



LEGACY

CLEAN AIR AND WATER
Decreased use of chemical inputs cuts costs and reduces pollution.

COVER THE SOIL
Use plants to minimize bare ground and protect soil from erosion and heat.

INTEGRATE LIVESTOCK
Grazing helps plants stay productive, and cattle return nutrients to the soil.

ROOTS IN THE GROUND
Live roots promote positive relationships between plants and microbes.

A BLUEPRINT FOR PROGRESS

FARMERS AND RANCHERS ARE GAINING NEW TOOLS FOR MEASURING THE INTERCONNECTED PIECES UPON WHICH REGENERATIVE AGRICULTURE IS BUILT.

SAM NOBLE
SCHOLARSHIPS CAN
RECEIVE
UP TO
\$20K

The Sam Noble Scholarship supports students from southern Oklahoma as they strive toward achieving their college education goals.

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Total scholarship:
\$20,000

Graduate
Total scholarship:
\$12,500

Technology
Total scholarship:
\$7,500

noblefoundation.org/scholarships

APPLY BY:
March 1

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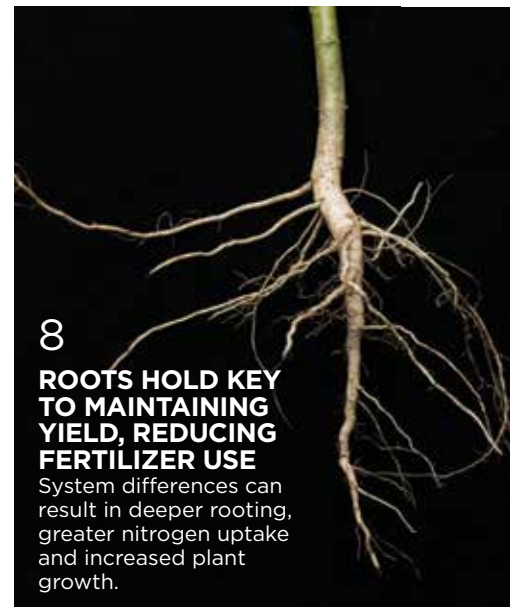
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ON THE COVER: There are many interconnected components to consider on the journey to regenerate the land. Building soil involves plants, microbes and animals, and the benefits extend far beyond the ground to the air, water and all living things. Producers are finding success when they look at these individual pieces as part of a greater whole, but the process is difficult to measure. Turn to page 22 to learn about Noble's Land Stewardship Program and its quest to help producers track their progress.



LEGACY

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TO OUR READERS: DIRECTION OVER PERFECTION



M My wife, Debbie, and I have lived on the same plot of land for almost 20 years. Just north of town, our place sits on about 10 acres where we raised our family. Debbie's mother owned the land before us for more than a decade. Our married life began with our wedding reception in what is now our backyard, and we continue to write our family history on this small plot of land.

The story of land rings true for so many families, specifically those in agriculture. A particular piece of land is often central to a family's narrative. It can play a role in recreation, livelihood or even guiding purpose. It is a place to call their own, but really only for a moment.

The story of the land begins before we arrive and will continue long after we return to it. We don't own it. We are merely caretakers for a season. Even as land is passed generation to generation, it eventually finds its way into other hands. One story ends. Another begins.

Our time with the land, then, becomes less about ownership and more about stewardship. We must write our chapter of the story while (hopefully) contemplating how it impacts the rest of book.

Noble Research Institute was founded on the principles of applying land stewardship and soil conservation so that land remains productive far into the future. Today must be carefully managed for tomorrow's benefit.

Noble continues to extol these virtues and embed them in every organizational activity, including research, consultation and education. Our goal is to provide knowledge to and guide farmers and ranchers to bring millions of acres of grazing lands under intentional land stewardship in the next 10 years. We focus our energy on the largest land type in the United States: pasture and rangeland. At almost 655 million acres, our nation's grazing lands impact available water quality and quality, can serve to seques-

ter atmospheric carbon, and provide other benefits to society and humanity.

We will undoubtedly learn many lessons in the coming years, but we begin with this core understanding: soil health is the bedrock from which we will build. Farmers, ranchers, researchers and scientists have developed five principles of soil health that mark the starting line for every producer's journey. They include:

1. Cover the soil: Soil health cannot be built if the soil is uncovered or is moving. Using dedicated plants for grazing, cover crops and crop residue minimizes bare ground and builds soil organic matter. Plant cover further protects the soil from erosion and serves as a barrier between the sun and raw soil, preventing escalated soil temperatures that can destroy soil microbial life.

2. Minimize soil disturbance: Mechanical soil disturbance, such as tillage, alters the structure of the soil and limits biological activity. Grazing, fire, and applications of fertilizer and other chemicals are also disturbances. "Minimize" does not mean eliminate; however, optimization of need, timing, frequency and duration of these activities is necessary to build and not degrade soil quality.

3. Increase plant diversity: Increasing plant diversity creates an enabling environment and catalyst for a diverse underground community. In nature, we find grasses, legumes and forbs all working together in a native, diverse rangeland setting. The complex interactions of roots and other living organisms within the soil defines the soil's water holding capacity, affects carbon sequestration and enables nutrient availability for plant productivity.

4. Keep living roots in the ground all year: A living root in the ground year-round is required to keep the soil biology processes working, no matter the season. Soil microbes use active carbon first, which comes from living roots. These roots provide food for beneficial microbes and spark beneficial relationships between these microbes and the plant.

5. Integrate livestock properly: Research, practical application and common sense tell us the same thing: livestock are a necessity for healthy soils and ecosystems. The Great Plains evolved under the presence of animals and grazing pressure. Soil and plant health is improved by proper grazing, which recycles nutrients, reduces plant selectivity and increases plant diversity. As with any management practice, grazing is a tool that requires intentional application.

Our ultimate target is not just sustainable land but rejuvenated land. Regenerative agriculture is more than a possibility. We can leave the land healthier and more productive than we found it.

Within this edition of *Legacy*, you will read about Noble's Land Stewardship Program and how we are applying concepts of intentional management, soil health, and research from the laboratory to the field. Our goal: assist producers to become regenerators. We are working with ranchers to implement practices, and they are seeing tangible results.

Regenerating the land is achievable, but it is not a recipe. It starts with a belief that soil, water, plant, animal and human are all connected, meaning every decision must work with this natural rhythm and not in spite of it. This is a complex process that requires dedication and a long-view. It has taken society generations to put our lands in their current state, and the road to renewal will require multi-generational resolve. Gains, in many instances, will seem incremental, but through time we can make a difference. As we say around here, direction over perfection.

We are responsible for the land for just a moment, so we must make every day count.

Sincerely,

STEVE RHINES, PRESIDENT AND CEO

WHY ARE CATTLE ESSENTIAL TO THE LAND?

Beef is not just for dinner. It's for the benefit of the earth.

by Arielle Farve

In the days before sprawling metropolises and social media, large herds of bison roamed the prairie. The Great Plains was shaped under their munching muzzles, which they used to graze down one area before moving to the next. The bison followed lightning-sparked fires, which cleared away old forage and gave way to new.

Native prairie ecosystems evolved under the balance of fire and grazing, and removing this essential duo is like removing the tide from the oceans. The land is forced to adapt, but tantrums eventually emerge with more severe wildfires and other symptoms of a weakened ecosystem.

In the absence of bison, cattle have become the modern instrument of grazing. Cattle play essential roles in improving the land and feeding a growing population. 🌱

Cattle graze land that is not suited for crops.

Different soils are good for different purposes. Cattle use lands that have typically marginal soils, which are not good for growing human food crops. Instead, these lands are ideal for growing grasses. Humans do not consume grass, but a cow's ruminant digestive system can convert grasses into a protein that fuels humans: beef.

Cattle return nutrients to the soil.

Plants take nutrients (like nitrogen, phosphorus and potassium) out of the soil as they grow. Once the plant is harvested, those nutrients are removed from the field. However, cattle harvest and use the plants right on the land. Cattle return about 85% of the nutrients they consume back to the pasture. This jumpstarts the nutrient cycling process, which, in turn, benefits the plants and the whole ecosystem.

Plants need to be grazed.

Grazing helps plants stay productive. When grazing is removed from a prairie ecosystem, plants become stagnant. They don't regrow as fast as they would if cattle were consuming them under a well-managed plan that considers timing, frequency and duration of grazing.

Grazing helps sequester carbon.

Typically, more productive plants grow deeper roots. The deeper the root, the more carbon and organic matter they produce. In this way, cattle can be used as a tool to sequester carbon and create a healthy environment for soil microbes.



SENSING THE SOIL

The land is becoming less of a mystery with the help of technology.

by Courtney Leeper

Sensors are like the observant helpers of the technology world. They detect and measure changes in the surrounding environment then provide that information to another device for interpretation. Once interpreted, this feedback offers insight that is useful for decision-making or for increasing understanding.

Sensors are showing up more and more in everyday life, even if they aren't visible. They enable cars to correct braking pressure so that they don't skid. They turn on lights when people walk into darkened rooms. In agriculture, they have limitless potential to assist farmers and ranchers in making land management decisions.

Here are three ways sensors are being used to understand soils on Noble's research and demonstration ranches.

1 Measuring Soil Organic Carbon



Noble seeks new approaches to accurately and economically measure soil organic carbon in the field. Noble is connecting geospatial data with organic carbon measurements to model field-scale soil carbon content. Noble researchers are currently testing prototype hand-held devices from Yale University that producers could use to measure carbon levels in their soils across a ranch. This is important because soils, and their productivity, vary from area to area because of differing levels of carbon across a property.

2 Determining Soil Loss

Drones equipped with light detection sensors and cameras can take images of a particular piece of land and measure the dimensions of eroded areas. Then researchers can calculate how much soil would be needed to fill up the eroded area. In one 5-acre no-till summer fallow field, researchers estimated a loss of 8 tons of soil. That is equivalent to losing more than the weight of an elephant.



3 Detecting Soil Moisture and Temperature

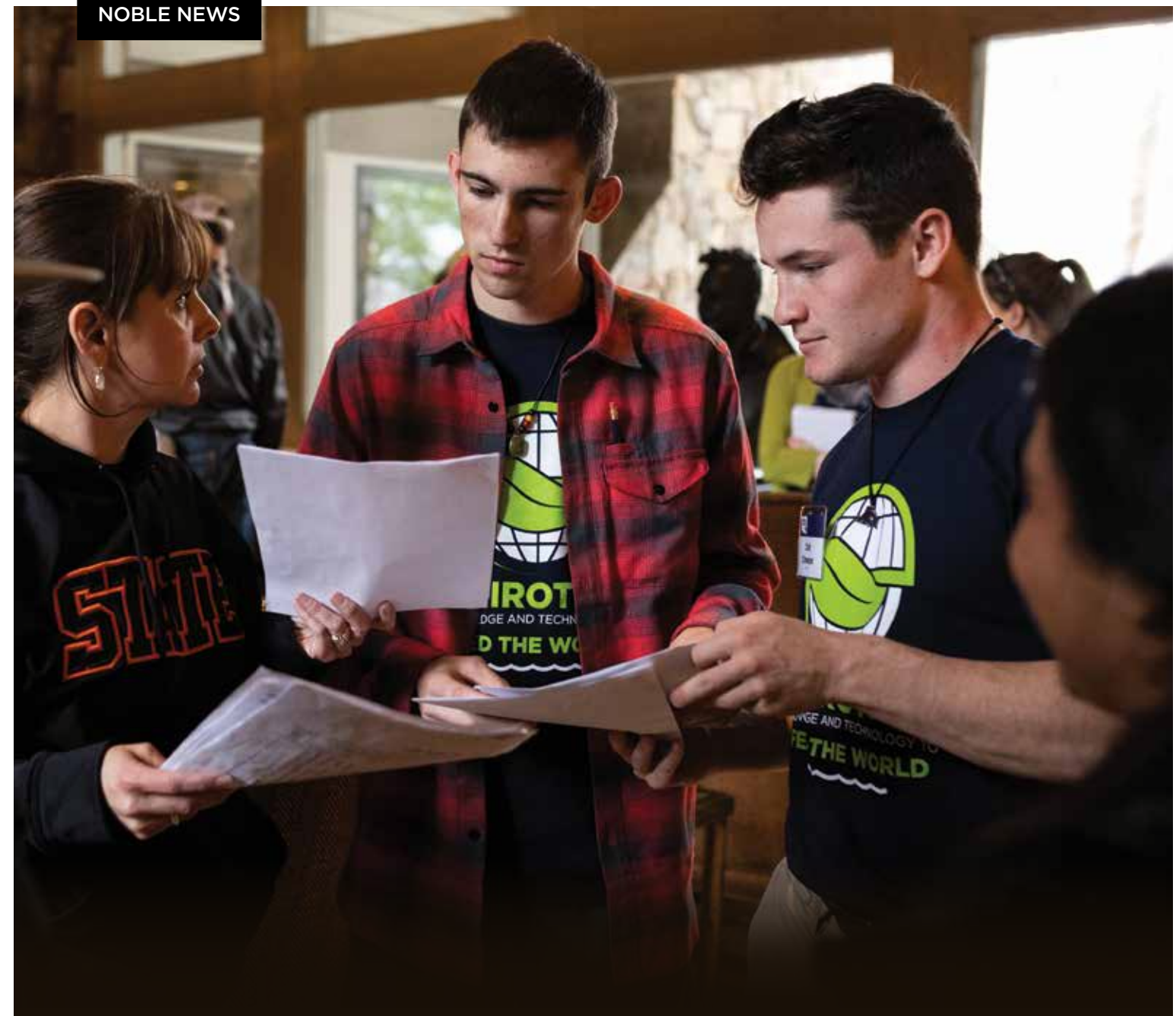


Researchers are using soil moisture sensors to better understand how summer cover crops in winter pasture forage systems use water as well as the effects of till and no-till within these systems. Measuring soil temperature is important because the warmer the soil gets, the more water moves out of it. Plus, soil microbial growth decreases when temperatures exceed 85 degrees Fahrenheit. In one study, no-till pastures without cover crops were found to surpass 110 degrees during the peak of summer. 🌱



ABOUT THE NOBLE EXPERTS

James Rogers, Ph.D., associate professor of forage systems, and Jeff Goodwin, conservation stewardship leader and pasture and range consultant, use sensors in their on-ranch research and land stewardship activities. Discover more of their research findings by reading their full *Noble News and Views* article at www.noble.org/soil-sensors.



