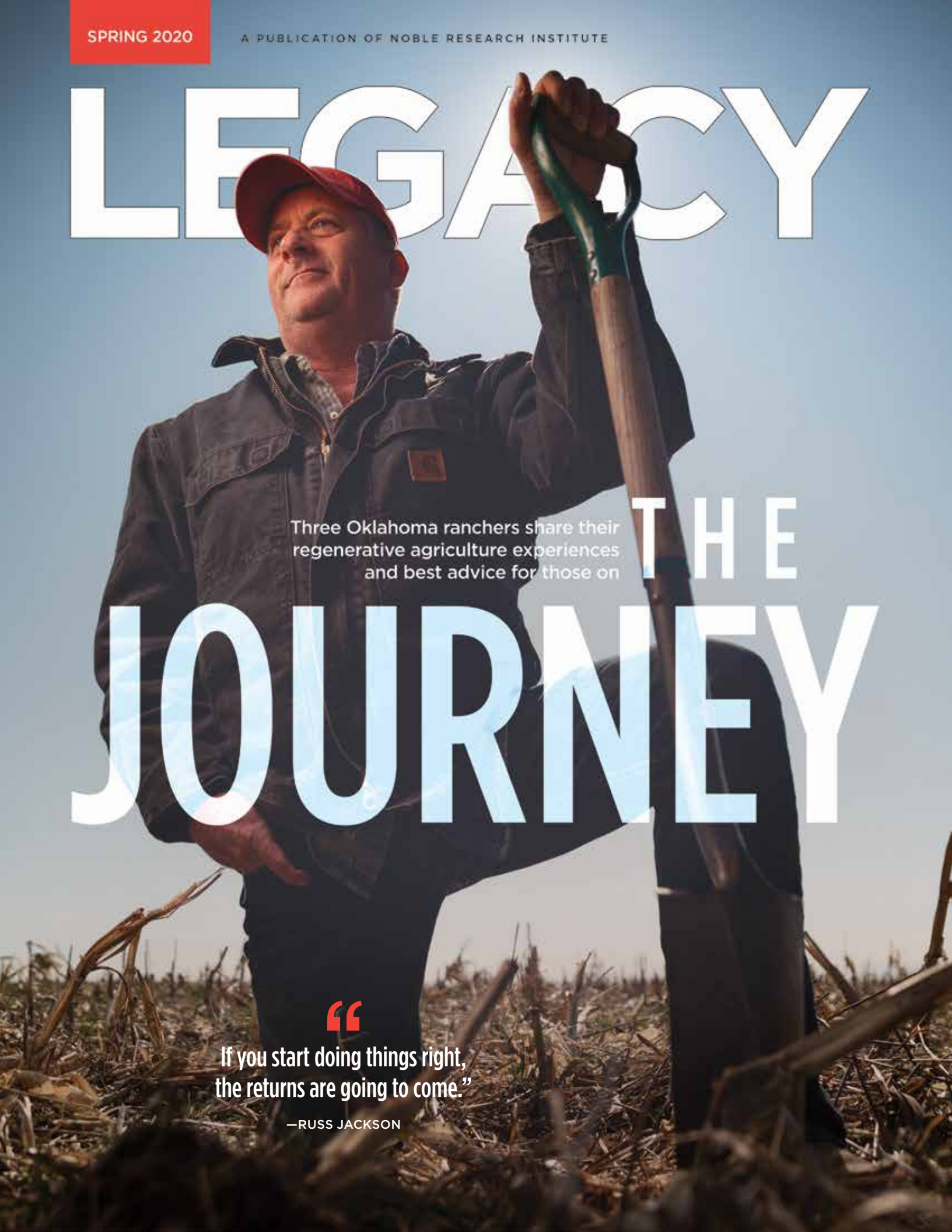
SPRING 2020

A PUBLICATION OF NOBLE RESEARCH INSTITUTE

LEGACY

Three Oklahoma ranchers share their regenerative agriculture experiences and best advice for those on

THE JOURNEY



"If you start doing things right, the returns are going to come."

