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Soybean Aphid Efficacy Evaluation

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Abstract
Soybean, Glycine max (L.), grown in Iowa and most of the north central region of the United States, has not required regular insecticide usage. The soybean aphid, Aphis glycines (Hemiptera: Aphididae), causes yield losses from direct plant feeding, and has been shown to transmit several plant viruses. In Iowa, soybean aphid can colonize soybean fields in June and has developed into outbreaks in July and August capable of reducing yields by nearly 40 percent.

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Soybean Aphid Efficacy Evaluation

RFR-A1149

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Introduction

Soybean, *Glycine max* (L.), grown in Iowa and most of the north central region of the United States, has not required regular insecticide usage. The soybean aphid, *Aphis glycines* (Hemiptera: Aphididae), causes yield losses from direct plant feeding, and has been shown to transmit several plant viruses. In Iowa, soybean aphid can colonize soybean fields in June and has developed into outbreaks in July and August capable of reducing yields by nearly 40 percent.

Materials and Methods

Plots were established at the Iowa State University Northwest Research Farm in O'Brien County, Iowa. Treatments were arranged in a randomized complete block design with four replications, and soybean (Syngenta 05RM310021 and 07JR801843) was planted in 30-in. rows using no-till production on May 18. In total, we evaluated 15 treatments with products alone or in combination (Table 1). The experiment included two controls: an untreated control, and a 'zero aphid' control in which a tank-mix of foliar insecticides (λ-cyhalothrin and chlorpyrifos) could be applied every time aphids were detected. Unless otherwise stated, seed did not have a seed treatment.

Application techniques. Foliar applications were made to all six rows within each treated plot in mid-August at full pod set (Table 1). Foliar treatments were applied using a backpack sprayer and TeeJet (Springfield, IL) twinjet nozzles (TJ 11002) with 20 gallons of water per acre at 40 pounds of pressure per square inch.

Estimation of soybean aphid populations and cumulative aphid days. Soybean aphids were counted on single plants at randomly selected locations within each plot. All aphids (adults, nymphs, and winged aphids) were counted on each plant. Summing aphid days accumulated during the growing season provides a measure of the seasonal aphid exposure that a soybean plant experiences. Cumulative aphid days (CAD) are calculated with the following equation:

$$\sum_{n=1}^{\infty} = \left(\frac{x_{i-1} + x_i}{2} \right) \times t$$

where x is the mean number of aphids on sample day i, x_{i-1} is the mean number of aphids on the previous sample day, and t is the number of days between samples i - 1 and i.

Yield and statistical analysis. Harvesting took place on October 3. Yields were determined by weighing grain with a grain hopper, which rested on a digital scale sensor custom designed for each of the three harvesters. Yields were corrected to 13 percent moisture and reported as bushels per acre.

One-way analysis of variance (ANOVA) was used to determine treatment effects within each experiment. The impact of treatments applied within each experiment on accumulation of aphid days was determined using log-transformed data to meet the assumptions of ANOVA. Means separation for all treatments was achieved using a least significant difference test ($P \leq 0.10$) with a Student-Newman-Keuls pairwise comparison.

Results and Discussion

In 2011, seasonal aphids were highly variable, but overall pressure exceeded the economic threshold and injury level. Foliar insecticides were applied to treatments on August 10 (Table 1). Soybean aphid populations averaged 263 ± 85 (± SEM; standard error of the mean) aphids per plant seven days prior to the August 10 application. Soybean aphid populations in the untreated control plots peaked on August 27 at 870 ± 349 aphids per plant and reached over 11,700 ± 3,690 CAD. As expected with high CAD, there were treatment differences ($P<0.0001$; $F = 7.39$; $df = 14, 3$). The treatment with CruiserMaxx Beans+ *Rag1* + Warrior II had significantly fewer CAD compared with all other treatments (Table 1). All the *Rag1*-containing treatments reduced season aphid pressure.

The zero aphid control had the highest yield (65.3 ± 1.3), but was not different than the *Rag1*-containing treatments ($P<0.0001$; $F = 20.70$; $df = 14, 3$) (Table 1).