MADILL TAKES FIRST PLACE IN 2019 OKLAHOMA ENVIROTHON COMPETITION

The Madill High School team placed first at the fifth annual Oklahoma Envirothon competition held at Noble Research Institute.

The winning team members were: Rio Bonham, Colt Crowson, Joel Halvorsen, Alejandra Salas and Jeremiah Sanchez. The team adviser was Kelly Goff.

"This team was dedicated, and they did an awesome job. They are each good at their own aspect of the competition, which makes them a great team," Goff says. "They are all driven and wanted to win the competition."

During the competition, students rotated among four stations that focused on an aquatic ecology, forestry, soil and land use, and wildlife. Each station included a written test based on the discussions. Each team also gave a presentation on agriculture and

the environment: knowledge and technology to feed the world, this year's special topic.

"The judges were especially impressed with the Madill team's oral presentation, where they offered recommendations for using land that balances agricultural production with ecosystem health," says Jenn Scott, Noble Research Institute youth education associate.

Noble sponsored the Madill team as the members represented Oklahoma at the North American competition in Raleigh, North Carolina. 🌱

Joel Halvorsen (center) and Colt Crowson (right), members of the winning 2019 Oklahoma Envirothon team, from Madill High School, review competition material with their adviser, Kelly Goff (left).

Roots Hold Key to Maintaining Yield, Reducing Fertilizer Use

Roots are central to the ability of crops to acquire and use nutrients from the soil. System differences can result in deeper rooting, greater nitrogen uptake and increased plant growth. Haichao Guo, Ph.D., postdoctoral fellow, and Larry York, Ph.D., assistant professor, conducted research in Noble Research Institute's root phenomics laboratory to investigate earlier observations that reducing the number of nodal roots in corn could have beneficial effects on plant growth in less fertile soil. Understanding how root systems operate is imperative to maintaining yields while decreasing fertilizer use, which could also save producers money. Fertilizers are typically used on agricultural fields in order to boost soil fertility and crop production. However, too much fertilizer can cause pollution by running off or leaching into waterways or by releasing greenhouse gases. 🌱



Learn more about the research and read the full report at www.noble.org/fewer-roots-deeper-rooting.



Collins Wins First Place in 2019 Junior Beef Contest

Noble Research Institute's Junior Beef Excellence Program recognizes the carcass merit of steers exhibited at the junior livestock shows by 4-H and FFA members in 14 south-central Oklahoma counties. Thirty-eight students entered the 2018-2019 contest. Kage Collins took home first place. The top 10 entries were awarded a total of \$9,650 as part of the annual contest. "The Junior Beef Excellence Program strives to reward and encourage production of superior beef cattle, while providing our future ranchers a glimpse into the commercial aspects of the industry," says Caitlin Hebbert, program coordinator and livestock consultant. "The students put a lot of hard work and good management into their steer projects, and it paid off." Eligible counties are Atoka, Bryan, Carter, Coal, Garvin, Grady, Jefferson, Johnston, Love, Marshall, McClain, Murray, Pontotoc and Stephens. 🌱

Cattlemen's Leadership Academy Selects Braunagel, Hebbert

Noble Research Institute research assistant Brooks Braunagel and livestock consultant Caitlin Hebbert were selected to the Oklahoma Cattlemen's Leadership Academy class 27. Braunagel joined Noble Research Institute in 2015. He assists with all ranching operations and helps collect data using electronic identification tags and cattle movement. "Brooks is eager to learn all he can about other cattle operations around the state," says Ronald Trett, farm facility manager. "This program will provide those experiences to him." Hebbert joined Noble Research Institute in 2018 as a livestock consultant. Her areas of interest include precondition management, grazing cattle nutrition and replacement heifer development. "Caitlin has been a complement to our program. She brings fresh insight to an area we needed most with her extensive ranching background," says Hugh Aljoe, director of producer relations. "This program will give Caitlin an in-depth opportunity to meet other agricultural leaders in the state, which will build her professional network." CLA is targeted for beef producers ages 25 to 40. The program is designed to develop young members through industry exposure, education and association communication. CLA consists of a series of four seminars that provide participants the opportunity to explore the state's cattle industry, gain essential information and network with fellow Oklahoma Cattlemen's Association members. 🌱



Caitlin Hebbert (left) and Brooks Braunagel



Carolyn Young, Ph.D.

Noble Promotes Young to Professor

Carolyn Young, Ph.D., has been promoted to professor. She has served as principal investigator in Noble Research Institute's mycology laboratory since 2006. "All of us who have worked with Carolyn know she is a skilled researcher, amazing mentor and an outstanding educator with an excellent publication record," says Michael Udvardi, Ph.D., chief scientific officer. "She is passionate about her work, all things fungi and Noble." Since starting at Noble, Young has worked on a fungal endophyte that imparts drought tolerance to tall fescue without causing fescue toxicosis, a condition that reduces animal health and productivity. Her work has contributed to the development of improved tall fescue varieties currently used throughout the South. Young has led a project on the dynamics of cotton root rot disease in alfalfa, which greatly improved the understanding of disease development and possible management strategies through fungicide application. Most recently, Young's extensive work in pecan scab is bringing researchers one step closer to understanding the pathogen's life cycle and gaining better control of the disease in pecan orchards. 🌱

Noble Selects Donica to Lead Human Resources

Gayle Donica has been promoted to director of human resources at Noble. Donica has served as the human resources manager for the past 14 years, providing leadership and oversight for the administration of human resources functions. As director, Donica will be responsible for overseeing all of Noble's human resources activities for the Institute.

Donica earned a bachelor's of science in personnel management at Oklahoma State University (OSU). After graduating from OSU, she worked at Noble Energy for 16 years. Donica has earned her professional in human resources certification and is trained in facilitation, DiSC and other human-resource-related activities.

Donica is a member of the Arbuckle Area Society of Human Resources Management. She previously served on the C/SARA (Crisis Support and Resource Association) Foundation Board of Directors for 10 years and was a founding member of the Dickson Foundation for Excellence in Education. Donica was a Carter County 4-H leader for 20 years. 🌱



Gayle Donica



Robyn Peterson

Oklahoma CattleWomen's Elects Peterson as President

Noble Research Institute public relations coordinator Robyn Peterson was elected as president of the Oklahoma CattleWomen's Association for the 2019-2020 year. Peterson has been a member of Oklahoma CattleWomen's Association for eight years and has served Noble Research Institute for 10 years. She recently completed Oklahoma Cattlemen's Leadership Academy, which allowed her to travel across the state learning about all sectors of the agriculture industry and about legislation.

"Robyn loves agriculture and has dedicated her life to supporting and promoting this vital sector. She will do an outstanding job for the association as president," says J. Adam Calaway, director of communications and public relations. "Her selection demonstrates that Noble is helping prepare leaders for agriculture and beyond." 🌱

Noble Sets New Safety Record

Between October 2016 and December 2018, Noble Research Institute went more than 1.7 million hours with no loss-time injuries (wherein employees are away from work due to injury).

Employers who reach 1 million or more hours of no loss-time injuries are recognized by the National Safety Council. To reach 1 million hours in an organization with 350 employees takes several years of consistent management.

The Occupational Safety and Health Administration defines a safety culture as an environment in which employees have not only a right to a safe and healthful workplace but a responsibility for their own safety and the safety of others.

"Our work involves many different occupations that involve various hazards — from farm equipment to research tools," says Robert Williams, safety and risk manager. "Our ability to hit this milestone demonstrates an organization-wide dedication to safety."

Workplace health and safety are top priorities at Noble Research Institute. The organization provides training and works to integrate safety into every part of its culture. This milestone bested the previous organizational record of 1.2 million hours set from 2013 to 2016. 🌱

CUSTOMIZE YOUR NEW NOBLE EXPERIENCE

GO TO NOBLE.ORG/MYACCOUNT TO SIGN UP FOR YOUR FREE ACCOUNT.

You'll need this account to sign up for events and to let us know your interests and communication preferences.

YOU CAN NOW USE YOUR NOBLE ACCOUNT TO:



CREATE A PROFILE that helps Noble better understand your interests and needs.



SIGN UP FOR NO-COST newsletters and publications filled with information you can apply to your operation.



SEE ALL OF YOUR LAND stewardship information, including maps and recommendations, in one place (a feature in the works).



HOW TO ACCESS YOUR NEW NOBLE ACCOUNT

1 LOG IN

Go to your computer or cellphone and pull up www.noble.org/myaccount. Fill in your email and create a password.

2 PROFILE

Complete your basic information, select your interest(s) and choose your publication (such as the monthly *Noble News and Views*) subscriptions.

3 BIO

Complete the "My Bio" tab on the right. (This will replace having to complete a bio sheet at every event.)

QUESTIONS YOU MIGHT HAVE ABOUT YOUR ACCOUNT

WHY DO I NEED A NEW NOBLE ACCOUNT?

Your account will be your new go-to place to manage your relationship with Noble Research Institute. You'll also need this account to sign up for educational events.

WHY WON'T MY LOGIN WORK WHEN REGISTERING FOR A FUTURE EVENT?

Your old login may not work because you need to create your new Noble account. If this is the case, you will automatically be prompted to do so when you click to register for the event.

WHAT IF I ALREADY REGISTERED FOR A FUTURE EVENT?

If you have already registered for a future event, you do not need to register for the event again.

WHY DO YOU NEED MY BIO INFORMATION AND INTERESTS?

Providing your bio information will help us better understand you and your operations so that we can plan educational opportunities that meet your needs. Providing your interests will enable us to send you tailored information, if you subscribe to our mailing list(s).

LEARN MORE AT NOBLE.ORG/ABOUT-MYACCOUNT

FOLLOW #EveryNobleStory

Catch up with our experts online for a behind-the-scenes look at Noble's research, education and in-field activities.



@noble_landstewardship

Join **Jeff Goodwin, conservation stewardship leader and pasture and range consultant**, as he shares tips and techniques for range and pasture management focusing on soil health and land stewardship.



Helping ranchers define land stewardship goals is one of our priorities at @nobleresearchinstitute. The day gets even better when we see those producers succeed in achieving those goals.



Often confused for one of the "bad thistles," American basket-flower is a good pollinator species and provides a hard seed used by many grassland bird species.



@ilovescienceandag

Maria Monteros, Ph.D., associate professor, is a scientist asking questions and exploring activities to engage students in STEM.



Cover crops keep the #soil covered to minimize #erosion and their roots are a great place for #beneficialmicrobes to live.



These seed pods from the #cover crop hairy vetch are growing in the #greenhouse and will be used to understand how some plants are capable of #podretention. Our goal is to develop improved #varieties of cover crops to help protect the soil.



@longlivethesoil

Join **Jim Johnson, soils and crops consultant**, on an adventure you will be sure to enjoy. Did you know soil quality can be measured by your underwear? That's right, Johnson will explain how you can use underwear to evaluate your soil.



When you #soilyourundies but the cattle pull up the flag and you have to search for them like buried treasure.



Burying underwear for a #nobleresearchinstitute #soilhealth field day coming March 27, 2019. #longlivethesoil #soilyourundies



@scientist_a_broad

From her daily life to working in the Noble lab, **Barbara Nova-Franco, Ph.D., postdoctoral fellow**, immerses you into her life abroad while capturing beautiful moments through black-and-white photography.



Be Noble ... This building is part of the @nobleresearchinstitute, my first home abroad. Noble has given me my first job, my first time leaving my parents and my country, and so many other great first times ... Noble is part of me and I feel nothing but grateful and blessed for being part of the #NobleFamily

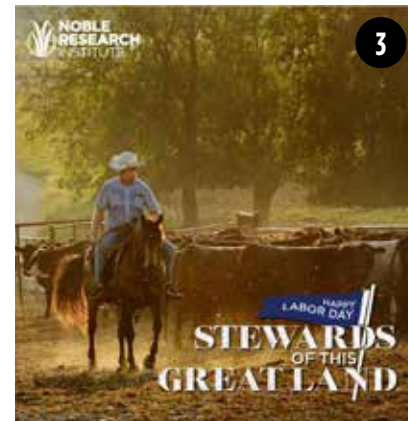


"You make observations, write theories to fit them, try experiments to disprove the theories and, if you can't, you've got something." — Kari Mullis

FROM OUR FEEDS

FOLLOW ALONG @nobleresearchinstitute

We love connecting with colleagues and friends on social media. Here are our top five recent moments on Instagram.



