Jourdan Bell

Texas Panhandle agronomist

Agronomists are plant and soil scientists, but beyond crop production and profitability, the goals of an agronomist are conserving natural resources and protecting the environment.

In the Texas Panhandle, Dr. Jourdan Bell works with producers to improve soil-plant-water relationships while conserving natural resources.

"Water and soil are our most important natural resources," said Bell, regional research and extension agronomist for Texas A&M AgriLife Research and Extension Center in Amarillo. "As an agronomist, it is important to assist producers with crop production practices that conserve soil and water resources."

For farmers dependent on the availability of groundwater from the Ogallala Aquifer in the Texas High Plains, the challenge is having enough water.

"The Texas High Plains is an agricultural-based economy, so optimization of agricultural production is important at many levels," Bell said, "but the future of High Plains crop production is dependent on how well we conserve soil and water resources today."

Lifelong resident of the Texas Panhandle

Bell's family was in the cattle feeding industry, farming and ranching in the Amarillo area. "I grew up understanding the importance of agriculture, specifically understanding how important water is for agricultural production," she said.

This long-term exposure to agriculture led Bell to pursue a bachelor's degree in general agriculture in 1997 and a master's degree in plant, soil and environmental science in 2000 from West Texas A&M University.

While getting her bachelor's degree, she worked as a student employee in Amarillo with Texas A&M AgriLife Research under Dr. Brent Bean. After graduating, she began working as a research technician at the U.S. Department of Agriculture's (USDA) Agricultural Research Service (ARS) Conservation Production Research Laboratory (CPRL) near Bushland.

There, she said, she gained valuable research experience in manure and nutrient management, irrigated and dryland cropping systems, tillage and forage systems, all with an emphasis in soil science and crop water use.

In 2007, she had the opportunity to go back to school to work on a doctorate in soil science at Texas A&M University.

She lived in College Station for a year to complete course work and fulfill the residency requirement before returning to Bushland to begin her dissertation research funded by the USDA Ogallala Aquifer Program.

"However, as I was completing my dissertation research focusing on irrigation strategies in grain sorghum, the Texas High Plains was gripped by the extreme drought of 2011-12. 2011 was the driest year on record across Texas," she said. "I learned so much about crop physiological responses to stress, soil water and irrigation scheduling during those two years."

In 2014, Bell earned her doctorate in soil science from Texas A&M and accepted her current position as an agronomy specialist at the Amarillo center.

The power of the environment

During Bell's time at Texas A&M, Dr. Kevin McInnes in the Department of Soil and Crop Sciences was her advisor. McInnes along with her co-advisor Dr. Robert Schwartz with CPRL were instrumental in her foundation in soil physics and environmental biophysics.

"Crop production is driven by the soil, water and environment," she said. "However, on the Texas High Plains, the environment often overrides agronomic practices." ⇨

The Panhandle has a variety of severe weather conditions throughout the year from extreme blizzards, drought and dust storms to tornados and crop-damaging hail.

"It is so important as an agronomist and soil scientist to learn how we can manage our practices, minimizing the effect of environmental stresses as well as minimizing our impacts on the environment," Bell said. "I've always had an appreciation for the region; it goes back to being raised on the Texas High Plains, always understanding and appreciating the power of the environment and that the value of water is key."

Soil: a farmer's water bucket

One of the key aspects of Bell's research and extension programs is evaluating production practices to increase soil-water storage and minimize evaporative losses.

"The soil is our bucket; however, bucket sizes vary across the Texas High Plains," Bell said. "As we move south of Amarillo, soils are sandy, and the soil's water-holding capacity is limited. Sandy soils can't store as much water as the clay loam soils of the northern Texas Panhandle.

"As an agronomist, it is important to consider soil texture when making agronomic recommendations, especially related to crop water demands," Bell said. "While irrigation is necessary to stabilize production across the entire High Plains region, there are often specific irrigation considerations that should be made depending on crop and soil texture to optimize water productivity.

