METER
ENVIRONMENT

SCREENING FOR DROUGHT TOLERANCE

Screening for drought tolerance in wheat species is harder than it seems. Many greenhouse drought screenings suffer from confounding issues such as soil type and the resulting soil moisture content, bulk density, and genetic differences for traits like root mass, rooting depth, and plant size. In addition, because it's so hard to isolate drought stress, some scientists think finding a repeatable screening method is next to impossible. However, a recent pilot study done by researcher Andrew Green may prove them wrong.

THE QUEST FOR REPEATABILITY

Green says, "There have been attempts before of intensively studying drought stress, but it's hard to isolate drought stress from heat, diseases, and other things." Green and his advisors, Dr. Gerard Kluitenberg and Dr. Allan Fritz, think monitoring water potential in the soil is the only quantifiable way to impose a consistent and repeatable treatment. With the development of a soil-moisture retention curve for a homogeneous growth media, they feel the moisture treatment could be maintained in order to isolate drought stress. Green says, "Our goal is to develop a repeatable screening system that will allow us to be confident that what we're seeing is an actual drought response before the work of integrating those genes takes place, since that's a very long and tedious process."

WHY HASN'T THIS BEEN DONE BEFORE?

Andrew Green, as a plant breeder, thinks the problem lies in the fact that most geneticists aren't soil scientists. He says, "In past experiments, the most sophisticated drought screening was to grow the plants up to a certain point, stop watering them, and see which ones lived the longest. There's never been a collaborative approach where physiologists and soil scientists have been involved. So researchers have imposed this harsh, biologically irrelevant stress where it's basically been an attrition study." Green says he hopes in his research to use the soil as a feedback mechanism to maintain a stress level that mimics what exists in nature.

TEROS 21 matric potential sensor

THE PILOT STUDY

Green used METER volumetric water content sensors, METER matric potential sensors, as well as column tensiometers to monitor soil moisture conditions in a greenhouse experiment using 182 cm tall polyvinyl chloride (PVC) growth tubes and homogenous growth media. Measurements were taken four times a day to determine volumetric water content, soil water potential, senescence, biomass, shoot, root ratio, rooting traits, yield components, leaf water potential, leaf relative water content, and other physiological observations between moisture limited and control treatments.

SOIL MEDIA: ADVANTAGES AND DISADVANTAGES

To solve the problem of differing soil types, Andrew and his team chose a homogeneous soil amendment media called Profile Greens Grade, which has been extensively studied for use in space and other applications. Green says, “It’s a very porous material with a large particle size. It’s a great growth media because at the end of the experiment you can separate the roots of the plant from the soil media, and those roots can be measured, imaged, and studied in conjunction with the data that is collected.” Green adds, however, that working with soil media isn’t perfect: there have been hydraulic conductivity issues, and the media must be closely monitored.

WHAT'S UNIQUE ABOUT THIS STUDY?

Green believes that because the substrate was very specific and his water potential and soil moisture sensors were co-located, it allowed him to determine if all of his moisture release curves were consistent. He says, "We try to pack these columns to a uniform bulk density and keep an eye on things when we're watering, hoping it's going to stay consistent at every depth. So far it's been working pretty well: the water content and the water potential are repeatable in the different columns."

TEROS 12 soil moisture sensor

PLANS FOR THE FUTURE

Green's pilot study was completed in the spring, and he's getting ready for the expanded version of the project: a replicated trial with wild relatives of wheat. He's hoping to use soil moisture sensors to make automatic irrigation decisions: i.e. the water potential of the columns will activate twelve solenoid valves which will disperse water to keep the materials in their target stress zone, or ideal water potential.

THE ULTIMATE GOAL

The ultimate goal of Green's research is to breed wild species of wheat into productive forms that can be used as farmer-grown varieties. He is optimistic about the results of his pilot study. He says, "Based on the very small unreplicated data that we have so far, I think it is going to be possible to develop a repeatable method to screen these materials. With the data that we're seeing now, and the information that we're capturing about what's going on below ground, I think being able to hold these things in a biologically relevant stress zone is going to be possible."

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