5. What does extra moisture mean for your hay quality? 4. Steve Rhines, president and CEO, watches Jeff Goodwin, consultant, as he contributes to the conservation discussion before the U.S. House Ag Committee. 3. Happy Labor Day to the stewards of this great land. 2. When is the last time you sampled your soil? 1. Integrity Beef member Meredith Ellis was highlighted in an article by the Dallas Observer.



3 Things to Look Up

Join the #OurLands Conversation

The National Grazing Lands Coalition is asking farmers and ranchers to join the conversation about agriculture. This feature video with Meredith Ellis, G Bar C Ranch, explains how #ourlands and soil are some of the world's most important resources. Ellis is one of 2,000 farmers and ranchers who work directly with Noble Research Institute on improving land stewardship and soil conservation.

Watch the video: bit.ly/our-lands



Building Healthy Pasture Soils

Boost your soil health knowledge with this introduction to soil properties. Learn about evaluating soil quality, and proper grazing management principles and techniques that promote healthy pastures.

View the full publication: bit.ly/healthy-pasture

Fire to Manage Pastures

Russell Stevens, wildlife and range consultant, explains in BEEF magazine the use of prescribed fire to manage pastures. Prescribed fire, grazing and rest are integral processes for maintaining the integrity, stability and beauty of the Great Plains.

View the full article: bit.ly/fire-manage-pasture

Q AND A

Meet some of the passionate people behind Noble's research.

WHAT IS YOUR FAVORITE PART OF YOUR JOB?

A rewarding part of my job is creating new plant populations that ultimately produce a better, strong forage. For example, we work to develop plants that are more drought tolerant. I enjoy going through the experimental process and being able to work with different groups to achieve a common goal.

HOW DOES IT IMPACT AGRICULTURE?

The information gained and new, improved plant varieties produced can significantly impact agriculture and benefit beef cattle producers who will use them.

JENNY BLACK
RESEARCH ASSOCIATE, SUSTAINABLE BERMUDAGRASS PRODUCTION



WHAT IS YOUR FAVORITE PART OF YOUR JOB?

For me, it's wonderful to be part of a team that develops and implements software that helps us look through tons of business and scientific data. This enables us to help beef cattle producers make better decisions.

HOW DOES IT IMPACT AGRICULTURE?

More than ever, agriculture relies heavily upon technology to thrive. Exploring new technologies can help us stay on the cutting edge of technology and, in turn, pass our research and information on to producers.

ALBERT SEMERVILLE
SOLUTIONS ANALYST



WHAT IS YOUR FAVORITE PART OF YOUR JOB?

I look at plant genomic sequences to discover novel genes that control important traits such as drought resistance or ability to efficiently use nitrogen and phosphorus from the soil. It is really interesting to explore the ocean of data and find its biological meaning.

HOW DOES IT IMPACT AGRICULTURE?

Discovering novel genes and understanding their roles in regulating important traits will accelerate plant breeding.

XINBIN DAI, PH.D.
SENIOR COMPUTATIONAL BIOLOGIST



WHAT IS YOUR FAVORITE PART OF YOUR JOB?

I enjoy collaborating with a multidisciplinary team to develop on-farm studies that generate critical data for alternative production systems, practices and technologies. I evaluate this data to determine whether or not these production systems and management practices have more economical potential for producers than the systems they currently use.

HOW DOES IT IMPACT AGRICULTURE?

My research program ultimately helps beef cattle producers improve their ability to make better decisions and be more economically sustainable. It also provides economic input and perspective to the organization so that we're able to focus our resources on projects that are most suited to helping land stewards.

JON BIERMACHER, PH.D.
ASSOCIATE PROFESSOR AND ECONOMIST

WHAT IS YOUR FAVORITE PART OF YOUR JOB?

My favorite part is thinking about new solutions to problems that impact agriculture. I'm interested in uncovering the genetic basis of why different varieties of the same crop species vary in biomass quality, such as protein and digestibility as a forage, or drought tolerance.

HOW DOES IT IMPACT AGRICULTURE?

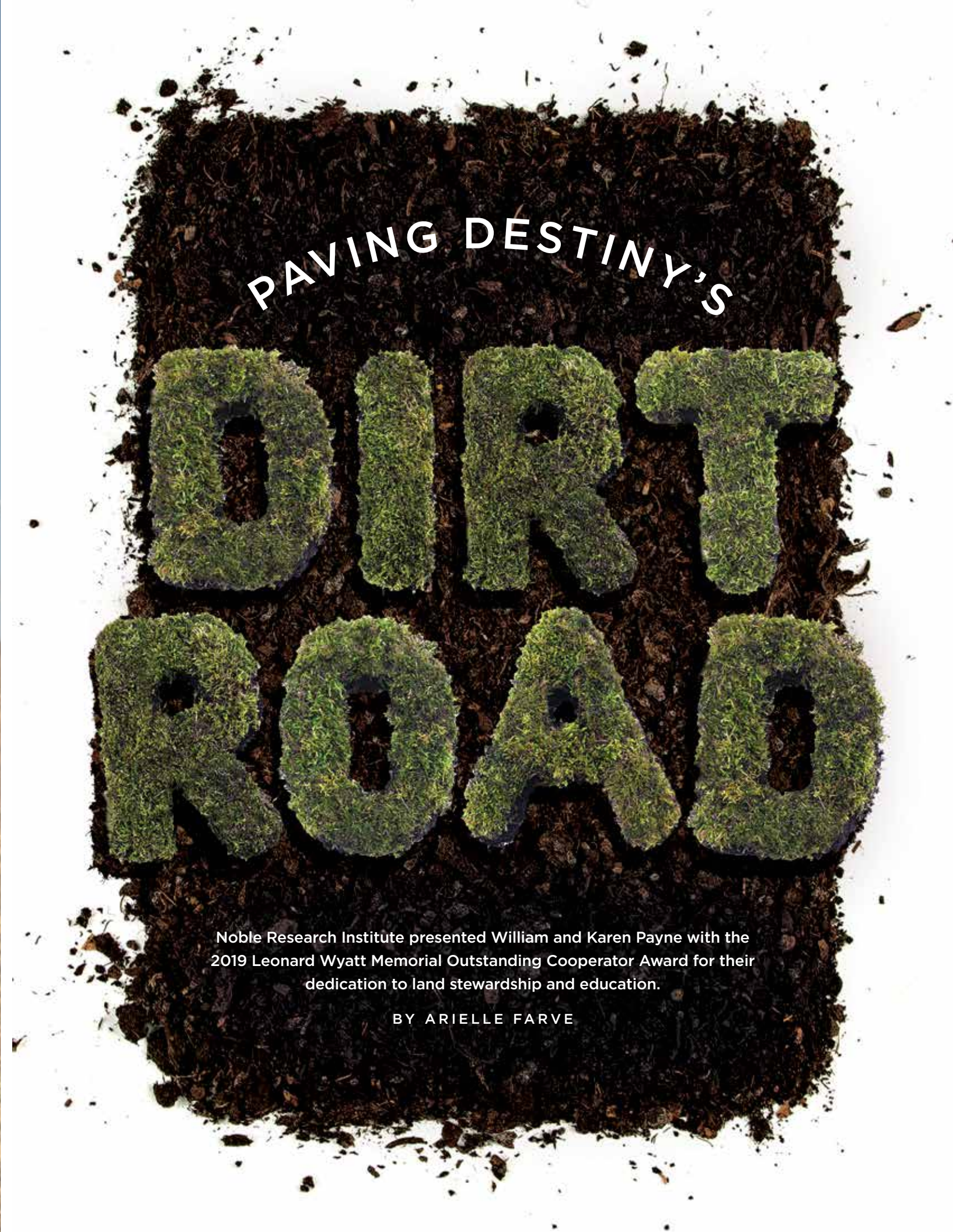
The knowledge obtained from my studies will assist in breeding better or more stress-resilient crops.

YUN KANG, PH.D.
STAFF SCIENTIST, MOLECULAR PLANT PHYSIOLOGY





William and Karen Payne, who call themselves "grass farmers," enjoy the results of their work to regenerate the land and raise cattle on their ranch near St. Louis, Oklahoma.



Noble Research Institute presented William and Karen Payne with the 2019 Leonard Wyatt Memorial Outstanding Cooperator Award for their dedication to land stewardship and education.

BY ARIELLE FARVE



Destiny is down a dirt road.

More than a decade ago, William and Karen Payne rumbled toward it in their maroon Ford F150. The couple were looking for the promise of a fresh start

in 2006 after two farms had flopped in drought. They were hoping to find a rancher's redemption in the 920 acres of rangeland they were en route to view in St. Louis, Oklahoma. Karen leaned close to the window, fogging up the glass. William raved about their grandson's baseball game from the night before. They were one mile from their future.

The romance of running cattle on an Oklahoma ranch fizzled as they pulled through the gate. The property looked

like a Christmas tree farm as eastern redcedars, which gorge themselves on groundwater and chase out native plants, blanketed nearly every acre. Grass roots anchoring sediment had shriveled away. Erosion had pillaged topsoil from the uncovered ground.

The Paynes spotted scant grass patches shuddering on the ocean of bare ground. These castaways were the last remnants of rangeland devoured by 22 years of poor land management. The tenacious blades were also a glimpse of the rangeland's former grandeur.

"A land consultant said don't buy it," William explains. "They said the land would need at least 20 years to recover, then he gave us the hard copy soil profile maps for the property. I realized there had been good soil here. Things had grown here. They could grow again."

The Paynes bought the property. Fourteen years later, their ranch is her-

alded as a masterpiece of environmental restoration. Land stewardship became their divine appointment, inspiring the property's name — Destiny Ranch.

DEFEATED IN DROUGHT

The Paynes know what happens when landowners treat soil like dirt.

Back in 1930, Karen's parents were children when a blizzard of dirt, known as Black Sunday, swept over their families' farms in the Oklahoma Panhandle. Some 300,000 tons of dirt blew east in one day. For years, the region's soil broke apart and was carried away by the wind like flour.

The Dust Bowl's ghost lingered over the Panhandle. Its phantom arose in the '70s, plaguing the Paynes on their first farm. William watched silt as fine as powdered sugar shroud his crops. Karen resurrected tactics from her parents' era.



ABOVE: William and Karen Payne were recognized as the 2019 Leonard Wyatt Memorial Outstanding Cooperator Award recipients by Noble Research Institute. Pictured with them (center) are, from left: Eddie Funderburg, Ed.D., senior soils and crops consultant; Hugh Aljoe, director of producer relations; Jim Johnson, soils and crops consultant; and Dan Childs, senior agricultural economics consultant. RIGHT: Karen Payne (pictured) and her husband, William, raise Hereford and Angus cattle on Destiny Ranch, which was in poor condition when they bought it in 2006.





She draped clean, damp sheets over her daughters' beds. The fabric was soaked in dirt by morning. She filled pans with sitting water to catch the earth seeping into her cabinets.

"We both realized the Dust Bowl could happen at any time if you don't take care of the land," William says. "We watched the soil get up and leave the Panhandle. We have to conserve everything. You can't just keep hammering the soil."

A suffocating layer of newly deposited silt consumed fields once green with wheat in 14 days. Those two weeks, coupled with a three-year economic downturn, forced the Paynes off their first farm. They established a second ranch in Colorado, only for drought to choke out their dream once again.

William took a job as a diesel mechanic. His first assignment sent him to the Amazon River in Brazil. Karen and their three daughters followed William's work there and to three additional countries during the next decade. Their dream of owning a ranch stayed with them everywhere they went.

"We always came back to the farm," Karen says. "We came back to the ranch no matter what kind of job he was on. It was our love."

When their daughter called about a ranch for sale in St. Louis, Oklahoma, they rolled down the road toward Destiny.

RESTORING RANGELAND

What might grow on the Paynes' new ranch was a mystery. The 920 acres didn't have enough grass residue to determine what species had grown on the property. With more questions than answers, the Paynes reached out to

TOP: William Payne (pictured) and his wife, Karen, prepare to wean cattle on their ranch. They use techniques to minimize stress in the herd during this process.

BOTTOM: The Paynes (center) sell a portion of the beef they raise directly to consumers at the Cleveland County Farmers Market in Norman, Oklahoma.



Noble Research Institute in 2006.

"Noble Research Institute was behind us in everything we had to do," William says. "They gave us the information to make educated decisions. Others came in and said we weren't going to make it, but Noble gave us the best advice we ever received: 'Let the land rest for a year, then we'll see what we have.'"

While the soil slept, the couple gradually eliminated barriers to natural regeneration. They cleared brush and trees without dozers or heavy machines. Overgrown barbwire barriers gave way

to lanes of electric fences. Stumps remained to ward off further erosion.

REVOLUTIONARY ROTATIONAL GRAZING

The Paynes welcomed 290 steer calves to the ranch in 2007. The land was ready and so were the Paynes with a little help. The first batch of calves costs \$40,000 to feed, more than the cattle would earn. The Paynes needed to shift their grazing style. Once again, Noble Research Institute was behind them.

“Noble Research Institute was behind us in everything we had to do. They gave us the information to make educated decisions.”