"And because the water in the Ogallala is declining across the region, there is not room for error when making irrigation decisions."

Motivated by water sustainability

Her research interests have always been motivated by the challenges that producers in the Texas Panhandle face, particularly their dependence on the Ogallala Aquifer.

"One of my goals working with producers is to help them manage their resources to ensure not just profitability but also the sustainability of these resources," she said.

Bell said crop production on the Texas High Plains is dependent on conserving water for the future, for as many years as possible.

Dr. Jourdan Bell, AgriLife Extension agronomist, enters data from a study testing the effectiveness of an herbicide on grain sorghum. Photo by Kay Ledbetter, Texas A&M AgriLife Communications.

In parts of the Ogallala Aquifer, the water table has declined to levels where the irrigation capacity is no longer sufficient to meet even a fraction of the crop water demands. Additionally, Bell said precipitation across this region is extremely variable. As water depletes from the aquifer, it becomes more expensive to pump.

"Because the Ogallala underlies eight states, we are looking at very different management strategies of this resource across the Ogallala Aquifer region from Nebraska to the Texas High Plains," she said. "Ultimately, some producers will transition back to dryland farming, and it is anticipated that where well capacities are depleted, we may see some cultivated land return to grasslands for grazing."

But, Bell said, there are still pockets of strong water on the Texas High Plains, and in those regions, producers will continue to irrigate. "Consequently, it is important that we continue to improve agronomic management, improving crop water-use efficiencies and extending the life of the aquifer," she said.

"When we talk about helping producers be profitable, it is important not just for the producers but for our small towns and rural economies," she said. "When we have a greater number of successful producers, there is a trickle-down effect."

Producers hire people in their local communities, which benefits the small, rural towns.

"Being from the Texas Panhandle, I personally find it very important to ensure the success of our farmers as well as our small towns. Everybody in the Texas High Plains is indirectly related to agriculture."

Thomas Marek

An engineer's engineer

Thomas Marek, senior research engineer with Texas A&M AgriLife Research and Extension Center in Amarillo, has spent his entire career doing what engineers do: designing, testing and then redesigning.

Known as 'an engineer's engineer,' his in-depth skills in irrigation enable him to design, build, maintain and use structures, machinery and electrical systems, conducting field operations on a commercial-scale research farm, all while leading his own highly successful agricultural irrigation research program.

"I do not just design it; I am one of the engineers that designs it, builds it, tests it and then writes about it," he said.

It all started at Texas A&M

A Bryan, Texas native, Marek chose his college major while looking through a Texas A&M University course catalog.

"During my junior year in high school, I sat in the front seat of a pickup truck and went through the syllabus curriculum and when I saw ag engineering, I knew what I wanted to be," he said. "So I enrolled at Texas A&M when I graduated from Bryan High School, and two years later I was in a work study program."

During the work study, Marek's first jobs were designing carrot and onion harvesting machines.

"I was always very good at building things, so the fact that I could build things and then go test it in the field and break it and figure out why it broke and then rebuild it and make it better, that's always kind of intrigued me," he said.

Marek received his bachelor's degree in 1975 and master's in 1977, both in agricultural engineering.

"I got interested in soil, water and irrigation when I was at Texas A&M working with Dr. Donald Reddell, professor of agricultural engineering, and Dr. Terry Howell, an assistant professor at the time. We were doing surface irrigation research in the Brazos River bottom when I heard they needed an irrigation engineer in Amarillo, and I was fortunate enough to get the job."

Howell went to work for the U.S. Department of Agriculture's Agricultural Research Service (ARS) in California but came back to the ARS Conservation and Production Research Laboratory near Bushland, Texas in 1983, Marek said.

It was then that Marek and Howell partnered to build large weighing lysimeters, which precisely measure the amount of water it takes to grow a crop. These world-class lysimeters became the basis of advanced state-of-the-art irrigation research for Texas and beyond.