—RUSS JACKSON

CONTENTS

A pecan sits in a groove in the bark of a tree that Thomas Jefferson planted in France during one of his journeys abroad as ambassador. Technologies are allowing scientists to better understand the genetic makeup of this tree, which has been productive more than 200 years.

ON THE COVER: Russ Jackson, a farmer from Mountain View, Oklahoma, kneels in one of the fields where he practices diverse crop rotations year-round and incorporates cattle grazing as part of his regenerative agriculture journey. Jackson is one of three producers who share their experiences in improving the land in "The Journey," beginning on page 24.

LEGACY

Spring 2020 | Vol. 14, Issue 1

Steve Rhines
PRESIDENT/CEO

J. Adam Calaway
EDITOR/WRITER

Rachael Davis
GRAPHIC DESIGNER

Rob Mattson
PHOTOGRAPHER

Courtney Leeper
COPY EDITOR/WRITER

Robyn Peterson
WRITER

Tim Woodruff
WEB

CONTRIBUTING WRITERS
Marilyn Cummins
Denice Rackley
Jessica Willingham

Legacy is published by the Department of Communications at Noble Research Institute. Headquartered in Ardmore, Oklahoma, the Noble Research Institute is an independent, nonprofit agricultural research organization dedicated to delivering solutions to great agricultural challenges. *Legacy* offers insight into the outstanding scientists and agricultural consultants who pursue the vision of founder Lloyd Noble.

Reprint requests may be made by contacting J. Adam Calaway, director of communications and public relations, at 580-224-6209 or by email at jacalaway@noble.org.

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Noble Research Institute, LLC
2510 Sam Noble Parkway
Ardmore, Oklahoma 73401
580-223-5810 (general information)
580-224-6209 (media)

ISSN: 1939-5035

NOBLE RESEARCH INSTITUTE

TO OUR READERS: TRANSFORMATIONAL LEARNING EQUALS TRANSFORMED LAND

Earlier this year, I had the great privilege to speak to The Economic Club of Oklahoma about Noble's mission and activities. Short of speaking about my wife and sons, there is nothing more I like to discuss than Noble.

Our organization's story begins with our founder, Lloyd Noble, and his vision for restoring soil and safeguarding the land for future generations. We have worked toward his vision for more than seven decades thanks to the support and leadership of Noble and his descendants. It's an amazing story, and I'm always excited to share it.

In preparation for my talk, I came across this quote from Noble, who spoke these words to the Tulsa Farm Club on Jan. 22, 1948 (just three years after he established our organization):

"Our major interest, however, insofar as the soil program is directly concerned, is putting at the disposal of our contestants and others who observe the work that is being done, a source of knowledge that after it becomes a part of them, will cause them to have more confidence in themselves."

I read and reread the quote. Each time the same phrase struck me — "after it becomes a part of them." The "it" was (and is) the knowledge of a method of farming and ranching that is both profitable and regenerates the soil. Noble understood that knowledge for knowledge's sake is not enough. Awareness alone changes nothing. A transformation of thought is the first step. The first step allows us to gain confidence and comfort that enables a transformation of practice. The "it" — the knowledge — has to take root and become part of who you are to be lasting.

SO OFTEN THE PRODUCERS WE WORK WITH DISCOVER WHAT THEY NEED MOST IS AN EXPERIENCED FRIEND TO ENCOURAGE AND OFFER PERSPECTIVE.

Within the pages of this issue of *Legacy,* you will read about three ranchers who exemplify the transformational learning required to undertake regenerative agriculture (the process of restoring degraded soils using practices based on ecological principles). So many producers are coming to the realization — just as Mr. Noble did — that we cannot simply sustain degraded land. We must repair and improve it.