—WILLIAM PAYNE, DESTINY RANCH

Five steps later, he speed dialed his wife: "Honey, we may have a bonus." Karen joined him just off the road. He pulled back branches to unveil a barn big enough to hold more than 80 round hay bales. They cleared away more trees to discover a second barn. The abandoned structures were in perfect condition.

The land blossomed under its first intentional care in two decades. The Paynes didn't sow a single seed, yet native grasses started to resurface from the soil. Since then, they solely manage Destiny Ranch for native grasses.

"Our vision for this ranch was to run stocker cattle, so we eat, sleep and drink our grasses and soil," William says. "It is all about our grasses and raising good quality beef. It's our grasses that make everything work. We can't have the cat-

tle without the grasses, so we are grass farmers at heart."

"Noble's experience and expertise allowed us to focus on what needed to be done," William says. "If we had tried to do what other folks recommended, we would have gone broke. We would have never made it. But with Noble having the research already done, they knew what worked."

The couple embraced a high intensity grazing system established by Noble consultant Hugh Aljoe. They began moving cattle every 24 hours by foot in 2010. Heat waves sizzled around them as they rolled and unrolled miles of temporary fence to close off 1-acre paddocks.

"We looked through the grazing records and gave them a proposal, but we told them it has to be your plan," Aljoe says. "We gave them the information, but they made the choice to move cattle every day. They put in the work to improve their average daily gain."

Drought flooded Oklahoma with thirst that summer. While the surrounding fields shriveled away, the Paynes' grasses — 5,000 pounds worth — shot to more than 2 feet. Destiny Ranch was an

oasis under the Paynes' innovative land management. "It's hard to take that step away from what's been going on the last 70 years," William says. "You're going to step out there and do something different. Maybe it will work, or maybe it won't. Not many people are willing to do that. But, Noble Research Institute has done the footwork for us, so it should be an easy step."

RESURRECTED RANCH

Today, with 300 stockers year-round with annual marketing of about 1,000 head, the Paynes move cattle with ritualistic efficiency. The cows are always ready to head toward a new paddock with fresh grass, proteins and nutrients.

Destiny Ranch sprawls out in front of visitors. Grassy hills and wildflower meadows have replaced tree tyrannized terrain. Native prairie grasses sway in the Oklahoma breeze around the Paynes as they move cows. Cattle trot past them with bovine swagger as they head to their next buffet of grass. Karen stoops to pluck a grass blade. She twirls it between her fingers, marveling at the ranch's renewal. Hundreds of producers trek to Destiny to attend seminars on the Paynes' property. Gasps bellow from the attendees when they see old pictures of the ranch. Their astonishment turns hopeful as the Paynes share land management strategies.

The Paynes' 14 years as land stewardship champions has captured more than just the attention of their peers. Noble Research Institute honored both William and Karen as the 2019 recipient of the Leonard Wyatt Memorial Outstanding Cooperator Award.

"The Leonard Wyatt award for us is the highest honor," William says. "For us it feels like recognition from our peers and all the people who have helped us. They can see what we are trying to do here. We are beyond words with how much this award means to us. It's just incredible to receive the award and to work with everyone who has helped us."

If you ask Hugh Aljoe, he'll tell you that Noble was glad to help. But, he says, it was the Paynes who paved the road to Destiny. 🌱



A BLUEPRINT FOR PROGRESS

FARMERS AND RANCHERS ARE GAINING NEW TOOLS FOR MEASURING THE INTERCONNECTED PIECES UPON WHICH REGENERATIVE AGRICULTURE IS BUILT.

BY COURTNEY LEEPER AND KATRINA HUFFSTUTLER

COVER THE SOIL

Minimizing bare ground protects the soil against heat and erosion. Increasing plant diversity helps build soil organic matter and support microbes.

CLEAN AIR AND WATER

Soil acts as a natural filter, and decreased use of chemical inputs cuts costs and reduces pollution.

MINIMIZE SOIL DISTURBANCE

Optimize the need, timing, frequency and duration of grazing and other soil disturbances to build, not degrade soil quality.

LIVING ROOTS

Keeping live roots in the ground year-round promotes beneficial relationships between plants and microbes.

IMPROVE RESILIENCY

Healthier and more productive soil can improve resilience in drought and floods.

COMBAT CLIMATE CHANGE

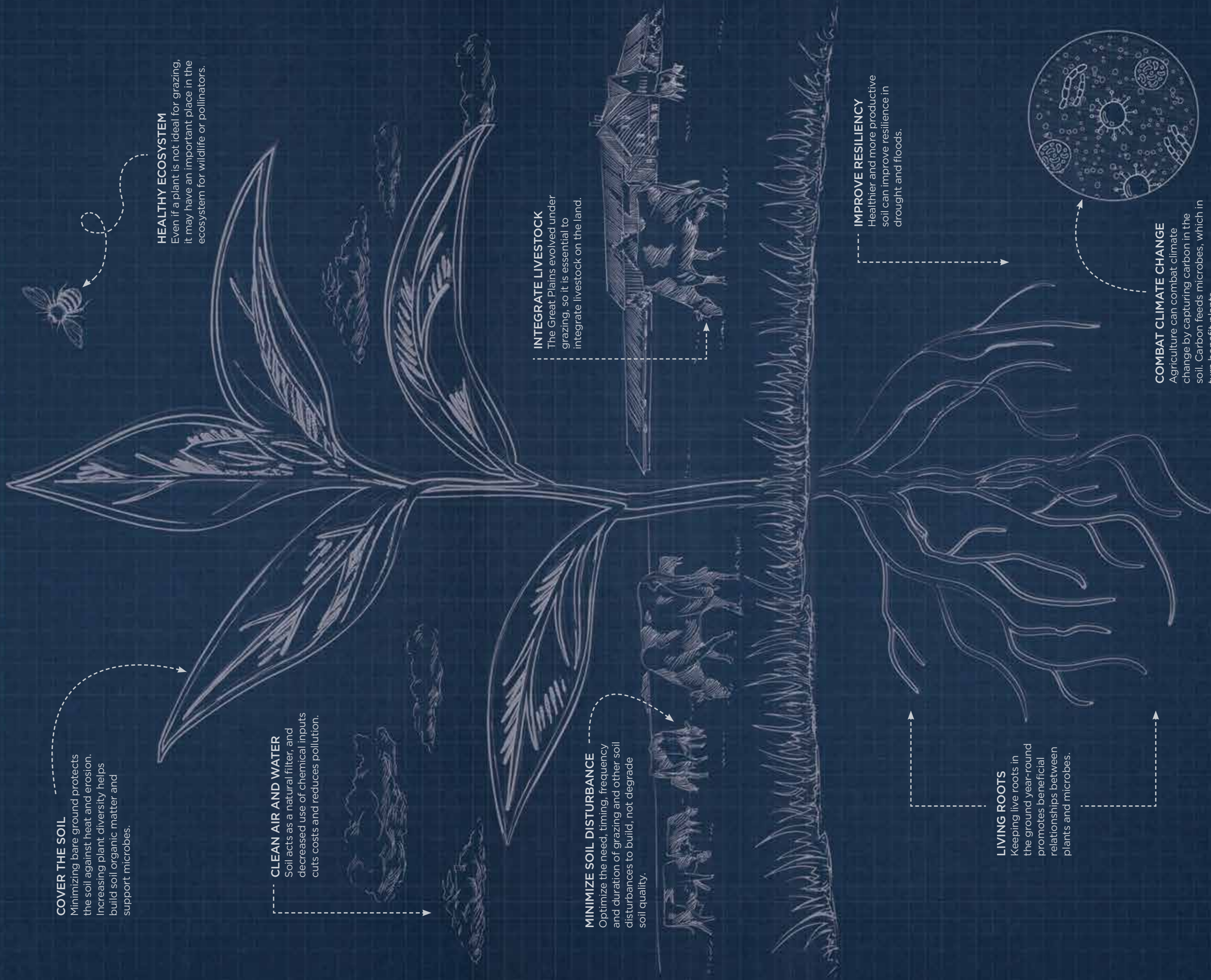
Agriculture can combat climate change by capturing carbon in the soil. Carbon feeds microbes, which in turn benefit plants.

HEALTHY ECOSYSTEM

Even if a plant is not ideal for grazing, it may have an important place in the ecosystem for wildlife or pollinators.

INTEGRATE LIVESTOCK

The Great Plains evolved under grazing, so it is essential to integrate livestock on the land.



When asked about his cow-calf operation in Blooming Grove, Texas, Gary Price doesn't open with the number of cows he runs or the breed he raises. Instead, he starts with the soil, describing the various types and combinations found on his ranch 50 miles south of Dallas.

It's rather telling of where the cattleman's priorities lie. He knows the importance of good stewardship because he's seen the effects firsthand, and he's not alone.



Gary Price (left) discusses soil microbes, water quality and broader beef industry challenges with county extension agents during a tour of his ranch.

ROTATION AND RESTORATION

Price rotates two herds of cattle through about 45 different pastures on the 2,600 acres he has put together through the last 43 years. His intense rotational grazing plan is an effort to mimic what the bison did a couple hundred years ago. The bison would graze each piece of land for a short time and then move on, giving it a long period of rest.

"To watch the recovery is pretty amazing," Price says. "Native grasses, if you continuously graze them ... that's how we lose them. They're so palatable that cattle will graze those good plants down, and then you get the less desirable grasses."

Between improving his grazing system, stocking conservatively and benefiting from evolving weather patterns, Price says he has

been able to avoid feeding hay or buying supplements for eight years — an almost unheard of accomplishment.

Another one? He's particularly proud to say a portion of his land has never been plowed, making it part of the less than 1% of tallgrass prairie that has not.

Cotton was king in his neck of the woods in the past. In fact, at the turn of the century, Ellis County had more cotton than any other county in the U.S. That means some of the acreage he has accumulated had been old cotton fields. He's gone in and planted those in native grass.

"We like to say our ranch has a mottled look," Price says. "We've got some pristine prairie, but we've also got some in various stages of restoration."

REGENERATIVE AGRICULTURE

Land stewardship is a journey that leads toward regenerative agriculture. It is not just about sustaining the land's ability to provide for future generations but about improving that ability.

Regenerative agriculture is the process of restoring degraded soils using practices based on ecological principles.

Regenerative agriculture promotes:



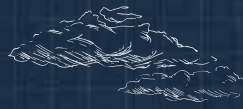
Building soil organic matter and biodiversity.



Healthier and more productive soil that is drought- and flood-resilient.



Decreased use of chemical inputs and subsequent pollution.



Cleaner air and water.



Enhanced wildlife habitat.



Capturing carbon in the soil to combat climate change.

"WE'RE PASSIONATE ABOUT WHAT WE DO. WE DON'T CONSIDER IT WORK. WE JUST CONSIDER OURSELVES FORTUNATE AND BLESSED. BUT THIS IS GREATER THAN THAT. WE WANT TO MAKE SURE WE LEAVE THE LAND BETTER THAN WE FOUND IT."

—GARY PRICE, 77 Ranch, Texas

5

BASIC PRINCIPLES OF SOIL HEALTH



1

COVER THE SOIL.

Use plants to minimize bare ground and protect soil from erosion and heat.

2

MINIMIZE SOIL DISTURBANCE.

Optimize the use of tillage, grazing, fire and other activities to build, not degrade soil.

3

INCREASE PLANT DIVERSITY.

Encourage different root systems to enable a diverse underground community.

4

KEEP LIVING ROOTS IN THE GROUND ALL YEAR.

Promote positive relationships between soil microbes and plants.

5

INTEGRATE LIVESTOCK GRAZING.

Foster the grass's historical relationship with grazing and recycle nutrients.

Learn more at www.noble.org/5-principles-soil-health

About 200 miles north, outside of Sulphur, Oklahoma, Susan Bergen's ranch is on its own path to recovery. When she took over management of the family's 12,000 acres seven years ago, it had not been profitable for decades.

Though the land had not been overstocked with cattle, the stocking rate was set on a per acre basis — 100 head in a 1,000-acre pasture — rather than through an intentional management plan. Bald spots, 240 acres worth, were left in areas the cattle had constantly used, and less desirable plants were taking over. The most desirable species — big bluestem, indi-grass, little bluestem and switchgrass — had been weakened.

year, giving the land 300 days of rest.

The grazing, when used properly, actually spurs growth of the native grasses, something Cruz Guerrero, Bergen's ranch manager, can attest to. Guerrero worked on the same land from 1998 to 2003 and says the quality of grass is much better now. Today, good stands of little bluestem, indiagrass and even big bluestem are reappearing across the ranch.

But when Bergen looks out over the range, she still sees what many would consider weeds. She has had to learn that even if a plant isn't perfect for cattle, it might be beneficial to wildlife or pollinators. At the very least, it has roots, which means it is feeding the soil microbes.



Susan Bergen's ranch near Sulphur, Oklahoma, stretches across 12,000 acres and is home to beef cattle, wildlife and, more recently, sheep.

