METER
ENVIRONMENT

IMPROVING DROUGHT TOLERANCE IN SOYBEAN

Limited water availability is a significant issue threatening the agricultural productivity of soybean, reducing yields by as much as 40 percent. Due to climate change, varieties with improved drought tolerance are needed, but phenotyping drought tolerance in the field is challenging, mainly because field drought conditions are unpredictable both spatially and temporally. This has led to the genetic mechanisms governing drought tolerance traits to be poorly understood. Researcher Clinton Steketee at the University of Georgia is trying to improve soybean drought tolerance by using improved screening techniques for drought tolerance traits, identifying new drought-tolerant soybean germplasm, and clarifying which genomic regions are responsible for traits that help soybeans cope with water deficit.

WHICH TRAITS ARE IMPORTANT?

Clinton and his colleagues are evaluating a genetically diverse panel of 211 soybean lines in two different states, Kansas and Georgia, for over two years to help him accomplish his research objectives. These 211 lines come from 30 countries and were selected from geographical areas with low annual precipitation and newly developed soybean lines with enhanced drought-related traits, along with drought susceptible checks.The researchers are looking at traits such as canopy wilting. Some plants will take a few days longer to wilt, allowing these plants to continue their photosynthetic ability to produce biomass for seed production. Other traits that he is interested in evaluating are stomatal conductance, canopy temperature with thermal imaging, relative water content, and carbon isotope discrimination.

USE OF MICROCLIMATE STATIONS TO MONITOR ENVIRONMENTAL CONDITIONS

Clinton says to make selection of drought-tolerant lines easier and more predictable, knowledge of field environmental conditions is critical. He says, “You can phenotype all you want, but you need the true phenotype of the plant to be observed under real drought conditions so you can discover the genes for drought tolerance and improve resistance down the line in a breeding program.”

ATMOS 41 microclimate weather station

In addition to METER soil moisture sensors, the team used METER microclimate weather stations to help monitor water inputs at their two field research sites and determine ideal time periods for phenotyping drought-related traits. Steketee says, “We put microenvironment monitors in the field next to where we were growing our experimental materials. Both locations use those monitors to keep an eye on weather conditions throughout the growing season, measuring temperature, humidity, and precipitation. Since we could access the data remotely, we used that information to help us determine when it was time to go out to the field and look at the plots. We wanted to see big differences between soybean plants if possible, especially in drought conditions. By monitoring the conditions we could just go back to our weather data to show we didn’t get rain for three weeks before we took this measurement, proving that we were actually experiencing drought conditions.”

RESULTS SO FAR

Though 2015 wasn’t a great year for drought in Georgia, Clinton says there was a period in late July when he was able to measure canopy wilting, and they identified some lines that performed well. He says, “We compared our data to the data collected by our collaborator in Kansas, and there are a few lines that did well in both locations. Hopefully, another year of data will confirm that these plants have advantageous drought tolerance traits, and we’ll be able to probe the advantageous traits out of those lines and integrate them into our breeding program.”

FUTURE PLANS

The team will use what's called a genome-wide association study approach to identify genomic regions responsible for drought tolerance traits of interest. This approach uses phenotypic information collected from the field experiments along with DNA markers throughout the soybean genome to see if that marker is associated with the trait they are interested in. If the scientists find the spot in the genome that is associated with the desired trait, they will then develop genomic tools to be used for selection, integrate that trait into elite germplasm, and ultimately improve the drought tolerance of soybeans.

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