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Soybean Aphid Efficacy Evaluation

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Abstract
Soybean (Glycine max), grown in Iowa and most of the north central region of the United States, has not required regular insecticide use. 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-A11122

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Introduction

Soybean (*Glycine max*), grown in Iowa and most of the north central region of the United States, has not required regular insecticide use. 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 Northeast Research Farm in Floyd 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 practices on May 17. Each plot was six rows wide and 50 ft long. In 2011, we evaluated 24 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.

Application techniques. The ideal foliar application would be when aphids exceeded the economic threshold of 250/plant; however, soybean aphid populations were moderate at this location, so most foliar applications were made to all six rows within each treated plot in mid-August during beginning seed fill (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 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 7. 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. 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

Foliar insecticides were applied to most treatments on August 16, a few had a target application of beginning pod set and were applied July 26 (Table 1). Soybean aphid populations averaged 50 ± 4 (± SEM; standard error of the mean) aphids per plant one day prior to the August 16 application. Soybean aphid populations in the untreated control plots peaked on September 6 at 435 ± 52 aphids per plant. The untreated control treatment had more CAD (3,563 ± 1,053) compared with all other insecticide treatments, but was not significantly different than most foliar insecticide treatments ($P<0.0001$; $F = 7.57$; df = 23, 3). There was some variability in yield between treatments ($P<0.0001$; $F = 6.28$; df = 23, 3), but the *Rag1*-containing treatments had some of the lowest bushels per acre (Table 1).

In 2011, seasonal aphids were highly variable. 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 ISU Northeast Research Farm, a single application of a foliar insecticide provided as much yield protection as two applications. In general, the *Rag1*-containing treatments had lower yield, but we attribute the lower yields to the plant genetic potential.

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/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 Floyd County, IA.

Treatment	Rate[a]	CAD ± SEM[b]	CAD-LSD[c]	Yield ± SEM[d]	Yield-LSD[e]
Untreated control	-------	3,563.0 ± 1,053.3	C	60.1 ± 1.0	BC
Rag1	-----	639.23 ± 416.7	B	55.8 ± 1.6	A
CruiserMaxx Beans	56 g	782.8 ± 247.5	BC	61.3 ± 2.7	CDE
CruiserMaxx Beans + *Rag1*	56 g	109.5 ± 46.9	A	60.2 ± 1.3	BCD
CruiserMaxx Beans + *Rag1* + Warrior II	56 g ------- 1.6 fl oz	74.8 ± 39.3	A	56.7 ± 3.0	AB
Warrior II	1.6 fl oz	267.8 ± 30.0	B	67.2 ± 0.8	E
Lorsban Advanced	16.0 fl oz	782.1 ± 81.8	BC	63.7 ± 0.6	CDE
Warrior II + Lorsban Advanced	1.6 fl oz 16.0 fl oz	55.9 ± 25.9	A	63.1 ± 1.0	CDE
Cobalt Advanced	13.0 fl oz	1,649.0 ± 865.1	BC	66.1 ± 1.1	DE
Asana XL	9.6 fl oz	1,256.2 ± 641.8	BC	65.2 ± 1.3	CDE
Asana XL + Lannate LV	8.0 fl oz 8.0 fl oz	521.4 ± 80.8	B	64.6 ± 2.0	CDE
Hero EC	5.0 fl oz	669.2 ± 107.3	BC	66.1 ± 1.3	E
Swagger[f]	10.0 fl oz	952.5 ± 193.1	BC	66.2 ± 0.8	E
Declare	1.02 fl oz	977.6 ± 318.8	BC	66.2 ± 1.2	E
Declare	1.28 fl oz	1,087.2 ± 257.1	BC	64.3 ± 0.2	CDE
Declare + Nufos 4E	1.02 fl oz 4.0 fl oz	663.4 ± 137.8	BC	64.6 ± 0.9	CDE
Leverage 360[f]	2.8 fl oz	1,807.0 ± 531.0	BC	62.8 ± 2.1	CDE
Leverage 360[g]	2.8 fl oz	1,147.0 ± 346.5	BC	62.9 ± 2.0	CDE
Leverage 360 (R3)[g]	2.8 fl oz	2,171.2 ± 1,237.3	BC	64.3 ± 1.1	CDE
Leverage 360 + Stratego YLD (R3)[g]	2.8 fl oz 4.0 fl oz	832.2 ± 185.3	BC	65.4 ± 1.3	CDE
Transform[h]	0.214 fl oz	1,671.1 ± 496.1	BC	66.1 ± 0.4	E
Transform[h]	0.257 fl oz	1,555.4 ± 300.0	BC	66.6 ± 1.3	E
Transform[h]	0.357 fl oz	954.5 ± 133.5	BC	66.1 ± 0.4	E
BAS310I[h]	4.0 fl oz	1,637.8 ± 616.0	BC	64.3 ± 0.8	CDE

[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.
[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 in the column with the same letter to not differ (P≤0.10).
[f]A non-ionic surfactant was included as an adjuvant and formulated at a rate of 0.25 qt/acre.
[g]Crop oil and ammonium sulfate were included as adjuvants and formulated at a rate of 1qt/ac and 2 lbs/acre, respectively.
[h]Product was not labeled for soybean aphid at the time of this publication.