Transitioning to a regenerative system is a slow process, and it requires an understanding that soil improvement is a long-term effort. Managing a regenerative system takes intentional work. The biological process is complex and intertwined with weather, moisture, seasons, supported plants, livestock and wildlife.

This is where Noble Research Institute comes in. Noble not only offers research-based information. We walk alongside farmers, ranchers and land managers. So often the producers we work with discover what they need most is an experienced friend to encourage and offer perspective. Noble is happy to fill this role through one-on-one interaction or through group educational events.

In our educational events, we bring together like-minded producers to meet, interact, and learn from us and each other. They grow stronger through collaboration and help each other apply knowledge into the real-world setting.

As we look to the future, imagine regenerative practices powered by the hands and hearts of the nation's livestock producers, guided by mentors who possess research-based answers and quality information, fueled by collaboration, and applied to more than 650 million acres of pasture and rangeland across the country.

Regenerative agriculture can transform the land for all of society, building healthy and more productive soil that is drought- and flood-resilient; decreasing the use of chemical inputs and subsequent pollution; providing cleaner air and water; enhancing wildlife habitat; and capturing carbon in the soil to mitigate climate variability.

Regenerative agriculture is not a switch to be flipped or a quick-fix elixir. It is a working journey. It requires farmers, ranchers and land managers willing to transform their thinking and to allow that thinking to transform their actions. This, in turn, is how we transform the land for this generation and all those to come.

Sincerely,

STEVE RHINES, PRESIDENT AND CEO

WHAT IS A PHYTOBIOME?

This holistic view of plants and everything around them may be the answer to feeding the world's growing population.

by Marilyn Cummins

Seven years ago, a group of scientists met to discuss how crop production could possibly meet the food needs of the 9 billion people expected to be on the earth by the year 2050. Out of that meeting came a new word — "phytobiome" — to describe plants, their environment and the complex world of organisms associated with them.

Why is this new word and concept important to producers? Because to be able to increase production quickly and sustainably, producers will need to consider and learn to manage the whole phytobiome with a systems approach rather than focusing on individual components alone, according to the Phytobiomes Roadmap developed by American Phytopathological Society.

Interactions within phytobiomes, such as croplands and rangelands, are dynamic and affect the health of soil, plants and the entire ecosystem. Researchers believe a richer understanding of phytobiomes will lead to new practices that can maximize yields while protecting the land.

Research in many disciplines will initially look deep into the phytobiome networks and collect information on all the components. For example, scientists now can identify and sequence the genes of large numbers of soil microbes to take a snapshot of well-performing communities. Knowing just what kind of microbiome a particular plant needs in order to flourish may let producers grow such plants, and others, on depleted soils.

The best practices for a given field or pasture will consider the interactions of all phytobiome components, which influence yield, quality, safety and sustainable production. Ultimately, producers in the future would be able to manage seeds, biologicals, nutrients, soil, water, microbial communities and other phytobiome components with tools that allow them to sow seed and apply inputs in just the right places, at just the right amount.

Specifically, a vision for phytobiomes is that by 2050, all farmers will have "the ability to use predictive and prescriptive analytics based on geophysical and biological conditions for determining the best combination of crops, management practices, and inputs for a specific field in a given year."

