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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 did not require regular insecticide usage before 2000. But the arrival of soybean aphid (Aphis glycines) has changed management practices because yield losses from direct plant feeding can reduce yield by 25 percent. Host plant resistance for soybean aphid is now commercially available and included for the first time in the efficacy evaluation.

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Soybean Aphid Efficacy Evaluation

RFR-A1034

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Introduction

Soybean, *Glycine max* (L.), grown in Iowa and most of the north central region of the United States did not require regular insecticide usage before 2000. But the arrival of soybean aphid (*Aphis glycines*) has changed management practices because yield losses from direct plant feeding can reduce yield by 25 percent. Host plant resistance for soybean aphid is now commercially available and included for the first time in the efficacy evaluation.

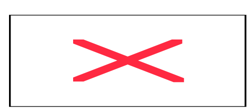
Materials and Methods

Plots were established at the Iowa State University Northeast Research Farm, Floyd County, Nashua, IA. Treatments were arranged in a randomized complete block design with four replications, and soybean (04RM148034 and 07JR801843) was planted in 30-in. rows using no-till production practices on May 18, 2010. Each plot was six rows wide and 50 ft long. In total, 35 treatments were evaluated; however, only 25 treatments are commercially labeled and therefore reported here (Table 1). Two controls were used, including an untreated control and a 'zero aphid' control in which a tank-mix of two foliar insecticides (λ-cyhalothrin and chlorpyrifos) could be applied every time aphids were detected. Unless otherwise stated, seed did not have a fungicide or insecticide seed treatment.

Plant stand. Plant stands were taken on June 21. Two 10-ft sections were randomly selected within the first five treatments and the number of emerged plants was counted (Table 1).

Application techniques. The ideal foliar application would be when aphids exceeded the economic threshold (i.e., 250 aphids/plant). However, soybean aphid populations were very low at both locations. Instead foliar applications were made to all six rows within each treated plot in mid-August during beginning pod set. 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 per square inch.

Estimation of soybean aphid populations and cumulative aphid days. Soybean aphids were counted on randomly selected plants within each plot. The number of plants counted in each plot was variable depending on plant growth stage. After plant emergence, 20 plants/plot were examined. But as plants matured, only five plants/plot were examined. 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 are calculated with the following equation:



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 2. Yields were determined by weighing grain with a grain hopper that 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/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 studies was achieved using a least significant difference test ($P \leq 0.05$). Treatment impacts on yield were determined using untransformed data. All statistical analysis was performed using SAS® software.

Results and Discussion

Foliar insecticides were applied to most treatments on August 19, but a few were not applied until August 25 due to lack of product (Table 1). Soybean aphid populations averaged four aphids/plant four days prior to the August 19 application. Soybean aphid populations in the untreated control plots peaked on August 30 at 17 aphids/plant. The zero aphid control did not have significantly less cumulative aphid days compared with the other insecticide treatments, and the yield was not significantly higher than most single application treatments (Table 2, Figure 1 and 2). The foliar applied insecticides provided similar levels of soybean aphid control and yield protection (Table 2, Figure 1 and 2). Soybean aphid reached over 200 cumulative aphid days in the untreated control treatment. In 2010, aphid populations measured in untreated control plots reached 200 cumulative aphid days. This is considered to be very low seasonal exposure to soybean and is insufficient to warrant an application to protect yield. As with previous soybean aphid efficacy evaluations, there are slight differences in performance among most of the foliar insecticides. Overall, we saw a good knockdown of soybean aphid three days after application for all products used in 2010.

This is the first year host plant resistance for soybean aphid is commercially available. The *Rag* genes (Resistant *Aphis glycines*) were discovered through naturally occurring germplasm and are expressed as antibiosis. This is the first soybean aphid efficacy evaluation at Iowa State University to include host plant resistance. Both locations included CruiserMaxx Beans with the *Rag1* gene.

Our recommendation for soybean aphid management continues to be to scout your fields and to apply foliar insecticides 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. Rarely is the economic threshold exceeded twice in a single season, which would require multiple applications. We are not recommending seed-applied insecticides (i.e., seed treatments) for aphid management, and we are not recommending one insecticide over another. Most foliar insecticides are very effective at reducing soybean aphid populations if the coverage is sufficient. At this time, achieving small droplet size to penetrate a closed canopy may be the biggest challenge to manage soybean aphid.

Table 1. Treatments and rates at the ISU Northeast Research Farm, Floyd County, Nashua, IA.

