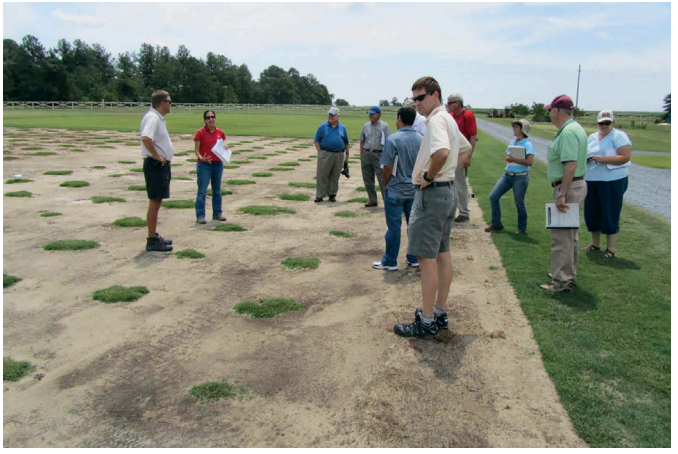
UNIVERSITY SCIENTISTS GROW WATER SAVINGS WITH DROUGHT-TOLERANT TURFGRASS

By Jennifer Howard

Editor's note: When this article was written, on April 27, 2020, Covid-19 restrictions had dramatically impacted research activities. See the Sidebar for an update on how 2020 played out and what is predicted for research activities in 2021.

Which half of landscape water use is wasted? Experts estimate that more than 50 percent of our outdoor irrigation goes to waste—even more in dry years and dry climates. Our landscape watering habits are the primary culprit in this overflow. It's a big issue. The typical suburban homeowner irrigates an estimated 10,000 gallons of water each year, primarily aimed at their lawn. Conserving our freshwater supply is essential for long term sustainability.



Milla-Lewis's team reviews test plots in 2019.

Saving Water & Natural Grass' Benefits

Turfgrasses occupy over 30 million acres in the U.S. It's tempting to assume that eliminating our outdoor grass carpeting could solve the water demand problem. But it's not so simple. Natural grass provides substantial environmental and economic benefits in our landscape. It mitigates heat around our homes, stabilizes soil against erosion, provides safe play space, and reduces noise, glare, and pollution. Eliminating natural grass would create a whole new set of environmental challenges.

A network of turfgrass researchers from six major universities, including NC State, is solving this dilemma by developing turfgrasses that are attractive and healthy with minimal water.

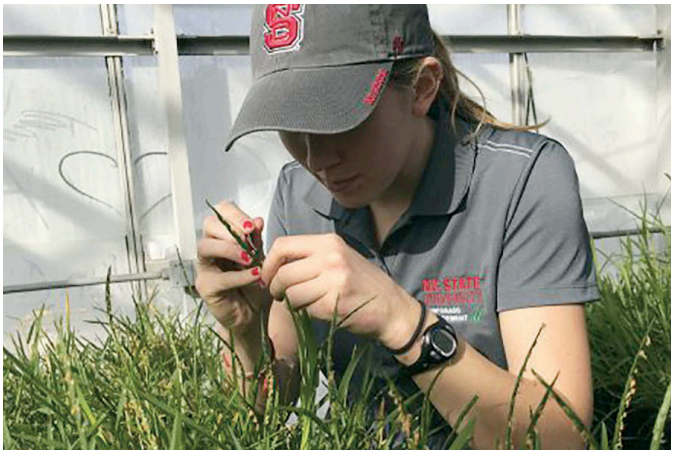
NC State Leads New Research

The National Institute of Food and Agriculture approved a specialty crops grant to continue the multi-university group's work producing drought-tolerant warm-season turfgrasses. The team (representing five universities—North Carolina State University, Texas A&M University, University of Florida, University of Georgia, and Oklahoma State University) has collaborated for ten years with a rotating leadership structure. For the five-year grant that began in 2020, the team decided to expand the evaluations out west and invited the University of California Riverside, lead by Dr. Jim Baird, to join in the collaboration. Thus, the team is now 32 scientists strong. NC State's Dr. Susana Milla-Lewis, associate professor of Turfgrass Breeding and Genetics, is at the helm in their new phase of study. "Our 2010 and 2015 projects were crucial in the development of drought-tolerant turfgrass cultivars. The levels of improvement of these grasses are promising and validate the need to promote adoption, continue cultivar research, and develop tools that facilitate the breeding process," Milla-Lewis said.

