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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), is the most important soybean pest in Iowa and is capable of reducing yield by 40 percent. Nymphs and adults feed on sap within the phloem and can vector several plant viruses. In Iowa, soybean aphids have been a persistent pest that can colonize fields from June through September. Their summer population dynamics are dependent on weather and other environmental conditions.

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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), is the most important soybean pest in Iowa and is capable of reducing yield by 40 percent. Nymphs and adults feed on sap within the phloem and can vector several plant viruses. In Iowa, soybean aphids have been a persistent pest that can colonize fields from June through September. Their summer population dynamics are dependent on weather and other environmental conditions.

Materials and Methods

Plots were established at the ISU Northeast Research Farm, Nashua, Iowa. The treatments were arranged in a randomized complete block design with four replications. Soybean (Syngenta NK S20-Y2 and S21-Q3 brands) was planted in 30-in. rows using conventional tillage production practices on June 19. Each plot was six rows wide and 50 ft long. In total, we evaluated 26 treatments with products alone or in combination (Table 1). Treatments included foliar and seed-applied products and host plant resistance (*Rag1* gene) for soybean aphid. Some fungicides were used in combination with insecticides.

Application techniques. The ideal foliar application would be when aphids exceeded the economic threshold of 250/plant. Soybean aphid populations were low to moderate at this location until late August and most foliar applications were made to all six rows within each treated plot 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/acre at 40 lb of pressure/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 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. Plots were harvested on October 12. Yields were determined by weighing grain with a hopper, which rested on a digital scale sensor custom designed for the combine. Yields were corrected to 13 percent moisture and reported in bushels/acre. One-way analysis of variance (ANOVA) was used to determine treatment effects within each experiment. Mean separation for CAD and yield treatments was achieved using a least significant difference test (alpha=0.10).

Results and Discussion

In 2013, aphid populations were moderate until August. Exponential growth in the untreated control was noted in late August when populations exceeded the economic threshold at beginning seed set (R5). The untreated control had 91.5 ± 15.8 aphids/plant one day prior to the August 21 application. Aphid populations peaked in the untreated control at 477.2 ± 171.5 on August 31. Quilt Xcel had the most CAD, but was not significantly different than the untreated control ($P<0.0001$; $F=7.41$; df=21, 3) (Table 1). CruiserMaxx Vibrance improved aphid suppression but was not as effective as foliar insecticides. All foliar insecticides were effective in reducing CAD. However, there were no significant differences in CAD with any foliar insecticides on susceptible seed.

There were some significant differences in yield among treatments, but many were not statistically different ($P<0.49$; $F=0.99$; df=21,3). Overall, a tank mix of Cobalt Advanced and Headline had the lowest CAD and corresponded to the highest yield. The lowest-yielding treatments were Besiege and Leverage 360, but it is not clear why these treatments had reduced yield because they sufficiently reduced CAD (Table 1). The late-season accumulation of aphids may not have impacted yield, indicating a late-season application may not be cost effective.

Treatments with the *Rag1* gene performed well and all were below the economic injury level for CAD ($P<0.042$; $F=3.6$; df=3, 3) (Table 1). There were no significant yield differences for *Rag1*-containing treatments ($P<0.057$; $F=3.21$; df=3.3) (Table1). Using *Rag1* likely will suppress aphid populations and prevent economic injury in most areas of Iowa.

Our recommendation for soybean aphid management is to continue to scout soybean 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 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. 2013 soybean aphid treatments and rates at Floyd County, Iowa.