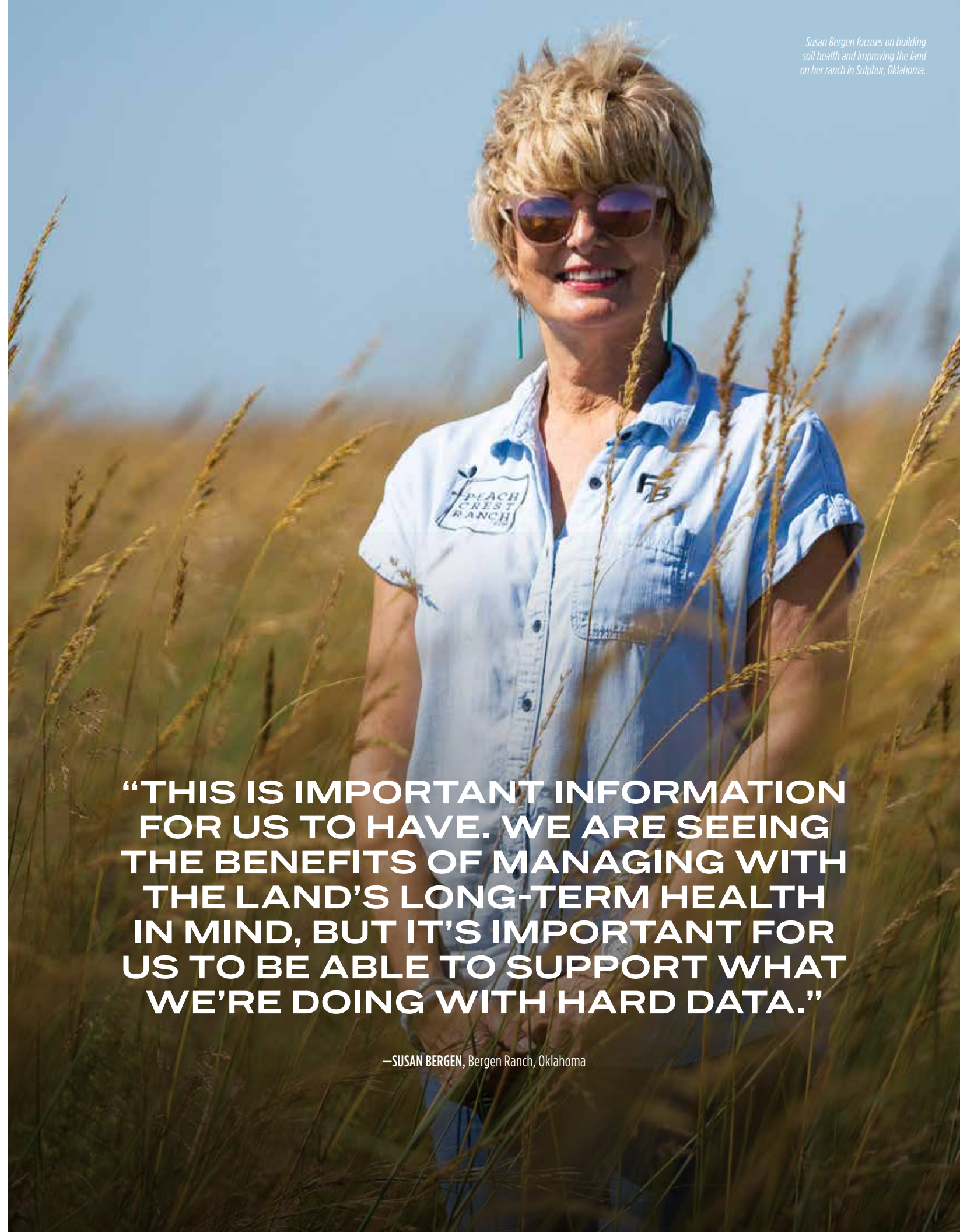
At the recommendation of Hugh Aljoe, Noble Research Institute director of producer relations, Bergen took an inventory of her resources and began to work toward the goal of regenerating the prairie. She bought wheat, turnip, radish and Austrian winter pea seeds to no-till drill into both the bare ground and weakened pasture. Within three years, the previously "lizard licked" land was covered by a sea of green.

Bergen credits the mix with kick-starting the buildup of biology back into the soil, but she says her No. 1 tool has been grazing management. Her cattle are rotated under the guideline of "take half (of the forage), leave half." They cross some pastures only twice per

"It took four years to have eyes to understand that," Bergen says. "I understand now that every plant is an indicator of something going on in the soil and for the overall ecosystem. Sometimes I have to take a breath, step back and know that this is a journey. I have to focus on what's right and keep learning and working to improve."

Price and Bergen can see progress on their ranches, but the process takes time. And right now, there are no tools for producers to easily measure their ecological investment in the land or the value — beyond food and fiber — they provide to society. Jeff Goodwin, Noble conservation leader and pasture and range consultant, wants to change that.

Susan Bergen focuses on building soil health and improving the land on her ranch in Sulphur, Oklahoma.



"THIS IS IMPORTANT INFORMATION FOR US TO HAVE. WE ARE SEEING THE BENEFITS OF MANAGING WITH THE LAND'S LONG-TERM HEALTH IN MIND, BUT IT'S IMPORTANT FOR US TO BE ABLE TO SUPPORT WHAT WE'RE DOING WITH HARD DATA."

—SUSAN BERGEN, Bergen Ranch, Oklahoma

THE QUEST TO QUANTIFY

Three cowboys look down at the ground where Goodwin crouches in the tall prairie grass on the Bergen ranch. With both hands, he drives a shovel into the earth and lifts upward, bringing forth fresh soil.

“You hear that?” Goodwin asks, following the crinkling of fibrous threads as they stretch then snap. “That’s the sound of roots. That’s a good thing.”

Goodwin explains the roots secrete sugars that feed the microbes in the soil, which in turn create an environment in which the best native grasses thrive. Especially the prized big bluestem, which is highly dependent on mycorrhizal fungi.

“Five years ago, this would have broken off into slabs,” Goodwin says, pointing to the deep brown soil as he crumbles it easily in one hand. Now, thanks to the life teeming within it, the soil is more porous. It can hold more water, giving the land greater resiliency in drought and a better chance at soaking up precipitation.

The soil also acts as a natural filter for water cycling from sky to stream to ocean. It provides home base for plants, which, with the help of their microscopic neighbors in the soil, pull carbon from the air and sequester it underground for food. Livestock, in addition to wildlife and pollinators, use the plants while returning nutrients to the soil and spreading seeds. Humans use what the land provides and, from the Noble perspective, are responsible for managing those resources in ways that keep these complex, interconnected pieces in balance.

“It takes a great deal of intentionality on the producer’s part to keep the system balanced,” Goodwin says. “It’s not just about applying practices. It’s about managing the entire operation with the land in mind.”

Right now, in general, farmers and ranchers are only able to go off observations and anecdotal evidence to determine the health of their land. As part of Noble’s Land Stewardship Program, Goodwin is working to provide producers with a process to quantify the value of managing land with a stewardship focus.

“We often say, ‘You can’t manage what you can’t measure,’” Goodwin says. “That’s the idea behind this program. We want to develop a science-based process for people to measure their land’s health so they can see their progress and share that story.”

Right now, the program is in a pilot testing phase with 12 ranches that stretch across



Healthy soil plays host to a range of microbial creatures that promote plant growth and benefit the overall ecosystem, which includes people and their environments.

almost 40,000 acres in Texas and Oklahoma. The land stewardship team has traveled ranch to ranch taking soil cores to a depth of 3 feet from more than 600 locations. They have also measured the vegetative metrics associated with those sampling locations.

Goodwin has measured available water holding capacity and is working to correlate that with remotely sensed satellite data like NDVI, a greenness index that can determine how green a field stays over time. Often, water, not nutrients, is the limiting factor that keeps a pasture from reaching its production potential, Goodwin says. Sometimes the land is just thirsty, even when there is no obvious drought.

The samples will be sent off to the laboratory. Once Goodwin receives the results, he’ll provide a report — what he calls the “baseline measurements” — to each rancher. In three to five years, new measurements will be taken and producers will be able to compare those against the baseline. Finally, the land managers will have numbers to back up the progress they have seen.



WHAT ARE MYCORRHIZAL FUNGI?

“Mycorrhizal fungi grow within or alongside plant roots. The fungus forms a mutually beneficial relationship with the plant, which provides the fungus with food and nutrients. In return, the fungus helps the plant take in nutrients and water.”

—KELLY CRAVEN, PH.D.,
Associate Professor,
Microbial Symbiology

HOW DO YOU MEASURE LAND HEALTH?

One goal of the Land Stewardship Program pilot is to determine which metrics are the most valuable in indicating to producers how they are doing in keeping the ecosystem they manage in a healthy balance.

SOIL SAMPLES

89

total measurements from 5 tests that indicate:

- Water storage capacity
- Soil organic carbon
- Soil texture
- Type and amount of biological organisms present
- Nutrient levels
- Overall soil health

VEGETATIVE SAMPLES

9

total measurements that indicate:

- Percentage of bare ground
- Height of plant canopy
- Plant biodiversity
- Forage production
- Soil’s ability to take in water and resist erosion

Pilot producers are also testing MaiaGrazing software, developed by an Australian-based company. The unique platform provides forage and grazing forecasting analytics, which helps a producer make stocking rate decisions. Learn more about MaiaGrazing at maia grazing.com.





Noble Research Institute and collaborators test technologies that could be used by farmers and ranchers to measure soil organic carbon in field.

FOR THE BENEFIT OF US ALL

“When people talk about agriculture’s impact on the environment, they talk about how cows emit methane. But how much carbon is sequestered in the ground by plants — including the grasses those cows live on? The Land Stewardship Program gives us the opportunity to have someone come out and measure carbon sequestration on our property and then again in five years. We’ll get a better idea of our true impact, which is important to me because I want to be sure I’m doing things that are going to benefit my son and all of us.”

—MEREDITH ELLIS, G Bar C Ranch, Texas

WHAT MATTERS MOST

Goodwin hopes that what he learns in the pilot will have application for producers nationwide. One goal of the project is to take all of the data and figure out which metrics tell a person the most about his or her land. This way producers don’t have to spend the time or money needed to test for information that isn’t as helpful.

Once the top metrics are identified, tools can be honed to make it easier for an individual on any soil type, in any part of the world, to take that measurement.

For example, Goodwin is working with Yale University to test a hand-held device that measures soil organic carbon. Such a tool could allow a producer to simply scan soil in the field rather than send it off to a laboratory. But does the device work? To find out, the team used it to measure soil organic carbon in all of the soil samples Goodwin collected, which he also sent off for testing. They’ll compare the laboratory results to those from the new technology. This will enable them to give confidence ratings on how well the device works on different soil types.

Goodwin says developing ecological baselines will give producers a way to prove to themselves and others that their efforts are truly benefiting the land and, in effect, all of society.

In addition to giving producers site-specific, real-time information upon which they can tailor goals and make decisions, the program could eventually set them up to participate in marketplaces designed to pay them for their ecosystem services, like carbon sequestration.

It was important to create a program that works in real life, Goodwin says. That’s why they brought in pilot producers like Bergen and Price.

“I think the world of Noble and their credibility and integrity that shows in everything they do,” Price says. “It’s so important to find those producers who are doing some good management practices on their land and tell their stories to show it can work.”

While Land Stewardship Program participants follow science-based best practices based on land stewardship and soil health principles that lead to regenerative agriculture, Goodwin and the producers recognize that land stewardship is not one-size-fits-all.

“We understand every ranch has a unique set of assets to manage and challenges to overcome,” Goodwin says. “But there are fundamental principles that apply no matter the operation. Good stewardship is universal, and we’re going to be able to measure it soon.”

**ASK THE EXPERT:
HOW DO I GET STARTED ON IMPROVING MY LAND?**

Jeff Goodwin shares advice from more than 15 years of working with ranchers and other land managers.

Know that this is going to be a journey. The land didn’t get degraded overnight, so it won’t come back overnight. It takes time, persistence and management. However, it doesn’t take as much time as you might think. You’ve got to start somewhere, so don’t be afraid to start small. Just focus on what you can do, and work toward what you want to do. It’s direction over perfection. For example, your grazing management might

YOU’VE GOT TO START SOMEWHERE, SO DON’T BE AFRAID TO START SMALL. JUST FOCUS ON WHAT YOU CAN DO, AND WORK TOWARD WHAT YOU WANT TO DO. IT’S DIRECTION OVER PERFECTION.

start by just shutting a gate or stringing up a few electric fences. You could integrate some other forage species into your bermudagrass and let the cows fertilize it naturally, at no extra cost to you.

Manage for outcomes you want to see. For example, if you want to see big bluestem on the range again, know that it is highly dependent on mycorrhizal fungi. When you don’t have the fungi, you won’t have the grass. To attract the fungus, you’ll need to provide diverse root systems in the ground year-round and manage your grazing with rotations that allow for rest periods.

You’re not going to see change if you’re not managing for that particular change, so set your goals and do what you can to work toward them. Understand that we want to optimize production instead of maximizing it. That will allow us to optimize other important things, like soil and water quality.

And don’t give up. Talk to others who are on the journey, and know that moving in the right direction is a success.



WHEN PLANTS TALK

Research explores tiny compounds called peptides — keys to plant communication and potentially to a future with more efficient use of nitrogen and phosphorus nutrients.

BY DENICE RACKLEY AND COURTNEY LEEPER

Bailey Christie, research technician, places *Medicago truncatula* plants in a defined nutrient medium with specific peptides so that researchers can test the peptides' ability to help plant roots take up nutrients from their surroundings.



