PRACTICAL farmers of Iowa

Healthy Food, Diverse Farms, Vibrant Communities

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Aphid resistant versus susceptible soybean varieties

Written by Sarah Carlson and Amber Anderson

Abstract

Soybean aphid, Aphis glycines Matsumura (Hemiptera: Aphididae), is a pest to soybeans in Iowa. In certain years, it can be economically devastating to a farming operation. Conventional farmers can use insecticides to control soybean aphid populations but those insecticides can also harm natural enemies that feed on soybean aphids. In addition, organic farmers do not have good pest deterrent alternatives to insecticides to control aphids. Data from four farmers in western Iowa who tested aphid-resistant (AR) and susceptible (SC) soybean varieties suggest that in 2011, at three of four locations the aphid-resistant varieties were equal to or outperformed the susceptible varieties. At one location the susceptible variety outperformed the aphid-resistant varieties. Based on the 2011 data considering the crop protection costs, yield and aphid-pressure differences, planting an AR variety might be a good insurance policy in both organic and conventional farming systems.

Background

Soybean aphid, Aphis glycines Matsumura (Hemiptera: Aphididae), is an economically important pest for both conventional and organic soybean farmers to manage. Since 2003, aphids have been detected in every county in Iowa. Soybean aphid reduces soybean yield by directly feeding on the plant and transmitting plant diseases. Once aphid populations reach 250 aphids/plant, farmers are encouraged to apply an insecticide (Rice et al., 2005). Economic injury is expected to occur after 650 aphids/plant (Lewis, 2010). On-farm strip trials have reported soybean-aphid damage to be greater than 50% yield loss and on average 14% reduction in yield in Iowa (Johnson and O'Neal, 2005). In 2003 in Iowa, roughly 4 million acres of soybeans were treated for aphids (Pilcher and Rice, 2005). Organic farmers cannot use insecticides to control aphids. Organic soybean producers are limited to only a few commercial products (Neem oil, mineral oil, insecticidal soap and Pyrethrins) that are cleared for organic use. Their efficacy for controlling aphids in soybeans has been mixed at best, according to farmer observations (Mugge, Personal communication, 2010). In addition, insecticides can damage natural enemy populations like lady beetles, which can greatly reduce aphid populations by feeding. With decreased natural enemy populations, future aphid outbreaks can occur (Thies et al., 2003). Aphids could be controlled through natural host plant resistance. Screening of several soybean varieties by USDA and researchers at Iowa State University (ISU) and the University of Illinois discovered soybean varieties with natural resistance to aphids. Practical Farmers of Iowa member Ron Rosmann compared a SC and an AR soybean variety, both commercially available, in 2009. The SC variety yielded one bushel higher than the AR variety but had more aphids from two aphid counts that Ron conducted. As a follow-up, four locations tested SC and AR varieties in 2010. The 2011 study added the additional complexities of glyphosate-tolerant soybeans selected for aphid resistance at one location and an insecticide treatment at another location in addition to two organically managed locations.

Table 1

LOCATION	Glyphosate tolerant		Non-glyphosate tolerant	
	Aphid Resistant	Susceptible	Aphid Resistant	Susceptible
Harlan			BR29AR9	BR27AD
Sioux Center	S25F2	S25R		
Stanton	2600ATRR	RR92Y73	BR25AR	
Sutherland			IA3027RA1	IA3027

Method

*Four locations in western Iowa, two certified-organic and two conventional farms, raised aphid-resistant and susceptible soybeans in 2011. Each location contained both aphid-resistant and susceptible cultivars in multiple replications randomized throughout the field. (**Table 1,** page 1) displays selected varieties planted at each location.*

ISU researchers conducted aphid counts August 17–18 near Harlan and Stanton. Due to low aphid pressure in this part of the state, additional counts were not needed. Dordt College took aphid counts weekly between July 25–August 29. Paul Mugge, near Sutherland, took two counts on August 6 and August 20.

Weeds in organic fields (Harlan and Sutherland) were managed with multiple rotary hoe and cultivator passes. Non-organic fields (Sioux Center and Stanton) employed herbicides for weed control. The Stanton location had both glyphosate-tolerant (GT) and non-GT varieties. The plot was treated as a conventional soybean plot without the use of the glyphosate herbicide for weed control. Both soybean varieties at Dordt College were glyphosate-tolerant and glyphosate was used to control weeds.