We included several established insecticides and a few products not yet approved for soybean aphid. Most foliar products were effective at reducing CAD and protecting yield. We did not detect any thriving aphid populations three days after foliar application for any product. At the Northwest Research Farm, a single application of a foliar insecticide provided as much yield protection as two applications. In general, the *Rag1*-containing treatments had similar yield to many of our foliar treatments.

Soybean aphid populations typically fluctuate between locations in Iowa. In the absence of heavy aphid pressure, we do not expect to see a yield response to insecticides. Therefore, our recommendation for soybean aphid management is to continue to scout soybeans and to apply a full rate of a foliar insecticide when populations exceed 250 aphids per plant. One well-timed foliar application applied after aphids exceed the economic threshold will protect yield and increase profits in most situations. We would also strongly encourage growers to incorporate host plant resistance into their seed selection. At this time, we are not recommending insecticidal seed treatments for aphid management because of soybean aphid biology in Iowa. To date, most foliar insecticides are very effective at reducing soybean aphid populations if the coverage is sufficient. Achieving small droplet size to penetrate a closed canopy may be the biggest challenge to managing soybean aphid.

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Table 1. 2011 treatments and rates at O'Brien County, IA.

Treatment	Rate[a]	CAD ± SEM[b]	CAD-LSD[c]	Yield ± SEM[d]	Yield-LSD[e]
Untreated control	-------	18,896.0 ± 4,420.8	E	56.8 ± 0.6	A
Rag1	-------	1,546.0 ± 776.1	C	65.0 ± 1.5	C
CruiserMaxx Beans	56 g	19,738.9 ± 3,785.9	E	57.1 ± 1.7	A
CruiserMaxx Beans +	56 g	399.8 ± 136.0	B	64.8 ± 0.7	C
Rag1	-------				
CruiserMaxx Beans +	56 g	55.2 ± 11.5	A	64.8 ± 1.8	C
Rag1 +	-------				
Warrior II	1.6 fl oz				
Warrior II	1.6 fl oz	4,342.8 ± 1931.1	D	62.8 ± 0.8	BC
Warrior II	1.6 fl oz	2,957.6 ± 948.9	CD	62.6 ± 1.1	BC
Warrior II +	1.6 fl oz	394.5 ± 91.5	B	65.3 ± 1.3	C
Lorsban Advanced	16.0 fl oz				
Cobalt Advanced	13.0 fl oz	2,407.1 ± 262.0	CD	62.3 ± 0.3	BC
Endigo ZC	4.5 fl oz	4,424.9 ± 1391.3	D	62.5 ± 0.6	BC
Voliam Xpress[f]	6.5 fl oz	4,111.2 ± 551.1	D	62.2 ± 0.4	BC
Agrimek SC[f]	2.0 fl oz	2,0253.4 ± 6,930.2	E	58.7 ± 2.3	AB
Agrimek SC[f]	2.5 fl oz	18,978.0 ± 7045.3	E	57.3 ± 1.0	A
Agri-flex SC [f,g]	7.0 fl oz	7,399.7 ± 1,732.5	DE	62.1 ± 0.8	BC
Agri-flex SC[f,g]	8.5 fl oz	4,606.8 ± 1,220.1	D	61.1 ± 1.4	BC

[a]Foliar product rates are given as formulated product per acre, and seed treatments are given as grams active ingredient per 100 kg seed.
[b]CAD ± SEM; cumulative aphid days ± standard error of the mean.
[c]CAD-LSD; least significant different mean separation test for cumulative aphid days. Means within a column followed by the same letter do not differ ($P \leq 0.10$).
[d]Yield ± SEM; yield in bushels per acre ± standard error of the mean.
[e]Yield-LSD; least significant different mean separation test for yield. Means within a column followed by the same letter do not differ ($P \leq 0.10$).
[f]Product was not labeled for soybean aphid at the time of this publication.
[g]A non-ionic surfactant was included as an adjuvant and formulated at a rate of 0.25qt/acre.