IMAGINE BEING ROOTED IN PLACE.

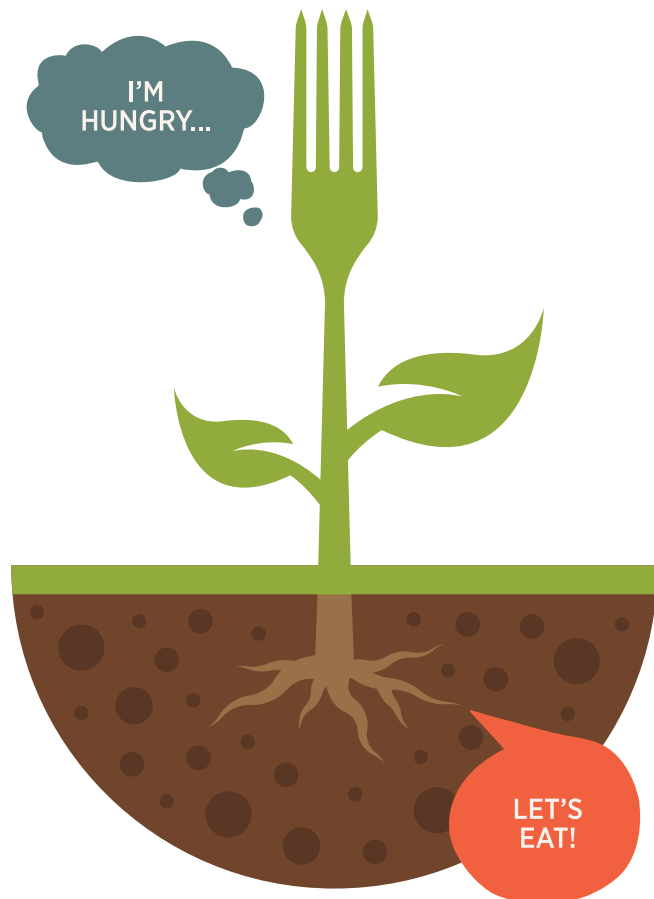
Everything you need must be within your reach, including food. Rooted close to a buffet might be the perfect location.

Plants need to “eat,” just like us. Ever wonder how plants know they are hungry? How do they know what nutrients they need? What actually happens inside plants when they are starving?

These are questions that have intrigued Wolf Scheible, Ph.D., professor and plant biologist at Noble Research Institute, for most of his career.

In order for plants to overcome challenges associated with being rooted in place, scientists know there must be a lot of sophisticated coordination and communication within the plant as well as between plants and their environment. This communication enables the plants to defend themselves against threats, to survive extreme weather and to sense the availability of nutrients. Scheible and colleagues at Noble, including Michael Udvardi, Sonali Roy, Sheng Ying, Silvas Prince Kirubakaran, Clarissa Boschiero and Patrick Zhao, are working to understand these signaling pathways in plants and the corresponding genes involved in these complex communications.

If researchers can learn more about how plants speak, both to themselves and with their surroundings, they could find ways to strengthen the plant’s natural ability to thrive in challenging situations — including environments with limited nutrients.



Medicago truncatula grows in hydroponic, or water-based, tanks before peptides are introduced. This allows researchers to understand the influence of solely peptides on the plant roots' ability to take up nutrients.

SEARCHING FOR THE RIGHT GENES

Figuring out how to encourage plants to “eat” like us at a buffet, consuming more than they need while nutrients are available, is around the corner.

When a plant knows it is in a nutrient-limited environment, it sends a message to itself saying it needs to invest more resources into acquiring the nutrients.

But how does the plant “know” this? The answer is hidden in its genes, which code for specific actions that the plant then carries out. Each gene gives a unique set of instructions, and Scheible’s current research focuses on identifying the genes that enable a plant to recognize and communicate nutrient deficiencies. He is also investigating how the plants respond in those scenarios.

The quest to identify specific genes led researchers to look at peptide-encoding genes.

“Previously overlooked because of their small size, peptide-encoding genes represent approximately 5% of the gene content in a typical plant genome,” Scheible says. “Their abundance indicates their importance. It follows that peptides, compounds consisting of 5-60 amino acids, made by these genes must also be significant.”

It turns out that peptides are as crucial to plant communication as cellphones are to us.

Peptides work like a lock and key, turning on or off plants’ responses to different stimuli and stressors. Internal long-distance communication, which allows all the parts of the plant to coordinate actions, is at least in part accomplished by peptides.

Hee-Kyung Lee, Ph.D., research associate, takes a sample to help determine how a peptide affects nutrient uptake in alfalfa plants. Peptides help plants communicate within themselves, coordinating actions related to growth and protection against stressors, like drought and nutrient limitations. The research, which uses both alfalfa and the model legume *Medicago truncatula*, aims to find out which peptides are associated with increased root growth, changes in root architecture, nodule formation, nutrient uptake and other functions.



For example, when a plant's environment is dry, a peptide signal, called CLE25, is sent from the roots to the leaves. The peptide ultimately causes stomata, pores in the leaves that enable the plant to release water vapor into the air, to close. This, in turn, preserves moisture in the plant.

Peptides are now known to be involved in many steps of a plant's growth, development and environmental interactions. Peptides influence shoot, root, flower and seed development. They also regulate the plant's immune system, defenses against pathogens, associations with microorganisms, and other responses to environmental changes.

Scheible and colleagues are currently tasked with discovering which peptide families and individual peptides are associated with increased root growth, changes in root architecture, nodule formation, the uptake of nutrients and other functions.

"Identification is often based on guilt by association," Scheible explains. "If the activity of a certain peptide-encoding gene increases with nitrogen limitation, for example, it may be related to the acquisition of that nutrient. The same

"The goal of our research is to utilize the knowledge we learn in the lab, translate that information for continued testing in a field research situation, then apply what we learn to agriculture."

—WOLF SCHEIBLE, PH.D.
PROFESSOR AND PLANT BIOLOGIST

can be said with other processes. We look for peptide-encoding genes that are induced or repressed by a specific stressor and then determine the roles of the encoded peptides in the plant, for example by asking what parts of the stress response can be reproduced by externally added synthetic peptides."

The National Science Foundation is supporting Scheible's work to identify those peptide-encoding genes that influence nutrient uptake and to study the effect of similar synthetic peptides.

"The goal of our research is to utilize the knowledge we learn in the lab, translate that information for continued testing in a field research situation, then apply what we learn to agriculture," Scheible says. "The hope is that we can develop synthetic peptides that will be used like a health supplement for plants. The applied peptide will trigger the plant to activate a signaling pathway that leads to the desired response."

TAPPING INTO PEPTIDE POTENTIAL

Manmade peptides are being made to mimic natural peptides. Synthetic peptides are easy to formulate, work at very low concentrations, and could be applied to roots together with liquid fertilizers or as foliar sprays.

Applying peptides associated with nutrient uptake, in conjunction with precision agriculture (using only the right amount at the right time in the right places), could increase yields and significantly decrease fertilizer use. Synthetic peptides may present a significant ecological and economic advantage.

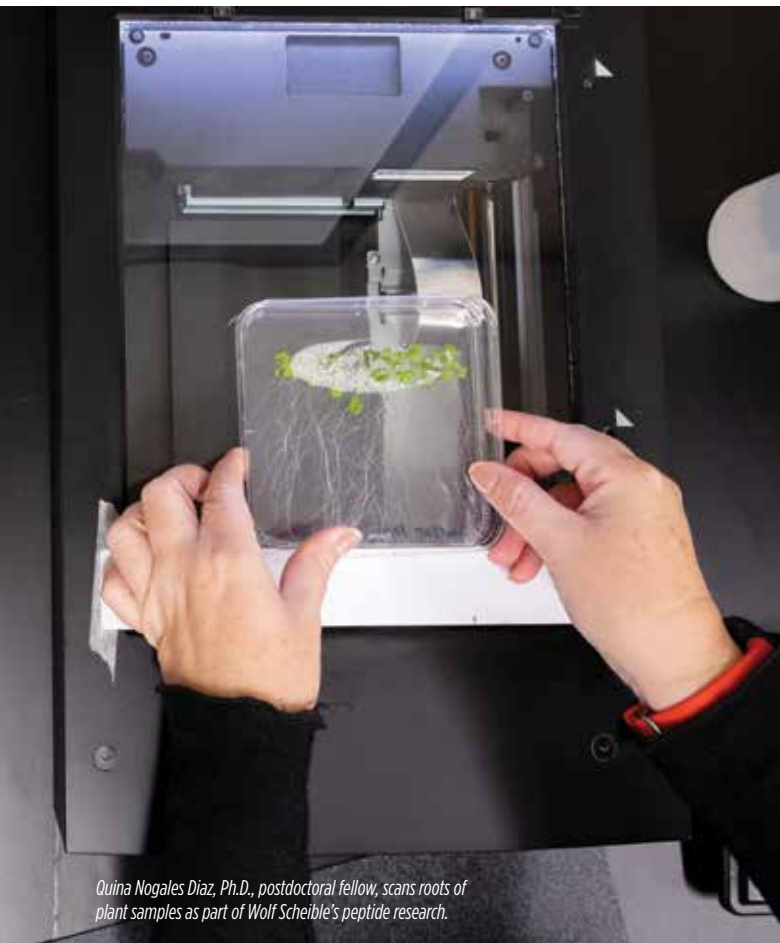
Legumes have the ability to make their own meal of nitrogen from the atmosphere thanks to their symbiotic relationship with nitrogen-fixing rhizobia bacteria.

"In one of the legumes we study, we found peptides that control nodule and root development," Scheible says. "Increasing nodule development may further lessen the need for nitrogen fertilizers. One of the next steps is to apply the synthetic peptides to study their effects on nodule development in a greenhouse and eventually field setting."

We eat more at a buffet simply because there is an abundance of food. If we can apply peptides to tell plants that they should take up more than they currently need when nutrients are readily available, not only could the amount of fertilizer that is applied be reduced but the amount lost to the environment may be decreased as well, Scheible states.

Plants typically use less than half of the nitrogen fertilizer and only 25-35% of the phosphate fertilizer applied. A fraction of the excess phosphorus is used by soil organisms or competing weeds, but the remaining phosphorus eventually becomes an environmental problem. Immobilized and bound to the soil particles, phosphorus ends up in rivers, lakes and seas as soils erode. Toxic algae blooms and subsequent depletion of oxygen in water is due in part to phosphorus contamination.

Wolf Scheible, Ph.D., shares the potential of peptides to improve plant performance and decrease fertilizer use when applied in conjunction with precision agriculture (using only the right amount at the right time in the right places). This could present farmers and ranchers with an ecological and economic advantage.



Quina Nogales Diaz, Ph.D., postdoctoral fellow, scans roots of plant samples as part of Wolf Scheible's peptide research.



Applying a synthetic peptide that would encourage plants to "eat" more of the available phosphate would limit the needed field applications while also preserving the world's limited phosphorus reserves.

"The use of synthetic peptides will likely provide an alternative to genetic modification of plants," Scheible says. "We will be able to achieve the desired results with bioactive peptides without lengthy plant breeding programs and concerns associated with genetic modifications."

Scheible and his colleagues hope to expand their research to identifying peptide-encoding genes in fungi, bacteria and soil microbes. This will shed light on the complicated good or bad interactions between plants and other organisms.

"We already know nematodes produce peptides that influence plant development, and they are nearly identical in structure to plant peptides," Scheible says. "However, the majority of soil biology remains a mystery. Discovering the interactions and communication pathways between soil organisms and plants will lead to continued advances in agriculture."

With the use of peptides, it is theoretically possible to stimulate crop or forage growth without stimulating competing species of plants. Scheible is excited about the future of peptide research and the real-world applications. The possibilities are virtually endless.

Synthetic peptides hold promise as potential agrochemicals to improve plant performance and provide economically and environmentally sound options while enabling plants to belly up to the nutrient buffet we provide. 🌱



SYMBIOTIC RELATIONSHIPS

A math teacher learns about endophytes during a summer laboratory experience designed to connect real-world research with STEM education.

BY KATIE MILLER

Kelsey Rogers Lawrence didn't grow up farming, but rather next door to agriculture in Madill, Oklahoma. Her Texoma hometown of less than 4,000 people is best known as the home of the National Sand Bass Festival. For Lawrence, though, it served as the backdrop that sparked her love for agriculture as she watched friends and neighbors care for livestock and steward the land.

Madill is a short drive from Noble Research Institute's headquarters in Ardmore, Oklahoma. As Lawrence followed in her older brother's footsteps, she became active in 4-H and the FFA. She learned more about how Noble worked to help agricultural producers find practical solutions for their farms and ranches.

The agriculture industry was a natural fit for Lawrence. Even though she didn't grow up on a farm, she enjoyed exhibit-

ing livestock, learning about the industry and mingling with local producers. Perhaps one of the things she loved most about agriculture was how it allowed her to have a hands-on, real-world approach to two of her favorite subjects: math and science. Through 4-H and FFA, she could take equations she learned in algebra to calculate feed efficiency and concepts she learned in biology to better understand animal science.

"I was always one of those kids who needed to know why you do something," Lawrence says. "It helps to know why you need science and math in your day-to-day life. Yes, it's important that you can do the assignment, but it's also important to know how to use it."

