approximate depth of 1 inch. Warrior II was applied on 31 July at both locations with a CO_2 backpack sprayer and a four-row boom. TeeJet TTJ60-11002 spray tips were calibrated to deliver a volume of 20 gallons per acre (gal/A). Active ingredients for all insecticides are listed in Appendix II.

Yields were estimated by harvesting the center two rows of each subplot on 11 and 12 October at Morrison and DeKalb, respectively. Weights were converted to bushels per acre (bu/A) at 13% moisture.

Agronomic Information

Agronomic information is listed in Table 7.1.

Climatic Conditions

Temperature and precipitation data are presented in Appendix III.

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

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

Statistical Analysis

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

Results and Discussion

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

Mean densities of bean leaf beetles, grasshoppers, Japanese beetles, and stink bugs were very low across all sampling dates.

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

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

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

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

[1] Rates of application for Warrior II are ounces (oz) of product per acre.
[2] Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
[3] Means for the same date and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[4] DAT = days after treatment (with insecticide).
[5] Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
[6] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[7] Soybean aphid resistance was conferred by the *Rag1* gene.
[8] Soybean aphid resistance was conferred by the *Rag2* gene.

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

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

[1] Rates of application for Warrior II are ounces (oz) of product per acre.
[2] Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
[3] Means for the same date and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[4] DAT = days after treatment (with insecticide).
[5] Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
[6] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[7] Soybean aphid resistance was conferred by the *Rag1* gene.
[8] Soybean aphid resistance was conferred by the *Rag2* gene.

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

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

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

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

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

[1] Rates of application for Warrior II are ounces (oz) of product per acre.
[2] Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
[3] Means for the same date and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[4] DAT = days after treatment (with insecticide).
[5] Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
[6] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[7] Soybean aphid resistance was conferred by the *Rag1* gene.
[8] Soybean aphid resistance was conferred by the *Rag2* gene.

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

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

[1] Rates of application for Warrior II are ounces (oz) of product per acre.
[2] Means were derived from the numbers of insects per 20 sweeps in each subplot in each of four replications.
[3] Means for the same date and followed by the same letter do not differ significantly ($P = 0.05$, Duncan's New Multiple Range Test).
[4] DAT = days after treatment (with insecticide).
[5] Soybeans were harvested from the center two rows of each subplot and converted to bushels per acre (bu/A) at 13% moisture.
[6] Means followed by the same letter do not differ significantly ($P = 0.1$, Duncan's New Multiple Range Test).
[7] Soybean aphid resistance was conferred by the *Rag1* gene.
[8] Soybean aphid resistance was conferred by the *Rag2* gene.