

Discovering soybean plants resistant to aphids and a new aphid

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This year farmers in the Midwest are growing a new variety of soybeans developed by University of Illinois researchers that has resistance to soybean aphids. However, in addition to the resistant plants, U of I researchers also discovered a new soybean aphid which is not controlled by this resistance.

Soybean aphids made their first appearance in North America in the summer of 2000, resulting in tremendous crop losses for farmers. U of I researchers began immediately searching for a variety of soybean that is resistant to the new pest.

Dowling and Jackson were the first two resistant varieties to be identified. "We have the U. S. Soybean Germplasm collection here at Illinois. It houses about 18,000 different accessions," said Glen Hartman, soybean plant pathologist with the USDA and U of I. "We didn't screen all 18,000, but we went through a small set of 4,000 to 5,000 and that's where Jackson and Dowling came from. We knew they were resistant, but we had to do the crossings and look at the inheritance patterns to figure out whether the resistance was because of a single gene or multiple genes."

With additional screening, a third soybean resistant to aphids was found -- a Japanese variety known as PI 200538. "After we mapped the genes from these sources, we discovered that Jackson and Dowling had genes mapping to the same place on a chromosome and the PI had a gene mapping to a different place. This means that Jackson and Dowling

likely have the same resistance gene and PI 200538 has a different gene we can use in breeding."

Diers said that both Jackson and Dowling originated in the southern United States, so neither could be grown to seed in the Midwest. They used traditional breeding techniques together with marker-assisted selection to quickly breed the resistance genes into varieties that are adapted to the Midwest.

"Because the aphid resistance is conferred by a single gene in the resistance sources, we were able to breed these genes into Midwest-adapted varieties quickly and easily," Diers said. "We can complete three crossing generations a year by using both greenhouses and fields. This year is a milestone because we now have a variety that's being commercially produced that carries the resistance gene from Dowling. This is its first commercial production of an aphid-resistant variety in the Midwest."

Unfortunately, the celebration didn't last long. While studying soybean plants, they discovered a new type of aphid. "We were excited about finding the resistance. We discovered this gene from Dowling and Jackson, bred it into varieties and we 'hoped that we could solve the aphid problem,' but of course things are never that simple," Diers said. "We found that there are different biotypes of soybean aphids, including a biotype that can overcome the resistance gene for Dowling."

In tests, this new aphid was able to infest Dowling as well as it could any susceptible genotype of soybean. "We don't know how widespread those aphids are or whether or not this is actually going to occur in fields, but certainly it's something to be concerned about because we know that resistance isn't going to be perfect," Diers said.

The good news is that the PI 200538 gene for resistance is different than

the one in Dowling and Jackson. "We found that this second resistance gene in the PI protects the plants against this new biotype of aphid. We are currently breeding the PI 200538 gene into varieties, but it will be at least a few years before any varieties with this gene will be released."

Even after the appearance of this new aphid, Diers is still optimistic. "We have one variety with the Dowling resistance gene that's being commercialized this year. A company is increasing seed of a second variety with the Dowling gene that should be commercialized next year. So we'll have two varieties available to growers." He explained that the U of I aphid-resistant germplasm and marker technology is licensed to private seed companies who are using it to breed their own varieties."

The first aphid-resistant variety developed and released by the University of Illinois is Round-up Ready, and the second is a conventional, non-Round-up Ready variety. Diers says "we believe that the aphid resistance in a conventional background will be especially helpful to organic soybean producers because currently if they have aphids in their fields, they don't have any practical method of control because they cannot spray insecticides. I've been contacted by some organic growers in northern Iowa and southern Minnesota who are ready to give up growing organic soybeans because aphids have caused such large losses."

Diers said that resistant varieties can save farmers money and help the environment. "Farmers have been controlling soybean aphids by spraying insecticides. If we can deploy resistance, this could reduce the use of these insecticides, which will have many environmental benefits."

The message to farmers is that there are going to be varieties with soybean aphid resistance available. "The tests we've done have shown that we have less aphid reproduction on these resistant lines than on susceptible lines," Diers said. "But so far the resistance isn't a magic

bullet. You can't grow these aphid-resistant varieties and not scout for aphids because there may be aphids in your fields that can defeat the resistance."

The other unknown is how adaptable aphids will be to these new varieties. "Our hope is that we can combine these two genes and get more durable resistance," Diers said. "We hope that we can develop a plant with a number of resistance genes so that if any one of them breaks down, the plant would still be resistant."

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More information: The work appeared in the following journals: Soybean Aphid Resistance Genes in the Soybean Cultivars Dowling and Jackson Map to Linkage Group M was published in a 2007 issue of Mol Breeding. Discovery of Soybean Aphid Biotypes was published in the May-June 2008 issue of Crop Science. Inheritance of Resistance to the Soybean Aphid in [Soybean](#) PI 200538 was published in the July-August 2009 issue of Crop Science.

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