Treatment	Rate[a]	CAD ± SEM[b]	CAD-LSD[c]	Yield ± SEM[d]	Yield-LSD[e]
Untreated control	-------	9,944.9 ± 1,921.0	C	59.5 ± 2.6	ABC
CruiserMaxx Vibrance	62.5 g	7,291.8 ± 488.1	B	58.4 ± 1.9	ABCD
Warrior II CS	1.92 fl oz	1,149.5 ± 279.0	A	57.1 ± 2.2	ABCD
Warrior II CS +	1.92 fl oz	491.1 ± 53.8	A	57.5 ± 3.6	ABCD
Lorsban Advanced EC	16.0 fl oz				
Lorsban Advanced EC	16.0 fl oz	1,736.3 ± 243.6	A	57.8 ± 1.1	ABCD
Asana XL	9.6 fl oz	1,423.8 ± 222.1	A	58.4 ± 1.3	ABCD
Asana XL +	8.0 fl oz	1,128.1 ± 219.2	A	58.5 ± 0.9	ABCD
Lannate LV	8.0 fl oz				
Orthene 97 ST	1 lb	2,915.1 ± 865.2	A	60.8 ± 0.9	AB
Declare CS	1.02 fl oz	2,109.1 ± 473.2	A	58.0 ± 1.5	ABCD
Declare CS	1.28 fl oz	1,684.7 ± 91.4	A	54.9 ± 3.3	DC
Declare CS +	1.02 fl oz	1,305.5 ± 448.2	A	56.7 ± 2.4	ABCD
Dimethoate 4E	4.0 fl oz				
Belay SC	4.0 fl oz	6,620.4 ± 2,091.6	B	58.6 ± 1.7	ABCD
Endigo ZCX	4.5 fl oz	1,810.0 ± 287.1	A	58.4 ± 2.6	ABCD
Quilt Xcel SE	14.0 fl oz	11,618.5 ± 3,602.5	C	59.9 ± 1.9	ABC
Warrior II CS +	1.92 fl oz	1,081.1 ± 145.7	A	56.5 ± 2.1	BCD
Quilt Xcel SE	14.0 fl oz				
Cobalt Advanced EC	26.0 fl oz	1,038.2 ± 147.3	A	55.8 ± 2.8	BCD
Cobalt Advanced EC +	26.0 fl oz	438.3 ± 140.8	A	61.7 ± 1.4	A
Headline EC	12.0 fl oz				
Besiege ZC	9.0 fl oz	1,860.2 ± 500.8	A	53.6 ± 1.6	D
Fastac EC	3.8 fl oz	2,241.4 ± 474.5	A	57.6 ± 2.6	ABCD
Hero EC	5.0 fl oz	1,429.0 ± 232.9	A	57.7 ± 2.2	ABCD
Stallion EC	9.0 fl oz	2,346.1 ± 364.4	A	60.4 ± 0.9	AB
Leverage 360 SC	2.8 fl oz	1,243.6 ± 328.9	A	54.3 ± 4.1	D
Rag1	-------	3,953.2 ± 1,376.7	b	54.3 ± 4.3	a
Rag1 +	-------	330.8 ± 54.4	a	56.1 ± 3.7	a
CruiserMaxx Vibrance +	62.5 g				
Rag1 +	-------	47.1 ±13.8	a	59.7 ± 1.0	a
CruiserMaxx Vibrance +	62.5 g				
Warrior II	1.92 fl oz				
Rag1 +	-------	744.3 ± 134.0	a	56.6 ± 2.1	a
Warrior II	1.92 fl oz				

[a]Foliar product rates are given as formulated product/acre, and seed treatments are given as grams active ingredient/100 kg seed.
[b]Cumulative aphid days ± standard error of the mean.
[c]Least significant difference for mean separation of cumulative aphid days (Susceptible seed: P<0.0001; F=7.41; df=21, 3; and *Rag1* seed: P<0.042; F=3.6; df=3, 3). Means followed by the same letter do not differ.
[d]Yield ± SEM; yield in bushels/acre ± standard error of the mean.
[e]Least significant difference for mean separation of yield (Susceptible seed: P<0.49; F=0.99; df=21, 3; and *Rag1* seed: P<0.057; F=3.21; df=3, 3). Means followed by the same letter do not differ.