Marek said the weighing lysimeters are essentially very, very large "flowerpots," being 10 square feet and 8 feet deep, and each weighing about 100,000 pounds.

"They sit on a very sensitive weighing scale and can measure or weigh the water it takes to grow a crop on top of it. The scales are sensitive enough that we can see the wind blow in the output data," he said. "What's measured in that large, monolithic block is representative of the rest of the field around it, giving the most accurate regional crop water-use values known to date." ⇨

A pioneer of irrigation technology

A registered Texas professional engineer, Marek was named a Texas A&M University Regents Fellow in 2015 and he is the 2018 recipient of the American Society of Agricultural and Biological Engineers John Deere Gold Medal award. These awards are evidence of his successful 45-year career.

Of Marek's many achievements, he said his most significant may be his part in converting high-pressure impact sprinkler systems to lower pressure, saving irrigated producers millions in energy costs.

"Back in the day, the overall thought was that the Ogallala Aquifer was unconfined and would never run out, and nothing was further from the truth," Marek said. "It is a confined aquifer, and we have been depleting it for effectively 50 years."

Marek said the initial center pivot irrigation systems would pump about 1,200 gallons per minute on a quarter-mile system and used impact spray nozzles on top of the system operating at 100 pounds per square inch (psi) or more. "The energy cost of that was substantial, but today we use much less," he said.

"We needed to find a system that was lower energy. The manufacturing of the hardware had to change along with cultural practices," he said. "We changed those high impact nozzles that required 100 psi and put them closer to the ground on hoses to operate at 10 psi, not spraying water as far into the air."

He said in the late 1970s, the breakdown of irrigation was about 15 percent center pivot irrigation and 85 percent irrigation or surface flow. "Today, those percentages are reversed.

"I have been in irrigation a very long time and watched it develop, particularly for the Texas North Plains region. The changes that we've seen with center pivot systems represents a massive step forward in efficiency and technology."

Making a Texas-sized difference

Marek considers co-developing the Texas High Plains Evapotranspiration Network (ET) to be another one of his significant achievements. "For 20 years, we developed an ET network with multiple stations across the Texas High Plains," Marek said. "That put data in the hands of producers and every morning they knew how much water their crops were using."

Dr. Dana Porter, AgriLife Extension agricultural engineer in Lubbock, was extensively involved in the design, operation and management of that network, he said.

"What we try to do is optimize how much you can stress a crop through daily irrigation management from both a production and profit standpoint.

Thomas Marek, Texas A&M AgriLife Research agricultural engineer in Amarillo, points to an advanced datalogger that monitors soil sensors in a research field at Bushland, Texas. Photo by Kay Ledbetter, Texas A&M AgriLife Communications.

We take a lot of high tech and make it simpler for the producer and the crop consultant to use," Marek said.

Implementing conservation management strategies can be as simple as crop conversion or implementing advanced technology to use less water, keeping producers profitable, he said.

"This is what I've been involved in for over 45 years, and from a research standpoint, this is where we have been; so where are we going?"

Keep moving forward

Marek said two things motivate his work — making a real difference and leaving things better than he found them. "This includes improving the tools and technologies that are used to assess performance with our systems," he said. "Today, we are integrating advanced machine-learning algorithms into our control systems and that's pretty high-tech stuff for agriculture."

Unmanned aerial vehicles (UAVs) have a promising potential in moving irrigation management forward. Marek said UAVs are used in the fields to assess crop performance and show things that cannot be seen with the human eye.

"We've saved a lot of energy and water and made a lot of money for producers in the state of Texas and elsewhere. We have done that through both the development and implementation of advanced technologies and put that information in the hands of the producers. That's pretty significant."

At the Amarillo center, Marek continues to serve as research project leader and principal investigator on irrigation water management, crop water-use efficiency and evapotranspiration projects.

"I have had the luxury, the pleasure and the privilege to not only watch all of this but to be a direct participant and that's been satisfying," Marek said.