



Photo: Iowa State University

## Host plant resistance to the soybean aphid

Soybean aphid continues to be an economically important pest in the North Central region. During outbreaks, if aphid populations are left untreated, their populations can easily exceed several thousand per plant. Once the economic threshold is achieved, soybean producers rely on timely insecticide applications to prevent yield loss. However, a new tool called host plant resistance may reduce the number of insecticide applications needed to manage soybean aphids, increasing profits for producers.

**This fact sheet will address how host plant resistance affects the soybean aphid, and summarizes field performance data collected from Iowa.**

Entomologists and agronomists throughout the North Central region are optimistic about host plant resistance as a viable pest management tool for the soybean aphid.

## What is host plant resistance?

Host plant resistance in soybean, specifically aphid-resistant soybean, works by suppressing aphid growth and reproduction on the plant. This is called **antibiosis**. Other types of host plant resistance include **antixenosis**, the inability of an insect to find and/or feed on a plant and **tolerance**, the ability of a plant to produce yields despite insect feeding. A single plant can express one or more types of resistance.

Scientists have been searching for genetic resistance to the soybean aphid since it was discovered in the United States in 2000. To date, at least four different genes have been isolated. The first gene to be commercialized, named **Rag1**, was first identified by scientists at the U.S. Department of Agriculture.



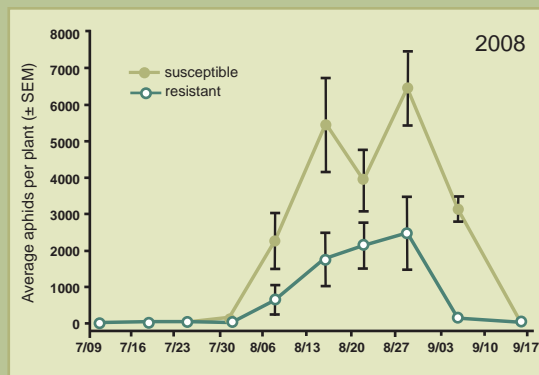
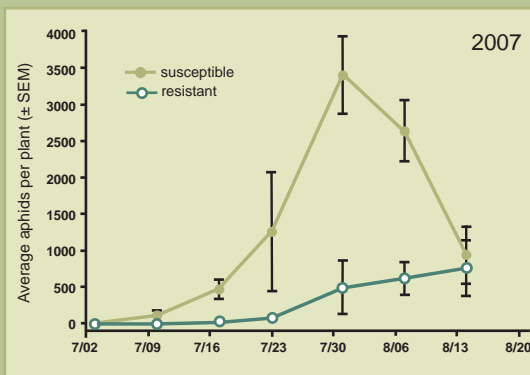
## Developing aphid-resistant soybean varieties

Soybean varieties expressing the Rag1 gene have been evaluated throughout the North Central region. In Iowa, there was a significant difference in soybean aphid population growth when comparing resistant and susceptible plots (Figure 1). When not treated with an insecticide, aphid-resistant soybean had higher yields than aphid-susceptible soybean (Figure 2). Similar results were observed in other states (MN, MI, IL, WI).

A comparison of a soybean aphid-resistant variety (left) to a soybean aphid-susceptible variety (right). Note the susceptible plants are stunted and have black sooty mold from heavy soybean aphid feeding. Photo: Iowa State University



**Figure 1.** Average number of soybean aphids per plant ( $\pm$  standard error of the mean) in 2007 and 2008 at Iowa State University Research Farm in Story County (O'Neal and Chiozza, unpublished data).



Visit our Web site to learn about ongoing research, like host plant resistance to the soybean aphid.

[www.soybeanaphid.info](http://www.soybeanaphid.info)

## Just the facts, please!

### *Do aphid resistant soybean varieties require a refuge?*

Because the resistance gene was introduced into plants with traditional breeding techniques, a refuge is not mandated by the Environmental Protection Agency.

### *When will aphid resistant varieties be commercially available?*

Growers should be able to purchase aphid-resistant varieties in 2010.

### *Will host plant resistant varieties be aphid-free?*

None of the known host plant resistance genes provides complete protection from the soybean aphid. Resistant plants will have fewer aphids compared to conventional plants, but do not expect fields to be aphid-free (Figure 1). Growers should still regularly scout fields to determine if aphid populations exceed the economic threshold and spray accordingly.

