Plant Breeding Can Solve Many Problems, Even Algae From Runoff

Dr. Vince Pantalone, Project Leader for the Soybean Breeding and Genetics Program at the University of Tennessee, explains some of the basic and applied research in developing commercial soybean varieties.

“I like to do in Tennessee is capitalize on making progress from genetic gain by crossing the northern soybean gene pool with the southern soybean gene pool,” he said. “There are actually two distinct pools of genetic material and breeders in the north historically will use the northern pool, breeders in the south pool will use the southern pool. But by bringing those genetic resources together you get some complimentary genes and we’re getting some high yielding varieties out of that effort. So several of my graduate students are involved with understanding the underlying genetics of the process of combining diverse genetic sources and they’re doing this with DNA molecular markers to identify where traits are located.

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Dr. Vince Pantalone discussed soybean varieties developed by the UT program which are Roundup Ready and are marketed by a company called UniSouth Genetics which is headquartered in Nashville, Tenn.

“One variety is USG 74T98 and it’s a 4.9 in maturity; it’s a late Group IV bushy determinant type which has done very well in commercial tests with other Roundup Ready varieties varieties over the past five years,” he said. “We released it in 2008 so it’s been on the market for just a couple of years now.

“We developed that variety by using DNA molecular markers,” he said. “We wanted to use the DNA markers in order to fingerprint the genetic background of the high yielding conventional variety that we developed called 5601T; then we simply cross pollinated our high yielding line with a donor in the greenhouse and field to add the Roundup Ready trait for farmer acceptance. Five years after we made the cross we were able to release 100 bushels of genetically pure material to UniSouth Genetics and begin marketing this new line. So it saved us about three to four years in variety development by using those DNA markers.”

The last commercial variety the group also developed was USG 75T40, a 5.4 in maturity. This new variety has been approved for release, and seed stock production for farmers is planned this season.

“If you have a prominent population of race 2, that new variety is also very high yielding. For two years in a row it was the second highest yielding variety in the Tennessee state variety test. This past year it averaged over six bushels per acre, better than the average of all commercial Roundup Ready varieties in the test.”

Pantalone also talked about some of the graduate student projects.

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on the chromosomes, how we can use them, and how we can make superior decisions in our crossing and selection program.”

Ben Wiggins is a new master of science student working on one population. Chris Smallwood is a second masters student working on a different population.

“In this case we’re working on a cross called Essex Williams 82. Essex is one of the founding fathers of southern soybean. Williams 82 is actually the DNA sequencing line used by the US department of energy. So we’ll be able to translate a lot of that information that will be applicable throughout the country.

“In Chris’s project we have 1,536 single nucleotide polymorphisms or SNPs with a single base pair change in DNA that we look at to identify differences between the parents and among the progeny and see how those are associated with major traits, like protein or oil or other compositional traits.

“In the case of Chris, he is going to be looking at isoflavones which are a secondary metabolite of soybean. Isoflavones have been shown to reduce the risk of cancer, to reduce the symptoms of menopause in women, and help to reduce bone density loss in an aging population, so they’re very important compounds.”

The third student project is conducted by Suzannah Mellinger who is working to develop low phytate soybeans.

“Phytate is a normal compound that is in soybean and corn. It forms a chelate of phytic acid which is a chemical ring structure that has phosphorus on every position of the ring. Phosphorus is negatively charged so it attracts positively charged cations. These are elements like zinc, calcium and iron which are natural mineral compounds in feedstock. But they become bound to the phosphorous ring so they’re no longer available to the feeding chickens and hogs and their metabolism is slower.

“This is the reason that most producers of chickens and hogs import an enzyme from Europe that is called phytase. That’s an added cost. That enzyme breaks down the phytate in order to free up these nutrients.

“The other thing that happens with the phytate is, because it’s not digestible by chickens or hogs, it passes out in the manure; then when you spread chicken manure on agricultural land, native soil bacteria can break that ring structure that frees up inorganic phosphorus which can leach into the surface waters.”

That causes algae problems, fish kill and nitrification problems in the water systems. There are federal regulations that limit the load of phosphorus into waters, so the effort is to work on plant breeding to try to solve this problem and develop low phytate soybeans that improve livestock nutrition and also protect the water quality.

“Plant breeding is an excellent way to improve seed yields, to increase disease resistance, to protect plants from soybean cyst nematode,” Pantalone summed. “By doing that you stabilize your yield over broad productive regions and stabilize the income from year to year to benefit farmers. We’ve been very successful in doing this in our program and we look for the opportunity to do this kind of research for many years to come.”

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