MU Drought Simulators Stop The Rain

COLUMBIA, MO.

Farmers face an age-old problem when rains fail to come. Without water, crops wither, harvests fail and people across the world experience economic hardship and hunger.

University of Missouri researchers hope two new drought simulators at the University of Missouri's Bradford Research and Extension Center will lead them to a deeper understanding of how crops respond to drought stress and use that knowledge to breed more drought-tolerant plants.

"Drought is the most important yield-limiting factor around the world as well as in Missouri," said Felix Fritschi, MU plant scientist and lead researcher on this effort. "For MU, these simulators are a big step allowing us to efficiently conduct drought research in the field so that fundamental research can bear fruit in farmers' fields."

Drought impacts the roots of crops like these soybeans. Two new drought simulators at the University of Missouri hope to expand what is known about how plants respond to the lack of water. Credit: Roger Meissen/MU Cooperative Media Group

These state-of-the-art simulators make that fieldwork possible.

Made of polycarbonate sheeting and steel, they look like greenhouses on railroad tracks. Most of the time, tests plots of soybeans and corn sit outside of this structure, allowing them to be exposed to sun, insects and variables like in any field, but when it begins to rain, gauges on the simulator detect the moisture and automatically move the structure to cover the crop. A $1.5 million Missouri Life Sciences Research Board grant makes the simulators possible. At 50-by-100 feet, they are some of the largest in the country and allow the research to be done with all the complexities any field crop experiences.

"Plants can be stressed when we want them to be stressed, in specific developmental stages for however long we want, we can impose the stress very rapidly or very slowly and to different stress levels," Fritschi said. "These simulators allow us to examine crop responses to drought stress at the level of the plant community, the whole plant – what happens above ground, what happens below ground – as well as on the cellular and molecular levels. Field conditions also let us examine the interactions with factors like insects and diseases."

A collaborative effort aims to marry long-term root research in the lab with the field studies. Robert Sharp, director of MU's Interdisciplinary Plant Group and co-investigator on the project, works in one of those labs. Part of his research focuses on corn root systems, and in particular nodal roots. Those are the worm-like roots you see at the base of mature corn, coming out of the stalk inches above the soil. They provide most of the plant's nutrients and stabilize the corn against wind and weather. When drought hits at the wrong time, those roots find it hard to penetrate the baked earth.

"Nodal, or brace roots, account for 90 percent of the root system and can explore to a depth of two meters," Sharp said. "When it stops raining, the first part that becomes very dry and hot is the surface soil, and if the nodal roots can't penetrate, the plant becomes vulnerable to root-less corn syndrome."

Other co-investigators in the project are MU plant sciences professors Robert Kallenbach, who studies forages that livestock eat, and Grover Shannon, a soybean expert. The project includes 13 collaborators representing diverse disciplines such as water quality, soil biology, soil physics, plant-insect and plant-disease interactions, and plant breeding and genetics.

When funding allows, additional simulators will be built at the Delta Research Center, Portageville, and at the Horticulture and Agroforestry Research Center, New Franklin.

Those other sites will allow research in different soil types and climate zones. That diversity of research sites will be helpful, because harm from drought is widespread.

Nearly 12 percent of the U.S. is experiencing exceptional drought right now while 41 percent of the country faces abnormal dryness or drought, according to the National Drought Mitigation Center. It is estimated that this year's drought alone cost the U.S. upwards of $1.5 billion. The drought is leading to lowered U.S. crop yield expectations and the smallest hay crop in more than a century. Much of Missouri suffered from soaring temperatures, and southern Missouri continues to feel the impact of drought.

In countries like Somalia drought has contributed to starvation and scarcity of food has raised world food prices 33 percent since July, according to the World Food Bank.

"Drought is the most important stress factor in many parts of the U.S. in most years, but also has the most impact on crop production in many areas of the world, for example, in Africa, Australia and India," he said. "With increasing needs for food production for the increasing world population with growing competition for water use, it's important to improve our understanding of how plants adapt to drought conditions." Δ