Treatment	Rate[1]	Active ingredient	Target application[2]	Stand[3]
Untreated	-------	-------	-------	72.9
Zero Aphid	1.6 fl oz	λ-cyhalothrin	Aug 18	68.6
	16 fl oz	chlorpyrifos		67.0
CruiserMaxx w/*Rag1*	56 g	thiamethoxam	ST	79.5
Warrior II	1.6 fl oz	λ-cyhalothrin	Aug 18	71.8
CruiserMaxx	56 g	thiamethoxam	ST	72.9
Lorsban Advanced	32 fl oz	chlorpyrifos	Aug 18	--
Steward	6.7 fl oz	indoxacarb	Aug 18	--
Asana XL	9.6 fl oz	esfenvalerate	Aug 18	--
Asana XL	8 fl oz	esfenvalerate	Aug 18	--
+ Lannate	8 fl oz	methomyl	Aug 18	--
Belay[4]	3 fl oz	clothianidin	Aug 18	--
Belay[4]	4 fl oz	clothianidin	Aug 18	--
Belay[4]	6 fl oz	clothianidin	Aug 18	--
Belay[4]	3 fl oz	clothianidin	Aug 18	--
+ Lorsban	16 fl oz	chlorpyrifos		
Hero[4]	10.3 fl oz	ζ-cypermethrin + bifenthrin	Aug 18	--
Belay[4]	3 fl oz	clothianidin	Aug 25	--
+ Brigade	4 fl oz	bifenthrin		
Brigade[4]	6.4 fl oz	bifenthrin	Aug 25	--
Endigo ZC[4]	4.5 fl oz	thiamethoxam + λ-cyhalothrin	Aug 25	--
+ Thiamethoxam	2.58 fl oz	thiamethoxam		
Cobalt Advanced	11 fl oz	chlorpyrifos + λ-cyhaolothrin	Aug 18	--
Cobalt Advanced	13 fl oz	chlorpyrifos + λ-cyhaolothrin	Aug 18	--
Declare	1.02 fl oz	γ-cyhaolothrin	Aug 18	--
Declare	1.28 fl oz	γ-cyhaolothrin	Aug 18	--
Declare	1.02 fl oz	γ-cyhaolothrin	Aug 18	--
+ Nufos 4E	12 fl oz	chlorpyrifos		
Mustang Max	5 fl oz	ζ-cypermethrin	Aug 18	--
Hero	5 fl oz	ζ-cypermethrin + bifenthrin	Aug 18	--
Hero	4 fl oz	ζ-cypermethrin + bifenthrin	Aug 25	--

[1]Foliar product rates are given as formulated product per acre, and seed treatments are given as grams active ingredient per 100 kg seed.
[2]ST = seed treatment.
[3]Reported stand number is given as the number of plants per 10 ft of row.
[4]A surfactant was included as an adjuvant and formulated at a rate of 0.25% the volume of the mixed product.

Table 2. Cumulative aphid days (CAD ± standard error of the mean) exposure and yield (bushels per acre ± standard error of the mean) at the ISU Northeast Research Farm, Floyd County, Nashua, IA.

Treatment	CAD ± SEM	CAD - LSD[1]	Yield ± SEM	Yield – LSD[1]
Untreated	208.4 ± 36.2	cde	64.0 ± 0.5	cd
Zero Aphid	67.61 ± 59.5	ab	59.9 ± 0.6	a
CruiserMaxx w/*Rag1*	211.4 ± 33.8	cde	60.2 ± 1.5	ab
Warrior II	129.1 ± 44.0	abcd	62.25 ± 0.8	bc
CruiserMaxx	39.6 ± 21.8	a	64.7 ± 0.8	d
Lorsban Advanced	35.2 ± 13.3	a	63.0 ± 0.5	bcd
Steward	255.6 ± 74.3	e	63.8 ± 0.7	cd
Asana XL	127.9 ± 57.0	ab	64.2 ± 1.3	cd
Asana XL + Lannate	73.2 ± 38.6	ab	64.1 ± 1.4	cd
Belay 3 oz	116.0 ± 67.8	abcd	64.8 ± 0.9	d
Belay 4 oz	164.1 ± 82.9	bcde	63.4 ± 1.3	cd
Belay 6 oz	102.0 ± 36.7	abc	64.2 ± 0.7	cd
Belay + Lorsban	40.7 ± 16.0	a	63.4 ± 0.5	cd
Hero 10.3 oz	37.0 ± 11.2	a	63.9 ± 0.5	cd
Belay + Brigade	216.0 ± 54.6	cde	63.2 ± 0.4	cd
Brigade	158.4 ± 24.1	bcde	63.6 ± 1.1	cd
Endigo ZC + Thiamethoxam	130.9 ± 37.4	abcd	64.0 ± 1.2	cd
Cobalt Advanced 11 oz	50.3 ± 23.1	ab	62.2 ± 0.6	bc
Cobalt Advanced 13 oz	35.7 ± 12.0	a	63.2 ± 0.5	cd
Declare 1.02 oz	58.2 ± 23.5	ab	63.6 ± 0.7	cd
Declare 1.28 oz	100.0 ± 38.8	abc	63.8 ± 0.6	cd
Declare + Nufos 4E	63.3 ± 24.6	ab	62.8 ± 0.5	bcd
Mustang Max	226.2 ± 57.0	de	62.2 ± 0.2	bc
Hero 5 oz	39.7 ± 8.2	a	63.6 ± 0.7	cd
Hero 4 oz	159.1 ± 24.4	bcde	64.0 ± 0.7	cd

[1]Least significant difference (LSD). Means labeled with a unique letter were significantly different ($P \leq 0.05$).

