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

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

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

ROOTS IN THE GROUND
Use roots to 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.
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Farmers and ranchers are gaining new tools for measuring the interconnected pieces upon which regenerative agriculture is built.

PAVING DESTINY’S DIRT ROAD
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.

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

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

Undergraduate Total scholarship: $20,000
Graduate Total scholarship: $12,500
Technology Total scholarship: $7,500

noblefoundation.org/scholarships

APPLY BY: March 1

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

There are many interconnected components to consider on the journey to regenerate the land. Building soil health is improved by proper grazing, which cycles nutrients, reduces plant selectivity and increases plant diversity. As with any management practice, grazing is a tool that requires intentional management.

Our ultimate target is not just sustainable but regenerative land. Regenerating the land is achievable, but it is not a recipe. It starts with a belief in the potential of our land but it is not a recipe. It starts with a belief in the potential of our land.

The Great Plains evolved through time we can make a difference. Throughs, in many instances, will seem incremental, but it is not a recipe. It starts with a belief in the potential of our land.

Our ultimate target is not just sustainable but regenerative land. Regenerating the land is achievable, but it is not a recipe. It starts with a belief in the potential of our land.

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 cycles nutrients, reduces plant selectivity and increases plant diversity.

As with any management practice, grazing is a tool that requires intentional application.

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As with any management practice, grazing is a tool that requires intentional application.
Cattle are not just for dinner. They are 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 ocean. 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 flood 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.

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.

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

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 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.
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 drives 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.

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.

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.
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, responsible for overseeing all of Noble’s human resources activities for the Institute. 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 Dixon Foundation for Excellence in Education. Donica was a Carter County 4-H Header for 20 years.

Noble Selects Donica to Lead Human Resources

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

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

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

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.

JON BIERMACHER, PH.D.
ASSOCIATE PROFESSOR AND ECONOMIST

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.

ALBERT SEMERVILLE
SOLUTIONS ANALYST

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.

JENNY BLACK
RESEARCH ASSOCIATE, SUSTAINABLE BERMUDA GRASS PRODUCTION

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.

XINBIN DAI, PH.D.
SENIOR COMPUTATIONAL BIOL O GIST

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.

JON BIERMACHER, PH.D.
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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 plowed 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 heralded 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. 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 cabin. “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, 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 the ranch’s renewal. Hundreds of producers trek to Destiny to attend seminars on Noble’s experience and expertise already done, they knew what to do. “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 the ranch’s renewal. Hundreds of producers trek to Destiny to attend seminars on Noble’s experience and expertise already done, they knew what worked.

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

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

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

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

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

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

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

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

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’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
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, indiangrass, little bluestem and switchgrass — had been weakened.

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 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, indiangrass 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.

“At 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.

“Soil is an important part of our ecosystem and the basis of our economy,” said Goodwin in an interview. “It’s the key to sustainability and the foundation of life. It’s critical that we understand and manage it properly.”

“I think there is a real opportunity 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 tool 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 almost 40,000 acres in Texas and Oklahoma. The land stewardship team has traveled this 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.
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 and recognize that and pay them for their ecosystem services, like carbon sequestration.”

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.”

For example, your grazing management might 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, 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.

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 or 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.
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
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.

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.
LEGACY

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 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.”

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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.

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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.

Applying a synthetic peptide that would encourage plants to “eat” more of the available phosphate would limit the need for 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 microorganisms. 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 enjoy up to the nutrient buffet we provide.

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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 exhibiting 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-
However, she spoke passionately about 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 research on endophyte-produced toxins, Lawrence admitted she wasn’t familiar with endophytes. However, she spoke passionately about 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 pastures 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 symbiotic 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.”

**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 Twin when evaluating your joint’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!

TASTY TACO TIPS

Street tacos are a great way to use up fresh or leftover venison backstrap (which is comparable to the prime rib or bone-in brisket from your local butcher). 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.
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.

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.
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

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.

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

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.
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.

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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 fry 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 that again. Fried yes.)

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 compassionate, 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 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 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.
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.