Aphid Resistant (AR) Versus Susceptible (SC) Soybeans

Cooperators
Jeff Olson, Winfield
Ron Rosmann, Harlan
David Haden, Primghar
Paul Mugge, Sutherland
Tom Frantzen, New Hampton

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Web Link
www.practicalfarmers.org

Contact
Sarah Carlson, 515.232.5661,
sarah@practicalfarmers.org

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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 five farmers in Iowa who tested aphid resistant (AR) and susceptible (SC) soybean varieties suggests that even in a year with low aphid populations, like 2010, aphid resistant soybeans can yield similarly or within 6 bu/A to commercially available susceptible varieties.

Background

Soybean aphid, Aphis Glycines Matsumura (Hemiptera: Aphididae), is an economically important pest for both conventional and organic soybean farmers to manage. Beginning in 2003, aphids have been detected in every county in Iowa. Soybean aphids reduce 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). 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 & 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. From farmer observations, their efficacy for controlling aphids in soybeans has been mixed at best (Communication, Mugge, 2010). In addition, natural enemy populations, like lady beetles, which can greatly reduce aphid populations by feeding,

Table 1

LOCATION	FOOD GRADE		FEED GRADE	
	Aphid Resistant	Susceptible	Aphid Resistant	Susceptible
New Hampton			BR19AR1	BR19A9
Primghar			BR29AR9	BR2A71
Sutherland	IA3027RA1	IA3027		
Winfield	IA3027RA1	IA3027		RR93Y50
Harlan	IA3027RA1	IA3027	BR29AR9	BR27AKD

Cooperators

Jeff Olson, Winfield, *combination organic and conventional row-crop and livestock, including cattle*

Ron Rosmann, Harlan, *Certified Organic integrated row-crop and livestock, including farrow-to-finish hogs and cattle*

David Haden, Primghar, *Certified Organic integrated row-crop and livestock, including cattle and lambs*

Paul Mugge, Sutherland, *Certified Organic row-crop*

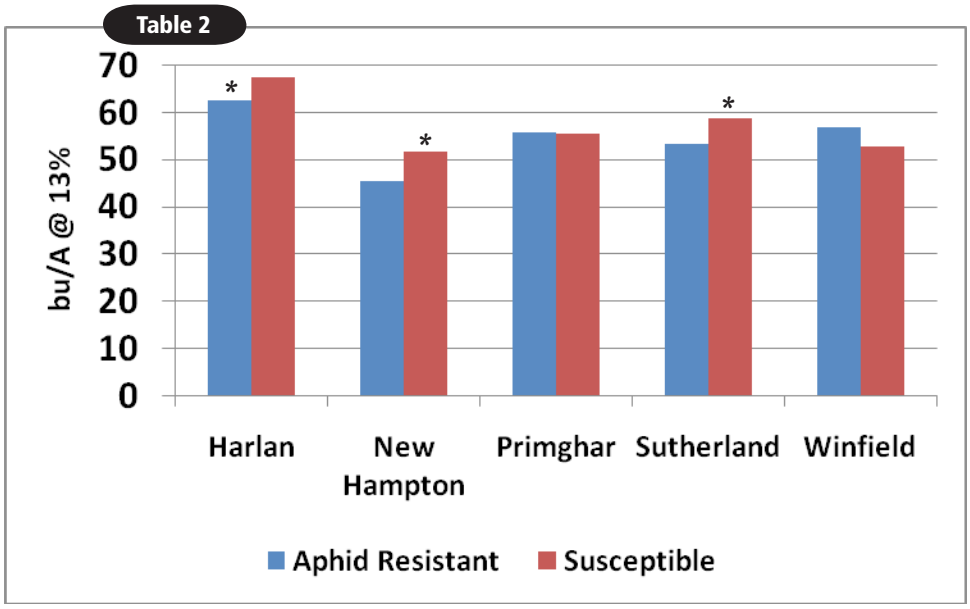
Tom Frantzen, New Hampton, *Certified Organic integrated row-crop and livestock, including farrow-to-finish hogs and cattle*

can be damaged by insecticides. With decreased natural enemy populations, future aphid outbreaks can occur (Thies et al., 2003).

Another form of aphid control could be 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 1 bushel higher than the AR variety but had more aphids from two aphid counts Ron conducted. To build on that initial study, Ron Rosmann, David Haden, Paul Mugge, Jeff Olson and Tom Frantzen participated in a multi-location comparison of AR and SC soybeans.

Table 2



Method

Five locations in Iowa, four certified-organic and one conventionally managed grew one or two AR and SC food or feed grade soybeans in the summer of 2010. (See table 1 on page 1 of this report.) "BR" varieties are commercially available soybean varieties from Blue River Hybrids. Maturity group 1.9 and 2.9 AR and SC varieties were tried. "IA" varieties are public varieties available through ISU. For these public AR varieties the RAG1 gene was selected for and has been measured to have decreased pressure from aphids. The food grade varieties have higher protein and larger seed sizes for use in the food industry than the feed varieties. Also at Winfield, a treatment of a commercially available Pioneer SC variety was planted. It is also tolerant to glyphosate, (Roundup®) and a feed grade soybean.

