Study opens doors for increases in Texas corn yields, aflatoxin resistance

March 18 2015

Dr. Seth Murray, Texas A&M AgriLife Research corn breeder in College Station, looks at corn plants during a field day. Credit: Texas A&M AgriLife Research photo by Li Zhang

A ground-breaking Texas A&M AgriLife Research-led study on corn has identified useful gene variations for yield increases, drought tolerance and aflatoxin resistance that could make a real difference to Texas producers in the years to come, according to researchers.

The study, titled "Genome Wide Association Study for Drought, Aflatoxin Resistance, and Important Agronomic Traits of Maize Hybrids in the Sub-Tropics" was recently published in *PLOS ONE*, an international, peer-reviewed, open-access, online publication.

The study included the growing years of 2011, a drought year, and 2012, and was conducted on dryland and irrigated corn in College Station and in Mississippi, all with similar results, said Dr. Seth Murray, an AgriLife Research corn breeder in the soil and crop science department of Texas A&M University at College Station.

Murray said at this time all corn seed available to growers in Texas comes from commercial breeding conducted in the Midwest. As a result, there's been no significant increase in corn yields in Texas for many years, as reflected in their previous publications.

Murray designed this recently published study to see if there was a genetic reason, possibly the use of Midwest-temperate rather than sub-tropical genetics, limiting production.

He was joined in his research by Dr. Mike Kolomiets, an AgriLife Research plant pathologist, and Dr. Tom Isakeit, a Texas A&M AgriLife Extension Service plant pathologist, both in College Station, along with students Dr. Ivan Barrero Farfan, Gerald De La Fuente and Pei-Cheng Huang.

Other researchers who also grew the test plots and contributed to the analysis were Dr. Marilyn Warburton, Dr. Paul Williams and Dr. Gary Windham, all U.S. Department of Agriculture-Agricultural Research Service researchers at Mississippi State University.

The study was funded by a USDA National Institute of Food and Agriculture, Agriculture and Food Research Initiative for Plant Breeding

and Education grant. Additional support was given by the Texas Corn Producers and Texas A&M AgriLife.

Basically, Murray said, there are 2.4 million acres of corn planted in Texas, with each bag of seed costing at least $150 and covering over 2 acres, which equates to well over $180 million of sales in Texas for corn seed.

Dr. Ivan Barrero Farfan, a Texas A&M University student working with Dr. Seth Murray during the study, pollinates corn to make hybrids for testing. Credit: Texas A&M AgriLife Research photo by Dr. Seth Murray

"The idea is if it is bred in the best conditions in the Midwest, it should survive in the not-so-good conditions we see here in Texas," he said. "So

we believe the private breeders for the commercial industry are trying to do the best for most producers, just not our producers. There has not been an effort to develop corn that addresses the unique needs of southern locations, especially not in the way they have for the Midwest."

Murray said addressing the needs of the southern locations is not as simple as adding more traits.

"A lot of it will come from identifying and using the right native genetics," he said. "Growers are smart and will find those companies that are selling adapted hybrids, which will improve both yield and aflatoxin resistance, ultimately improving everyone's bottom line"

He said in their search for genes or gene variants that improve corn for the southern U.S., most of the best diversity came from Mexico, where wild corn was domesticated, and South America, not the Midwest.

"There's a lot of benefit to having the tropical material brought up and crossed with temperate material generally sold by commercial companies," Murray said.

The AgriLife Research study used a diverse corn association mapping panel to identify genomic regions associated with grain yield, aflatoxin resistance and important agronomic traits in southern U.S. environments. This study also was one of the first in corn to test hybrids, he said.

"We are finding genes that can benefit temperate corn," Murray said. "We looked at a number of traits, but the best advantage was found with three genes that improved production by about 15 bushels per acre under both irrigated and dryland conditions. They seem to work synergistically."

He said this is only one study, but the results are exciting enough to

follow up on because they were the same over multiple years and in multiple environments. The follow up will concentrate on the three genes.

Aspergillus flavus fungus on corn, which can make aflatoxin. Credit: Texas A&M AgriLife Research photo by Dr. Seth Murray

"We don't know if they will work in a producer's corn field yet," he said. "So we are validating in some new populations this summer and will see if they actually have an effect on yield. We've already advanced the crosses, made hybrids and the DNA markers have been collected on all of them. This summer we will get our yield data, and we should know if they are real or not."

Murray said each of the three gene markers have two variants, one is good and one is bad. In the follow up to this study, he said they will look at other breeding material and select for the markers and screen for anything with bad markers and get rid of that, adding "just eliminating that bad variant should help overall production."

Two of the three genes have not been associated with functions previously, so the next scientific step is to figure out what these genes actually do; how they change the biology of the plant, he said.

"We have absolutely no idea how it is affecting yield and why, but that is where the science will take us," Murray said. "We are a lot closer to having a quality outcome. They appear to have effects in both dryland and irrigated conditions, so that is what is so exciting."

He said this initial research and its continuation in the future is ground-breaking in a couple ways.

"There have been no studies for genes with adaptation in the south, and no one has ever looked at this much diversity, especially beyond the Midwestern temperate types," he said. "We haven't had access to this many tools in the past. We looked at 60,000 DNA marker variants and eventually there might be millions for breeders to consider."

Murray said this research has provided additional guidance for improvement of corn in Texas and other southern states and will enhance Texas A&M AgriLife's breeding programs, which have already resulted in several releases of new inbred lines available for use in hybrids by seed companies.

Provided by Texas A&M University