Noble helped cultivate Lawrence's budding interest in agriculture through AgVenture, a four-day summer camp hosted by Noble Research Institute in the early-2000s. Then, with a Noble scholarship, she headed to Oklahoma State University to pursue a degree in

agricultural business.

Lawrence studied abroad then obtained her master's degree before returning to her hometown and managing a local feed store. When the feed store sold, Lawrence once again pondered her career path. She landed on the idea of teaching. She spent hours shadowing area teachers and took the appropriate tests to receive her certificate.

As she began applying for jobs, she realized she wanted to stay in Madill and give back to her community. As fate would have it, a middle school math teaching position opened up at the perfect time.

SEEING FROM A SCIENCE PERSPECTIVE

Lawrence isn't one who believes you can simply stop learning, so she was ecstatic when she learned of an opportunity to participate as an educational fellow as part of a grant received by Noble Re-



ABOVE: Kelsey Rogers Lawrence (center), a middle school math teacher, spent her summer learning about endophytes that influence forage production while working alongside Carolyn Young, Ph.D., (right) and Amy Flanagan, research associate, in Young's laboratory at Noble Research Institute. RIGHT: Lawrence's aim as a Noble Educational Fellow was to translate the research into educational lesson plans and activities that she and other teachers can use in their classrooms.



search Institute and University of Georgia: "Identifying Host Factors That Influence the Association of Tall Fescue with Beneficial Epichloe Endophytes." At the time, she wasn't sure what an endophyte was. However, she knew about Noble Research Institute's commitment to the agriculture industry and how much agriculture had reinforced her love for math and science. She quickly applied to be involved in the grant's outreach project to help teachers develop hands-on educational activities related to the research.

During her interview with Carolyn Young, Ph.D., principal investigator for Noble's part of the research, Lawrence admitted she wasn't familiar with endophytes. However, she spoke passionately of her commitment to education and her interest in agriculture. Young could see Lawrence was the ideal candidate and selected her as the first Noble Educational Fellow.

Lawrence soon learned an endophyte is a microorganism, such as a fungus, that dwells inside a plant and has a symbiotic, or mutually beneficial, relationship with certain types of grasses. However, some endophytes, such as those found in the KY-31 tall fescue variety, can produce harmful — even toxic — chemicals that can affect grazing animals. The research she conducted with Young helped her see the cattle pastures surrounding her hometown in a new light.

Lawrence realized how important it is for livestock producers to be aware of what type of endophytes are present in their grasses and how some strains could negatively affect their livestock. When she passed fields of cattle trying to cool off in ponds, she wondered if it was a product of KY-31 tall fescue since heat intolerance can be a symptom of endophyte-produced toxins.

Lawrence learned about the symbiotic, mutually beneficial relationship between endophytes and grasses, it struck her that there was also a symbi-



RESEARCH OUTCOMES

Noble Research Institute has released two tall fescue cultivars that do not cause problems for livestock, thanks to the perennial grasses breeding laboratory, led by Mike Trammell, which works in collaboration with the mycology laboratory, led by Carolyn Young, Ph.D.

1

Texoma MaxQ II is summer-active and benefits from a different endophyte that is safe for livestock.

2

Chisholm (pictured above) is summer-dormant and is endophyte-free.

otic relationship between agricultural research and STEM (science, technology, engineering and mathematics) learning. After all, it was her love of science and math that led her to agriculture.

"Kelsey's interest in STEM and agriculture was perfect for the program," Young says. "She was able to combine her knowledge as a teacher with our research ideas to help us deliver a classroom exercise that allows students to see a symbiotic association — a fungal endophyte growing in a plant. Key to all of this was to align the lesson with the science curriculum so teachers could easily recognize the value of the exercise."

EQUIPPING TEACHERS FOR MORE

During the summer, Lawrence aligned the endophyte research protocol with age-appropriate lesson plans and guidelines that could help teachers meet their state-mandated curriculum while utilizing hands-on experiments to help their students learn. She also reviewed the proposed plans to ensure they would be

affordable and attainable to educators across the nation.

Lawrence is proud to be a part of such a program that will contribute to Noble Research Institute's already robust youth education and outreach program. The program provides educators with age-appropriate, curriculum-aligned lessons. She's glad she stepped out of the familiar and into Noble's lab this summer.

"I just want other teachers to know that it's OK to step outside of their comfort zone too," Lawrence says. "You never know what background you can bring to the program and what you can learn from the program. I learned so much not only from the people but also from the research project. I also want to encourage people to use the youth education resources."

Lawrence also learned the true value of hands-on learning. When she arrived at Young's lab, it had been more than a decade since Lawrence had actively worked in a laboratory environment. She found herself relearning some of the technology and terminology. One of the laboratory's research associates, Amy Flanagan, a former science teacher, also taught Lawrence about teaching by example. When Lawrence would seek help with terms or protocols, Flanagan would patiently assist her.

Lawrence returned to the classroom this fall, and she brought with her a new arsenal of teaching methods she learned from Flanagan; new ways she can use hands-on, research-based experiments to enhance her school's math curriculum; and a new respect for the importance of agricultural research.

But, perhaps most importantly, Lawrence finished this summer with a greater understanding of symbiotic relationships — whether it is that between endophytes and tall fescue grass or the one between practical agricultural research and STEM learning in the classroom. 🌱

DO-IT-YOURSELF



DEAR LAND STEWARDS

There is no greater gift than being able to enjoy the rewards of a balanced ecosystem. As you work toward improving the land, you have the opportunity to feed the world and your own family. Turn the page for one of our favorite recipes that features a meat native to our woods and prairies combined with a little Latin American flair: deer street tacos. To help you in your quest to continually be a better land steward, we also offer a step-by-step on what to look for in the field when evaluating your soil's health on page 47. 🌱

Deer Street Tacos

Enjoy the fruits of your land stewardship efforts with a little spice and fiesta.



INGREDIENTS

- 1 venison (deer) backstrap cut into 1 ½-inch steaks (or 1 ½ pounds cooked meat)
- 1 packet (1 ounce) taco seasoning
- 3 tablespoons Worcestershire sauce
- Cooking oil
- 1 pack of street-taco-sized corn tortillas
- White onion, chopped
- Fresh cilantro, chopped
- Fresh avocado, sliced
- Sour cream
- Fresh lime, sliced to squeeze
- Salt and pepper

DIRECTIONS

Step 1: Heat a charcoal or gas grill to 350 degrees Fahrenheit. Season both sides of the deer steaks with salt and pepper, and cook them on the grill until they reach a medium internal temperature (145 degrees Fahrenheit). Let the meat rest three minutes after grilling.

Step 2: Thinly slice the cooked meat after it has cooled.

Step 3: Heat a nonstick pan over medium-high heat and add the sliced meat, taco seasoning and Worcestershire sauce. Stir to combine.

Step 4: Heat a small amount of cooking oil in a skillet (enough to coat the bottom) on medium heat. Add corn tortillas one at a time for just a few seconds on each side (just long enough to heat them up). Place the warm tortillas on paper towels to soak up the oil.

Step 5: Fill each tortilla with meat then top with onions, cilantro, avocado, sour cream and freshly squeezed lime juice as desired. Enjoy!

 Responsible hunting can be a valuable tool for managing deer, one of our natural resources, and land stewards can successfully utilize grazing to benefit wildlife, cattle and plant communities. To learn about optimizing both cattle production and deer habitat, go to www.noble.org/grazing-management-cattle-deer.



TASTY TACO TIPS

Street tacos are a great way to use up fresh or leftover venison backstrap (which is comparable to the prime rib in beef) or tenderloin from your latest hunt. This recipe is inspired by Strategic Consultation Manager and Wildlife and Range Consultant Russell Stevens' favorite use for leftover deer steaks. If using leftovers, simply adjust the seasonings to match the amount of meat you have. We chose to slice the meat into fajita-sized pieces, but you could chop it smaller. We also like to double up on tortillas for easier eating.



SHOVELS OF STEEL

Jim Johnson says any shovel will do, but he prefers one that is completely made from steel. That's because digging in the field tends to break shovel handles. He notes that if you have a lot of difficulty digging, that may be your first sign of a compaction (and soil health) problem.



Seeing Soil Health on the Ranch

All you need is a shovel and your senses to get an idea of your soil's health.

SUPPLIES

- Shovel

NOTE: You will want to complete the following steps at least twice: once in a field or pasture and once in a nearby fence row. Compare the soil in these two places. Typically, soil in the fence row has not been as disturbed by grazing, machinery and tillage, and shows signs of greater health. This is why it makes a good benchmark to give you an idea of what your working soil could look like.



For more information on the five soil health indicators you can see (and smell) in the field, go to www.noble.org/soil-health-indicators.



DIRECTIONS

Step 1: Push the shovel into the ground at your evaluation site. As you do, feel for resistance. While resistance could be caused by roots or rock, it is often a sign of compaction. The shovel should go into the ground easily.

Step 2: Turn the shovel full of soil out and take a look at the color. In general, the darker the soil, the better. Color is an indication of soil organic matter.

Step 3: While looking at the color, do a further check for compacted layers. One way to notice compaction is to look at the roots. Are they growing sideways, or in a "J" formation — in which they grow down to the resistance layer then turn 90 degrees because they can't penetrate it? You want the roots to grow downwards, deep into the ground.

Step 4: Look for biological activity. Are there a lot of living roots or channels where roots have grown? Are there earthworms and other forms of life, like dung beetles, or evidence of them? These are all signs that your soil is alive and healthy.

Step 5: Smell the soil. It should have a good earthy smell, like a freshly tilled garden or a root cellar. It should not smell like vinegar, a swamp, a rock from the creek or rotten eggs. Smell can be difficult to gauge at first, but remember to compare the soil in your field to the soil in the fence row. No smell equals no life.

Step 6: Take a look at the soil's structure. Soil should crumble easily, like a perfectly done, moist chocolate cake. Your soil should include both big clumps and small clumps. If your soil is a singular clump, you probably have a compaction issue. Alternatively, if your soil sifts through your fingers like flour, you are missing the biological soil activity that provides the soil its healthy structure.

Step 7: Both NRCS and Noble can help you build an action plan to regenerate your soil.

ABOUT THE NOBLE EXPERT

Jim Johnson, soils and crops consultant, has more than 20 years of experience working in plant and soil sciences across the Great Plains and Midwest. His areas of interest include no-till, cover crops and soil health, and he and his family run a small cow-calf operation in south-central Oklahoma.





JANUARY

9 ESTATE PLANNING FOR AGRICULTURAL PRODUCERS

10 a.m.-3 p.m. | Thurs., Jan. 9, 2020
Ardmore Convention Center
2401 Rockford Road
Ardmore, OK 73401

LEVEL 4 MASTER

Farm families work hard to build successful operations and to create estates. Often, however, insufficient time is spent planning for the transfer of an estate to the next generation. This workshop provides information on the need to plan for estate transfer as well as laws governing estate transfer and the tools available to use in estate planning. It is encouraged that all family members, especially both spouses, attend.

What You Should Bring:

- A perception of the size of your estate and how your assets are owned

\$25 registration fee, includes lunch. Registration fee goes up to \$35 for those who register within one week of the event.

FEBRUARY

21 SELECTING AND DEVELOPING BULLS

9 a.m.-3:30 p.m. | Fri., Feb. 21, 2020
Noble Research Institute
Oswalt Ranch
18414 Dixon Road
Marietta, OK 73448

LEVEL 2 BUILDING

Evaluating and selecting bulls can be difficult with all the data that comes with them. This course will help you identify the important traits for your operation and management goals. In addition, you will learn how to prioritize multiple traits and balance phenotypic selection of bulls. Once you have selected your replacement bull, it is just as critical that he is developed properly prior to the breeding season and that his nutrition is managed properly post-breeding season.

\$25 registration fee, includes lunch. Registration fee goes up to \$35 for those who register within one week of the event.



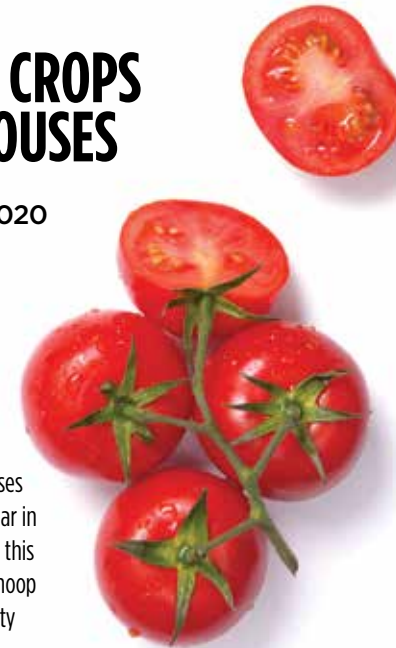
25 MANAGING CROPS IN HOOP HOUSES

6:30-8:30 p.m. | Tues., Feb. 25, 2020
Noble Research Institute
Kruse Auditorium
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 3 ADVANCED

Managing specialty crops in high tunnel hoop houses and managing specialty crops in the field are similar in some aspects but different in many others. During this course, you will learn how to manage the unique hoop house climate to produce high yielding, high quality crops.

There is no registration fee for this event, but we ask that you preregister prior to the event.