At Sioux Center, in addition to yield comparisons between the AR and SC varieties, on August 11 an application of Endigo at 4oz/A was applied to half of the plots to test the performance of the different varieties with and without an insecticide application and the aphid response.

Data were analyzed using a Mixed Model to determine significant treatment effects. Significant effects (P<0.05) were further analyzed using a Student's T test to compare means. Statistics were analyzed using JMP 9 (SAS Institute Inc., Cary, NC) and yield comparisons employ least squares means for accuracy. Yields are reported at 13% moisture.

Results and Discussion

Aphid resistance

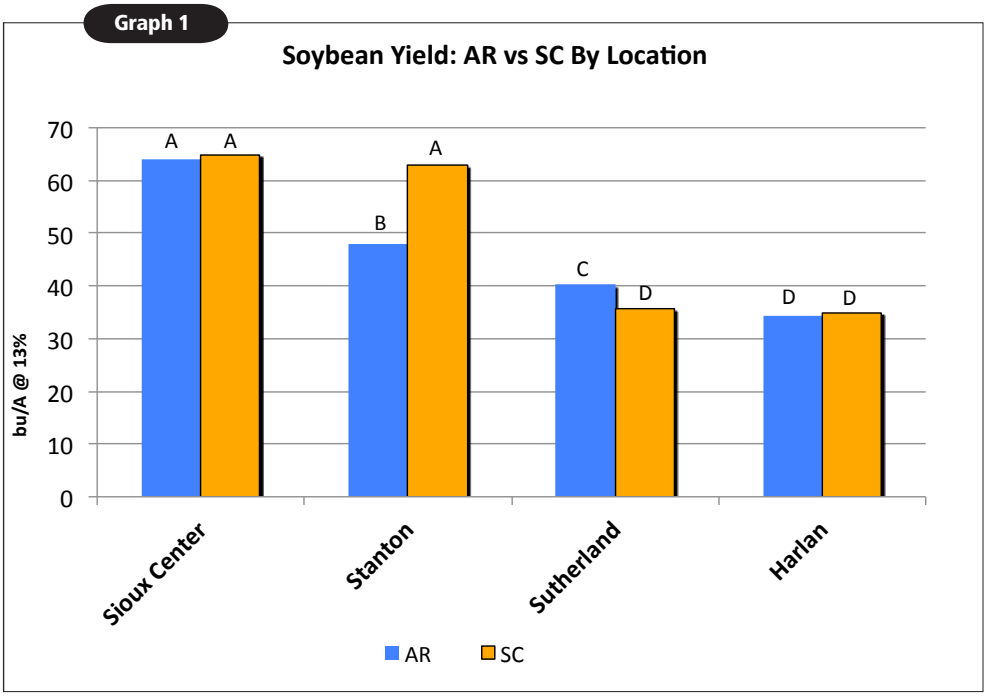
*Mean yields between AR and SC varieties were significantly different (at an α=.05 level) at two of the four locations (**Graph 1**). At Stanton, AR varieties yielded significantly less compared to the SC variety, 48.0 bu/A and 66.9 bu/A, respectively (P<0.05). At Sutherland, the AR variety yielded significantly higher than the SC variety, 40.2 bu/A and 35.7 bu/A, respectively (P<0.05). At Sioux Center and Harlan no significant differences in yield were measured between the two types of varieties. Sioux Center average yield was 64.5 bu/A while average yield at Harlan was 34.7 bu/A. Selection for aphid resistance is more complex than traditional yield-based variety selection and could be expected to come with a potential yield penalty. However, at three of the four locations, AR varieties were equal to or outperformed SC varieties.*

Table 2

Fall Biomass		
Location	**Planting Date**	**Harvest Date**
Harlan	5/27/11	10/16/11
Harlan Replant*	6/7/11	10/16/11
Sioux Center	5/10/11	9/28/11
Stanton	5/7/11	10/1/11
Sutherland	5/10/11	10/5/11

Due to poor emergence, BR27AD replaced previously planted cultivars

Graph 1



***Different letters indicate significant differences using Student's t-test at an α=.05 level**

Glyphosate-resistant versus non-resistant varieties

At Stanton, both AR and SC GT varieties and an AR non-GT variety were compared. At this location, GT soybean varieties yielded 59.4 bu/A, statistically higher than the non-GT yield of 51.5 bu/A. No interaction between the GT and non-GT and AR/SC varieties resulted.

