UNIVERSITY OF ILLINOIS
College of Agricultural, Consumer and Environmental Sciences

Identifying a Gene with Resistance to Soybean Aphids

After nearly three years of effort, a team of researchers at the U of I has identified a single-gene source of aphid resistance that can be easily crossed into elite commercial varieties.

The lead scientists in this effort are Glen Hartman, plant pathologist with the USDA's Agricultural Research Service at the U of I, Senior Research Associate Curtis Hill, and soybean breeder Brian Diers from the U of I's Department of Crops Sciences. Funding for this research has been provided by the Illinois Soybean Checkoff Board.

"This gene has been tested in both the greenhouse and the field and has consistently prevented colonization by soybean aphids," Hartman said. "Because it is a single dominant gene with identified DNA markers, it can be readily introduced into susceptible commercial soybean varieties by backcrossing using marker-assisted selection."

The methods for breeding plants with the aphid-resistance gene will be licensed for use in both public and private breeding programs.

The aphids were first discovered in large numbers in fields near the end of the 2000 growing season. After careful scientific investigation, they were identified as *Aphis glycines*, which had previously been reported only in Asia, Australia, and some Pacific islands. By 2003, this pest had emerged as a major problem for growers throughout the Midwest.

"When the aphids infest a field, the most common means of control is to spray the field with an insecticide that can cost as much as 20 to 25 dollars per acre," Hartman said. "In 2003 alone, more than one million acres were sprayed in Illinois and more than three million acres in both Iowa and Minnesota. Once resistant commercial varieties are available, the savings to growers will be substantial." Diers added that the environmental benefit of the gene is that it would reduce insecticide use.

As part of their initial screening process, the team evaluated the various commercial soybean varieties that had been submitted to the yield trials at U of I for resistance to the aphids.

"After screening more than 700 varieties, we found that all of them were basically susceptible to this pest," Hartman said. "We also determined that there had not been any reported resistance from the germplasm screened in the part of the world where the aphids originated, which is China."

In the next step, they began screening about 100 cultivars that had been identified as the major genetic contributors to modern soybean varieties. Those ancestral lines account for more than 90 percent of the genetic variation in our current soybeans.

"Luckily we found resistance in two different cultivars," Hill said. "One is called Jackson, which is an old southern cultivar. Another was Dowling, which also is an old variety grown in the south."

As part of the experimental design, the resistant cultivars were tested in a specially designed field cage with several commercial varieties and were treated with an insecticide or left untreated.

"Even with large numbers of aphids present, we found virtually no difference in yield and agronomic traits whether these resistant lines were treated with an insecticide or not," Hartman said. "At the same time, the commercial varieties were severely damaged when they were not treated with an insecticide, with many of the plants actually dying."

The researchers followed that up with a series of laboratory and fields studies that identified the single dominant gene that carried resistance to the aphids. They also developed methods for identifying and breeding resistant plants using marker-assisted selection.

"We were able to identify the specific region of the chromosome where the gene is located using genetic markers," Diers said. "Our team also confirmed that the resistance is conferred by a single major gene. We are now using that marker information to breed the resistance gene into adapted soybean varieties and to test whether there is any yield or agronomic drag associated with the gene. We hope to have resistant varieties available to farmers by 2008."

With assistance from the Office of Technology Management at the U of I, they have also applied for a patent and they are licensing this new technology to both university and industry breeders.

"The idea of licensing is to make it a fair playing field for everyone," Hartman said. "Otherwise an individual company could take this research and patent the gene for itself. By licensing the technology to a large number of companies and public breeders, we can ensure that the benefits will reach growers across the Midwest as quickly and cheaply as possible."

Additional details on this technology are available at http://www.otm.uiuc.edu/techs/techdetail.asp?id=267

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Source: Brian Diers (217-265-4062; bdiers@uiuc.edu)