MARCH

5 BEEF QUALITY ASSURANCE CERTIFICATION

1:30-5 p.m. | Thurs., March 5, 2020
Noble Research Institute
Kruse Auditorium
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 1 ESSENTIALS

Beef Quality Assurance (BQA) helps guide the daily ranch activities of cattle producers who embrace it. The nationally coordinated, state-implemented program is designed to educate producers on the importance of best management practices, such as vaccination and medicine handling and records as well as proper nutrition for each stage of production. You can earn BQA certification by completing this program and a short test.

There is no registration fee for this event, but we ask that you preregister prior to the event.



10 HEDGING TO INCREASE PECAN PRODUCTION

1-4:30 p.m. | Tues., March 10, 2020
Montz Pecan Orchard
867 Old T Bone Road
Wichita Falls, TX 76305

LEVEL 4 MASTER

Hedging pecan trees has been a strategy used in the Western growing region for years. Hedging removes a portion of the fruiting wood from the tree, allowing only non-hedge portions to set a fruit. This lessens crop stress on the tree, increasing nut quality and ensuring return bloom on the hedged portion of the tree in the following year. Join Noble Research Institute pecan specialists as they review strategies for hedging pecan trees and discuss management practices to maintain high quality pecans on a more consistent basis.

There is no registration fee for this event, but we ask that you preregister prior to the event.

For more information about one of our agricultural events, visit www.noble.org/events or call 580-223-5810. **You'll now need to sign up for events through your new Noble account.** To learn more or to create your free account, visit www.noble.org/my-account.

MARCH
26 MANAGING WEEDS AND INSECTS IN YOUR PASTURES

1:30-5 p.m. | Thurs., March 26, 2020
 Noble Research Institute
 Kruse Auditorium
 2510 Sam Noble Parkway
 Ardmore, OK 73401

LEVEL 1 ESSENTIALS

There are many different approaches to pest management, and each producer must select the approach, or combination of approaches, that best align with his or her own philosophy. The focus of this course will be on pest management following the integrated pest management principles and the responsible use of herbicides and insecticides. This course is designed to acquaint new producers with and remind experienced producers about the fundamentals of and practical approaches to pest management.

There is no registration fee for this event, but we ask that you preregister prior to the event.



APRIL
7 MANAGING EASTERN BLUEBIRDS

4:30-7:30 p.m. | Tues., April 7, 2020
 Noble Research Institute
 Protected Ag Demo Area
 2510 Sam Noble Parkway
 Ardmore, OK 73401

GENERAL AUDIENCE

Eastern bluebirds are among the most beautiful songbirds, which were declining up until the point that people began providing nest boxes for them. Come learn about eastern bluebirds, and other cavity-nesting songbirds, and how to build, place and manage their nest boxes. During this course, you will build a nest box that you can take home. You should also have the opportunity to view actual bluebird nesting activity in nest boxes.

\$25 registration fee, includes lunch. Registration fee goes up to \$35 for those who register within one week of the event.

21 DEMONSTRATING SPRAYERS FOR SPECIALTY CROPS

1-5 p.m. | Tues., April 21, 2020
 Noble Research Institute
 Protected Ag Demo Area
 2510 Sam Noble Parkway
 Ardmore, OK 73401

LEVEL 1 ESSENTIALS

During this field day, you will learn about the various types of sprayers available and have the opportunity to see some of them in operation. This course is designed to provide specialty crop growers with a basic understanding of the equipment and skills required to apply pesticides effectively, efficiently and safely.

There is no registration fee for this event, but we ask that you preregister prior to the event.



JUNE
19 UNDERSTANDING FACTORS AFFECTING CALF PRICES

9 a.m.-3:30 p.m. | Fri., June 19, 2020
 Noble Research Institute
 Oswalt Ranch
 18414 Dixon Road
 Marietta, OK 73448

LEVEL 3 ADVANCED

Join Noble Research Institute consultants as they walk you through all of the decisions that go into making a cattle bid and discuss different marketing strategies. At the end of the day, you will get the chance to try your hand at pricing different sets of cattle. During this workshop, you will learn about all of the moving parts of the livestock industry that influence the bids made by cattle buyers. By the end of this program, you should have a good understanding of the processes that go into cattle prices and what type of price you could receive when marketing your cattle. You should then be able to use that information to decide on the best marketing strategy for your operation.

\$25 registration fee, includes lunch. Registration fee goes up to \$35 for those who register within one week of the event.



23 APPLYING BEEF QUALITY ASSURANCE PRACTICES

9 a.m.-3:30 p.m. | Thurs., April 23, 2020
 Noble Research Institute
 Oswalt Ranch
 18414 Dixon Road
 Marietta, OK 73448

LEVEL 2 BUILDING

Noble Research Institute consultants are taking Beef Quality Assurance to the ranch. During this workshop, you will see various demonstrations of and gain hands-on experience with all best management practices for working and weaning calves. Beef producers looking to improve their best management practices and ensure quality beef products in the food chain should join us.

What You Should Bring:

- Weather-appropriate outdoor clothing. Participants will have the opportunity to experience hands-on practice, so clothing could get dirty.

\$25 registration fee, includes lunch. Registration fee goes up to \$35 for those who register within one week of the event.



BLUE-RIBBON WEEKEND

by J. Adam Calaway, editor

A cinnamon roll should not weigh as much as a brick. But there it was, spilling out of its little paper tray, bathed in morning light, loaded with extra pecans and a plum-sized dollop of frosting. So calorically dense and gooey obscene was this particular baked good, the mere sight would have caused any cardiologist to burst into tears.

There's only one place in the world to find such a gloriously inappropriate treat — the Oklahoma State Fair. Every fall, my family makes its annual pilgrimage to see the majesty and mayhem of the event simply known in our house as "The Fair." And each journey ceremoniously begins with a Silver Dollar Cinnamon Roll (followed immediately by a shot of insulin and regret).

For those who have never attended the fair, it's the only place on Earth where you can watch internationally acclaimed acrobats, see actual trained bears, enjoy a dog show, judge the six-horse hitch world championships, shoot hand-crafted longbows and buy a hot tub.

There's the Midway, where the carnies spin their ring-toss tales, promising small ego boosts and a stuffed member of the animal kingdom; just three tries for a dollar. And, of course, there are miles of fair food. Everything is deep fried, like God intended. Or it's on a stick. (Personal side note: If you're selling food on a stick, I'm buying. Corn dog? Two please. Fried cheese? Fried yes. Sirloin? I will never eat steak any other way.)

However, once you peel away the veneer of vendors and tsunami of cheap chachkies, you discover the soul of the fair. Like most of life, the fair's purpose is undeniably rooted in agriculture.

It's not about the arena full of made-everywhere-but-here knickknacks; it's about the homemade jam and canned goods in the Creative Arts Building. It's about the cakes that Mom made, the art from students across the state, the crochet masterpieces that will become family keepsakes.

It's not about foraging through a sea of food trucks; it's about the grazing animals and the students who have cared for them. Walk past the entertainment plaza and through the auto show. Sidestep the silliness. Look for Barn 2A. Smell the alfalfa hay. Marvel at the stature of the Clydesdales. Stop and watch the 12-year-old brushing their steer before they enter a show ring.

Months of work come down to a few minutes in the spotlight. They've done the chores. They've cleaned the stall. They've tended to their animal's every need. And for what? A chance at a blue ribbon that will hang in their room and — someday — will remind them that sweat equity always yields a return.

There's something powerful and essential about the fair. For many of the visitors who never venture away from a city's cement streets, the livestock competitions, the creative arts and AGtropolis — a building filled with a menagerie of animals and learning exhibits — is as close as they will ever get to experiencing the undeniable joy of agriculture. This event, these 10 days, link urban and rural in one messy and magical place. The fair is a gentle reminder of what is important and who we are. Not who we were, but who we are.

Agriculture will never be past tense. It lies forever in our future, a necessity that provides more than just food, fiber and feed, but offers us an opportunity to learn so much more about ourselves.

For me, the annual trip to the fair always reminds me of when I wore boots and had a cap-gun six shooter, when the Lone Ranger was my favorite TV show, and when I showed a goat named Honey and won a blue ribbon. Every fair, that memory resurfaces like a lost penny after a hard rain. And with it the understanding that we are all called to carefully steward what is before us — be it land, animal or the lives of those around us.

Today, I have the privilege of working at Noble Research Institute, an organization built on the principles of compas-



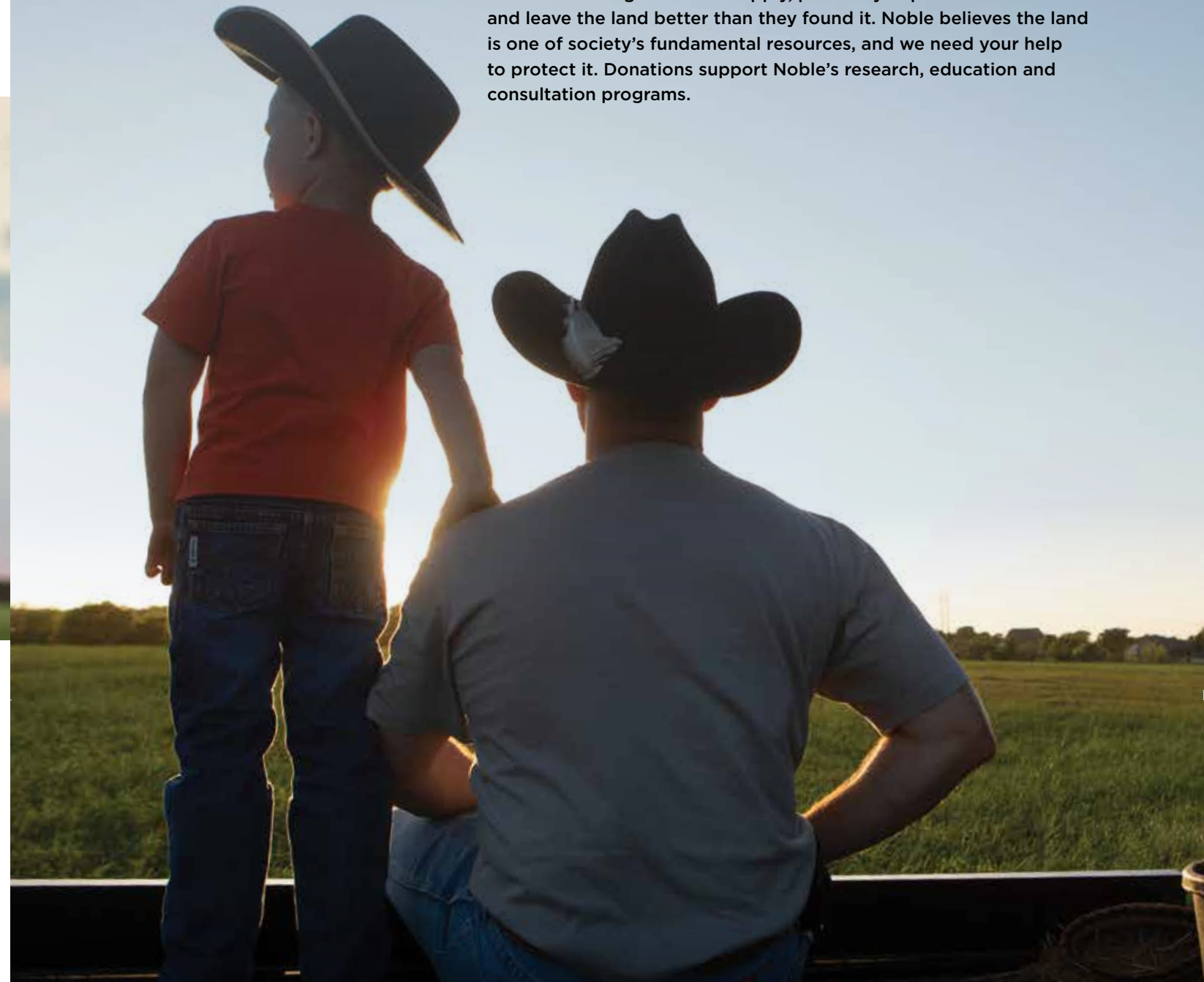
sionate, intentional stewardship. More than 300 of us have come together from around the world to make a tangible difference in agriculture — a mission that impacts ranchers and farmers first but ultimately serves all of society. We strive every day to advance projects aimed at providing solutions to agriculture's great challenges. Like all jobs, our days are filled with meetings and emails, planning and execution. Then — every once in a while — we have a blue-ribbon weekend and make deep-fried memories. We celebrate the effort, not just the harvest. We invite others to see, if only for a moment, why agriculture can inspire us all — no matter our addresses. And we remember why we work so hard.

It's so that we can grow up in a place and a time that still celebrates a state fair, that still teaches the value of stewardship before the show ring, and — on occasion — still gives us a chance to eat inappropriately sized cinnamon rolls. 🍩



GIVE TO THE LAND AND ITS CARETAKERS

Your gift enables us to guide farmers, ranchers and all land managers to contribute to a global food supply, positively impact the environment and leave the land better than they found it. Noble believes the land is one of society's fundamental resources, and we need your help to protect it. Donations support Noble's research, education and consultation programs.



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 **LEGACY** | Winter 2019 | Vol. 13, Issue 2

Susan Bergen, a producer in Noble's Land Stewardship Program pilot program, looks on as Jeff Goodwin, conservation stewardship leader and pasture and range consultant, checks for improvements made in her soil.