Insecticide treatment

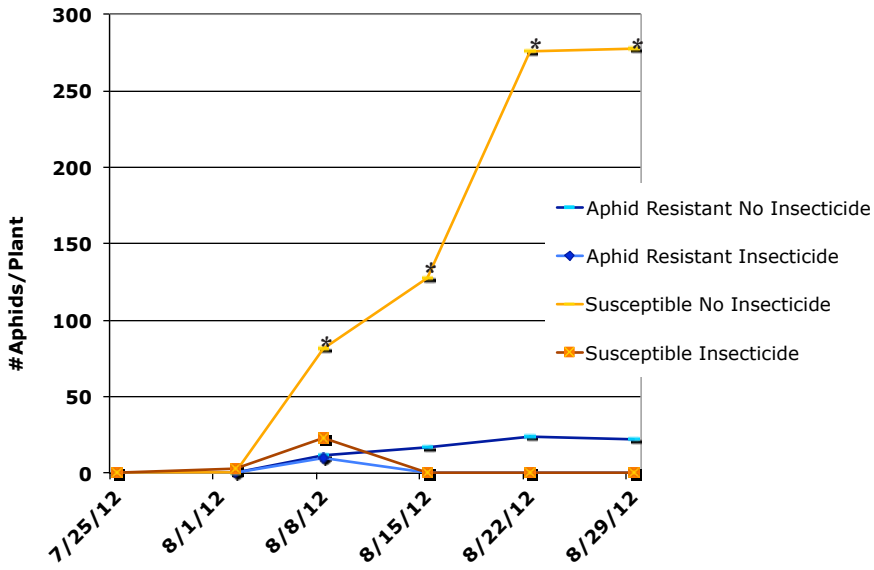
The Sioux Center location tested AR and SC varieties. Half of each variety received an insecticide or no insecticide treatment on August 11, 2011. Mean yields between

treatments were not statistically different at 63.4 bu/A no insecticide and 63.5 bu/A with insecticide treatment. Lack of significant differences could be due to low aphid counts in 2011.

Aphid counts by resistance

At Harlan, aphids were counted on August 17. Aphid numbers were significantly less on the AR varieties (6 aphids/plant) as compared to the SC varieties (33 aphids/plant). Two counts were taken at Sutherland, August 6 and August 20. On the first date, statistically more aphids (α=.05 level) were counted on the SC varieties (549 aphids/plant) compared to the AR varieties (103 aphids/plant). No difference between varieties and aphid populations were counted on August 20. Aphids could not be found at the Stanton location.

Graph 2



***Indicates significant differences using Student's t-test at an α=.05 level**

Conclusions

At three of the four locations, aphid resistant varieties had fewer aphids present during the height of the aphid season while yielding equal to or greater than susceptible soybeans. Only at one location did the susceptible soybean significantly outperform the aphid-resistant soybeans. At two locations aphid pressure was below the economic threshold of 250 aphids/plant. At one location, Sutherland, an organic farm, the AR variety statistically out-yielded the SC variety under economically-damaging aphid populations. In highly impacted areas or where a lack of aphid management options exists, it may be beneficial to plant resistant varieties as insurance against aphid damage in some years, in spite of the potential for lower yield. At Sioux Center, the AR without insecticide treatment had low aphid populations similar to the other insecticide-treated soybeans. The susceptible soybean without an insecticide application had aphid populations surpassing the economic threshold and also yielded the lowest (62.9 bu/A). This data suggest that in a farming system where insecticides are available to control aphids, an AR variety might yield as well as a SC variety even when an insecticide is applied. The cost of an insecticide application from the 2011 ISU Farm Custom Rate Survey ranges from $4-$14/A plus the estimated cost of a full rate of Asana® XL insecticide at $4.85/A for 2012. Additional charges for scouting soybeans would need to be attributed to the cost of managing the aphids in the SC fields. Considering crop protection costs and yield and aphid pressure differences, an AR variety might be a good insurance policy in both organic and conventional farming systems. More years of data with higher aphid populations will further confirm the expected performance of aphid-resistant soybeans.

Table 3

	Soybean yield	
	No Insecticide	**Insecticide**
	(bu/A @ 13% moisture)	
AR	63.9 AB	64.2 AB
SC	62.9 B	66.9 A

***Different letters indicate significant differences using Student's t-test at an α=.05 level**

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