### *Is the economic threshold still applicable for resistant varieties?*

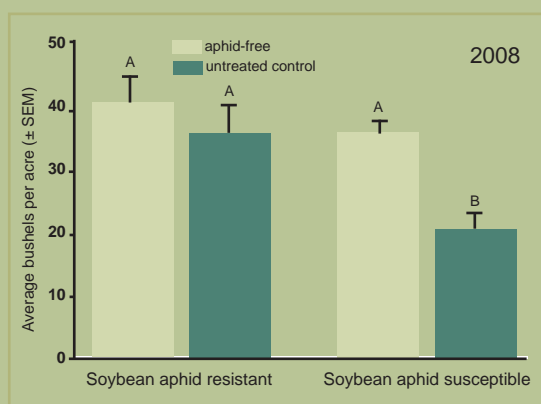
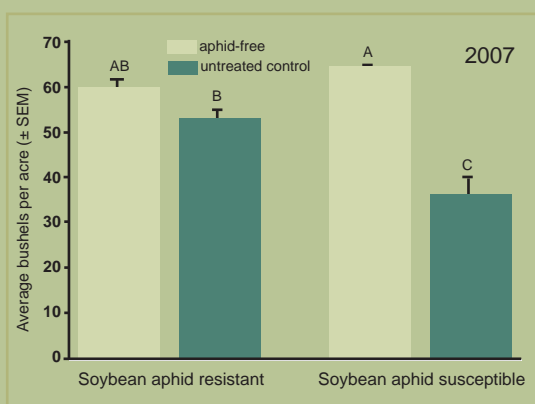
There is ongoing research to determine if the economic threshold of 250 aphids per plant is still appropriate for aphid-resistant soybean varieties. For now, continue to use the standard threshold, knowing that soybean aphid populations may not develop as quickly in fields planted with aphid-resistant varieties.



▲ Iowa State University Extension field demonstrations showcase new management tools like aphid-resistant soybeans. Photo: Iowa State University

### *Will growers still need to treat aphid-resistant varieties with an insecticide for aphid control?*

Insecticide use may be necessary in some years. Aphid populations in Iowa research plots planted with aphid-resistant soybean varieties exceeded the economic threshold in 2007 and 2008, requiring an insecticide application for yield protection (Figure 2).



▲ **Figure 2.** Average soybean bushels per acre (± standard error of the mean) in 2007 and 2008 at the Iowa State University Research Farm in Story County (O'Neal and Chiozza, unpublished data). Aphid-free plots were treated with an insecticide three times each season. Untreated control plots were never treated with an insecticide. Different letters indicate a significant difference in yield.

## Research Summary & Conclusions

- Only the Rag1 gene was tested in our field experiment. It is the most common source of aphid resistance and will be commercially available in 2010. Other sources of aphid resistance have been identified and may be released in the near future.
- In 2007 and 2008, soybean aphids exceeded the economic threshold in the resistant and susceptible varieties. However, the aphid growth rate was slower in resistant plots compared to susceptible plots. This pattern of aphid growth was also observed in other states.
- Yield loss from soybean aphid is still possible even from aphid-resistant plants. Insecticides may still be needed to protect yield.
- Aphid-resistant plants will still be at risk for other insect pest problems, like bean leaf beetle or spider mite infestations.

### Future work for host plant resistance to the soybean aphid

Research to improve the expression of host plant resistance genes in existing germplasm will continue. Additionally, scientists will attempt to couple genes that impart antibiosis and tolerance to produce more durable aphid resistance. They will also determine if a new economic threshold and economic injury level are needed for aphid-resistant soybean varieties.

Host plant resistance is a new tool for soybean aphid management. However, additional research is needed to evaluate its long-term use in commercial production.

**Many scientists in the North Central Region have contributed to the development of host plant resistance to the soybean aphid. We thank the following for their efforts:**

Mariana Chiozza, Iowa State University  
Silvia Cianzio, Iowa State University  
Eileen Cullen, University of Wisconsin  
Brian Diers, University of Illinois  
Chris Difonzo, Michigan State University  
Gustavo MacIntosh, Iowa State University  
Brian McCornack, Kansas State University  
David Ragsdale, University of Minnesota  
John Reese, Kansas State University  
Roy Scott, USDA-ARS  
Kevin Steffey, University of Illinois  
Kelley Tilmon, South Dakota State University  
Nicholas Tinsley, University of Illinois  
Dechun Wang, Michigan State University



*Matt O'Neal is an assistant professor and soybean entomologist with teaching responsibilities. Erin Hodgson is an assistant professor and soybean entomologist with Extension responsibilities. Matt and Erin work in the Entomology Department at Iowa State University in Ames.*

**We gratefully acknowledge the following for their financial support:**

IOWA STATE UNIVERSITY  
University Extension

  
Our soybean checkoff.  
Effective. Efficient. Farmer-Driven.



  
IOWA SOYBEAN  
ASSOCIATION  
Expanding Opportunities. Delivering Results.

  
NCSRP  
NORTH CENTRAL SOYBEAN  
RESEARCH PROGRAM

...and justice for all

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Many materials can be made available in alternative formats for ADA clients. To file a complaint of discrimination, write USDA, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Jack M. Payne, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.