Moisture content at harvest, yield, and aphid and natural enemy populations data were measured. At each location, farmers planted strips of the soybean variety treatments in a randomized, replicated design. Soybeans were planted and harvested on time during the normal dates for soybeans at each location.

On the organic locations weeds were managed with mechanical control (rotary hoe and/or cultivation). On the conventional farm weeds were managed using herbicides. Plot yield and moisture content were measured using yield monitors or weigh wagons.

Due to low aphid populations in 2010, only three farms counted aphid populations. Students or farmers counted the number of aphids on the plants three times during the sampling month, August. In addition to aphid counts, farmers placed yellow sticky traps at four locations in the research plot. Each sticky trap was stapled to a stake and located just above the soybean canopy. The traps were changed every week for a three week period in August. Sticky traps are a common tool used to measure a representative sample of the diversity of insects present. Insect counts and aphid counts are still being summarized and are not included in this report.

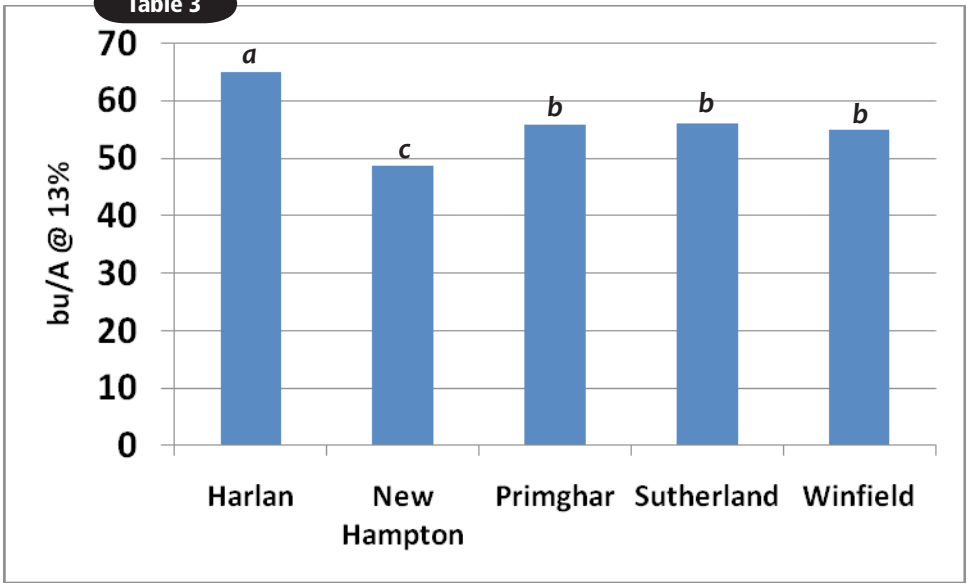
The data were analyzed using a Mixed Model to determine treatment effects. When effects were significantly different with a $P< 0.05$ means comparison were determined using the Student's T test at a $P < 0.05$. All statistical analysis was performed using JMP8.

Results

Aphid Resistant Verses Susceptible

From the Mixed Model analysis, AR and SC varieties yielded differently across the five locations. Across all locations AR varieties yielded 54.7 bu/A and SC varieties yielded 57.3 bu/A which was statistically significant ($p<0.001$). Moisture content was the same between AR (9.78%) and SC (9.93%) varieties ($p=0.36$). Within locations, AR varieties yielded equal to or less than SC varieties. AR and SC varieties yielded similarly at Primghar and Winfield locations. At New Hampton, Sutherland and Harlan AR varieties yielded less than SC varieties.

Table 3



Food Grade versus Feed Grade

Both food grade and feed grade soybean varieties were tested. Neither food grade nor feed grade attributes affected soybean yields. No significant difference between the food grade and feed grade soybeans was measured ($p=0.19$).

Location

Management, soil type, rainfall and temperature can affect the yields of the crops at different locations. Location did have a significant effect on soybean yield ($p=0.0001$).

Conclusions

2010 had low levels of soybean aphids present in Iowa. Although levels of aphids were low, new aphid resistant soybean varieties still yielded similarly or within 6 bu/A of the susceptible varieties. Food grade and feed grade soybeans yielded similarly. If soybean aphids can cause up to 50% damage to the soybean crop, organically certified aphid deterrents do not consistently reduce aphid pressure, and conventional farmers are looking to save costs, these new food grade and feed grade aphid resistant varieties that are bred through conventional breeding techniques will be good insurance in the event of a year with high aphid pressure

Table 4

VARIETY	COST/UNIT
BR19A9	$34.00
BR19AR1	$37.00
BR27AD	$37.00
BR29AR9	$37.00
BR2A71	$34.00
IA3027	$25.00
IA3027RA1	$25.00
RR93Y50	$48.95

References

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