Early Season Success

The team of turfgrass researchers' work has focused on selecting and testing drought-tolerant cultivars of four of the most economically important warm-season turfgrass species in the southern U.S. By exchanging plant materials and data among university breeders, turf varieties are tested under many climatic conditions, and the results accumulate quickly.

"The collaboration among breeders across such different environments is priceless," Milla-Lewis said. "It helps us select better lines with more performance stability because they have been tested against a wide range of weather conditions like drought and cold as well as an array of pests and diseases."



MS Student Greta Rockstad makes turfgrass crosses in the greenhouse.

The team has already released six new drought-tolerant varieties from previous project phases including two bermudagrasses ('TifTuf' and 'Tahoma 31'), two St. Augustine grasses ('TamStar' and 'CitraBlue'), and two forthcoming zoysiagrass varieties.

With tangible success already, what will the next research phase include? More trials with new avenues to share and test them. Plant breeding is a long-range game, 10-15 years in most cases. The group has already evaluated over 2,500 potential varieties in their nine years together. Now Milla-Lewis and team are intent on warping this speed with new technology.

Tackling Turfgrass Technology

The group's next phase of research will integrate tech specialists using drones and remote sensing devices to provide real-time feedback on plant stress—a plant breeder's dream. But how does a robot sense plant stress?

Drones equipped with specialized sensors will be programmed to fly missions over the test plots to detect changes in turf color, ideally even before visible to the human eye. By measuring color change over time resulting from turf stress, researchers can rank the highest performers and concentrate on those showing the greatest genetic potential.

Technology also brings objectivity to plant breeding. Instead of researchers assigning a visual grade of 1-9 on turfgrass color, the drone sensors capture a binary "stress/no stress" assessment. It's black or white—or brown or green in this case. Removing human bias will result in standardized scoring—important when measurements are taken across hundreds of plots at each of the collaborating universities. Because who's to say someone's turf score of a 6 in Raleigh is the same 6 as someone's in Texas?

Using autonomous data collection, breeders can measure more traits, evaluate more trials—and even more varieties at a time. Increasing the volume of data generated in a short timeframe speeds the plant breeding process by weeding out low performing options. Researchers call it 'high throughput phenotyping" and it promises to deliver fast feedback for a streamlined selection funnel. Greater testing volume into the research pipeline means better outcomes with the most resilient samples.

Consumer Education

Despite the team's field research success, Milla-Lewis's group recognized that improved varieties can't deliver their inherent benefits if end users don't adapt their lawn care. So the project's phase III incorporates a significant extension and consumer outreach plan spearheaded by Jason Peake at the University of Georgia.

The nationwide campaign will include broadcast media, a consumer decision tool website, and printed marketing pieces all aimed at educating consumers on why they should choose a drought-tolerant grass and, importantly, how to properly manage it to reap all the benefits. After all, a new lawn doesn't come with a care tag.

Industry Involvement

This new wave of consumer outreach will complement traditional extension activities such as field days and demonstration turf plots at public locations like municipal buildings (including NC State's forthcoming N.C. Plant Science Initiative building). To see details on that project, check out this website. *https://cals.ncsu.edu/psi/psb/*

The projected design of NC State's North Carolina Plant Science Initiative

These opportunities will reach industry professionals like landscapers, contractors, and sod producers who are often the decision-makers in turfgrass variety selection. NC State turfgrass extension specialist Dr. Grady Miller says it's not enough just to put new varieties out. "Like the old saying goes 'Those near the cutting edge may get cut.' Our efforts can convince the industry to adopt and produce, but the consumer needs to be able to properly manage the turfgrasses if we want these new varieties to be successful."

"We've learned in our investigations that the average consumer is concerned about their grass's environmental tolerance—to shade, drought, and winter-kill They are looking for low-maintenance landscapes," Milla-Lewis noted.

Convincing homeowners to adopt these drought-tolerant grasses would deliver on both accounts. "We have a young consumer audience with very different landscape needs. For some, lawn maintenance is at best a hobby, and at worst a nuisance. They are looking for lawns requiring fewer inputs, even if it is more expensive," concluded Miller.

New Conditions

Plant breeding didn't end in the project's phase II. It's the heart of the project, but there's always room to improve selections and methodology. "Some team members are working to understand what makes a grass more drought-tolerant. Others use that information to identify which genes might be responsible for the improved performance. All this information can be used to quickly identify plant materials worth field testing, saving breeders time and resources," Milla-Lewis said.

This closeup view shows one of the turfgrass samples in the research program.