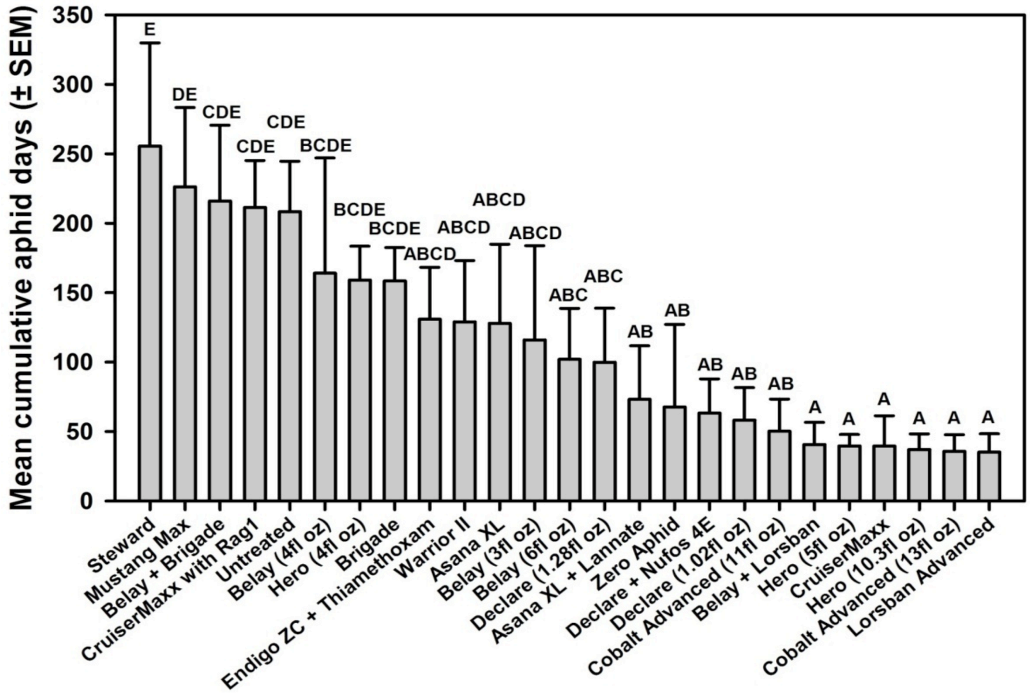


Figure 1. Soybean aphid cumulative aphid days (± standard error of the mean) for treatments evaluated at Floyd County, IA in 2010. Rates are only given if the same product was applied at different rates, all other insecticide rates can be found in Table 1. Means with a unique letter are significantly different (P≤0.05).

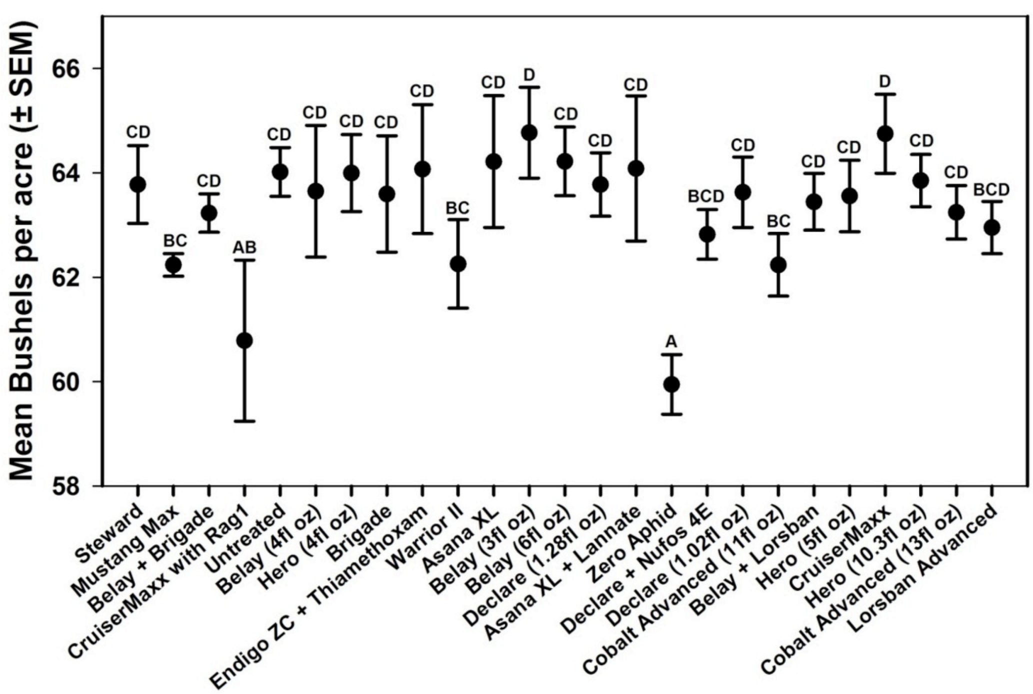


Figure 2. Yield in bushels per acre (± standard error of the mean) for treatments evaluated at Floyd County, IA in 2010. Rates are only given if the same product was applied at different rates, all other insecticide rates can be found in Table 1. Means with a unique letter are significantly different (P ≤ 0.05).