The group is looking not only to refine the varieties but to quantify best management practice guidelines for the new turfgrass varieties. This will involve testing under multiple conditions: restricted rainfall, reclaimed water irrigation, salty-spray exposure, shade, sod strength for cutting, and other production aspects. Surviving these endurance tests will produce turfgrass uniquely adapted for low maintenance production and management.

Testing the Technology

Part of the team's challenge isn't just testing turfgrasses, but technology itself. Most UAV technology wasn't developed for crop production. Part of the group's forthcoming research will be devoted to figuring out the best ways to use technology in plant breeding and developing protocols to standardize use. Rob Austin is a GIS specialist at NC State, "We're trying to figure out what works best for this application. Some experiments on drone use in plant breeding have been done, but large-scale research is scarce."

The group plans to collaborate on shared protocols that standardize drone data collection activities and data analysis techniques. Austin will oversee the Raleigh group's data strategy. He sees opportunity in automating the workflow. "We don't want to simply trade time in the field for time behind a computer screen," Austin said, "We need standards and processes to translate the data into meaningful results."

The Power of Teams

"The success of this project to date is because of teamwork. It just goes to show how much you can get done with a collaborative team—with no room for hierarchy," Grady Miller noted. The multi-university team is guided by an industry advisory board providing feedback and input to direct the research for environmental and economic benefit.

Milla-Lewis's leadership stint will extend the project for an additional four years. "The strength of this group resides not only in the wide range of expertise of the research and extension scientists involved in the project and how well we work together, but also in how closely we interact with our industry partners. They are our compass, making sure our deliverables fulfill real industry needs," Milla-Lewis concluded.

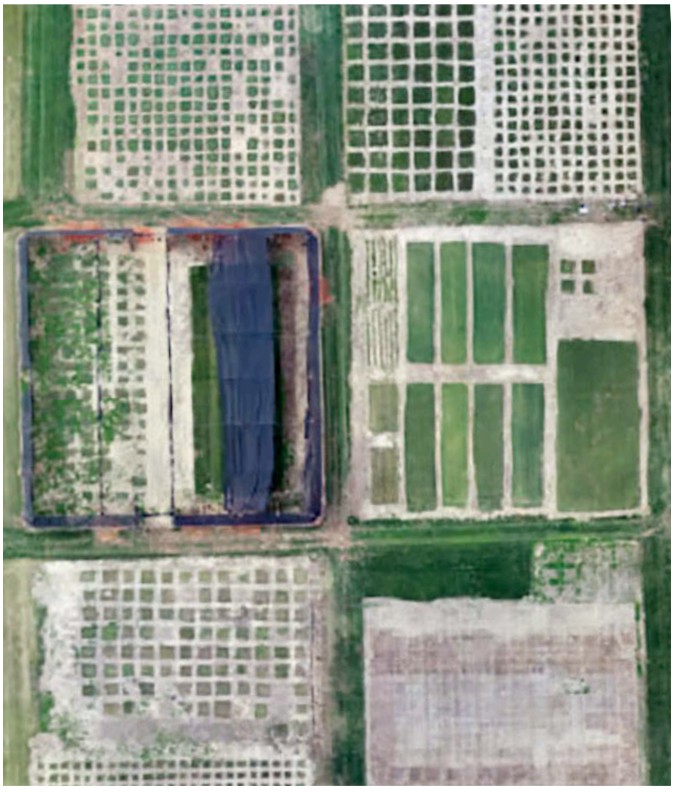
And Now

By Susana Milla-Lewis

Covid-19 made the first year of our project a bit more interesting than expected! Safety measures and social distancing changed protocols and by mid-March most programs were in a lockdown. For breeders, propagation of materials and planting were delayed. For genomics teams, their labs were closed, and they were unable to generate new data. For the extension and outreach teams, cancellation of field days limited traditional summer educational activities. By fall, research operations were resumed with restrictions in place. Some states/universities were more restrictive than others based on trending Covid-19 case numbers.

Despite these setbacks, we were able to attain the main project goals for year one. This can be attributed to good communication among team members, creativity to come up with contingency plans, and ultimately the team's commitment to this project which we all believe will have a significant impact on the turfgrass industry.

As vaccination progresses in the next few months, we expect restrictions to be slowly lifted. This should allow us to have a more normal field season this year and hopefully to regain capacity for holding face-to-face extension meetings in the not-too-distant future.



NC State turfgrass research plots as captured by a UAV (unmanned aerial vehicle, commonly known as a drone).

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All photos courtesy of North Carolina State University.