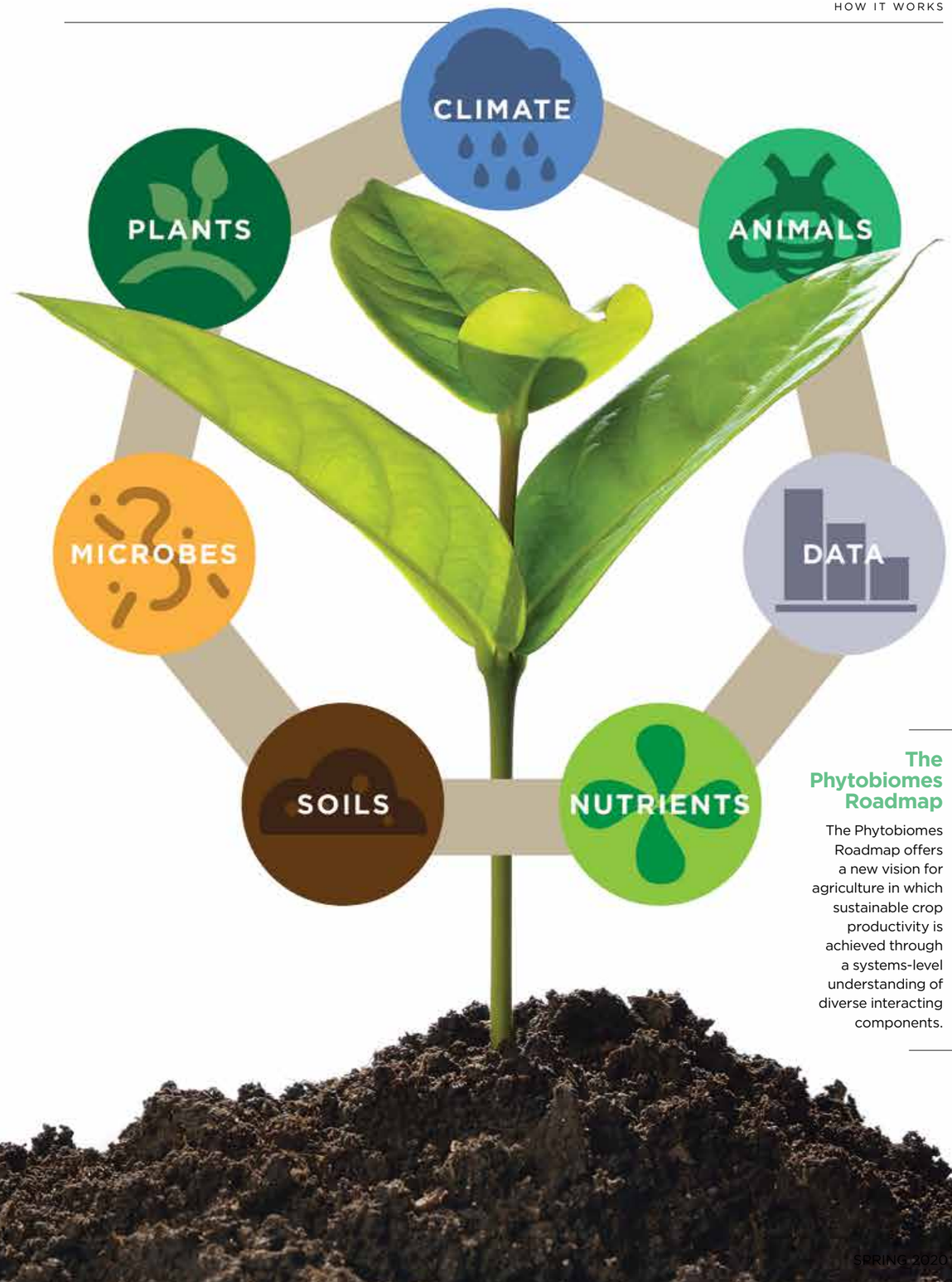
Phytobiome = A plant (phyto) in a specific ecological area (biome). It includes the plant itself, the environment and all organisms living in, on or around the plant.

Why the Phytobiomes Approach?

Managing with attention to the whole phytobiome as opposed to one component (such as soils or nutrients alone) can:

- **Increase resilience to water and nutrient limitations and heat stress.**
- **Increase resilience to the ongoing emergence of new pests and pathogens.**
- **Reduce crop losses due to pathogens and pests without relying solely on pesticides.**
- **Enhance safety, quality and nutrition of our food supply.**
- **Reduce reliance on external inputs to sustain crop productivity.**
- **Regenerate the land.**
- **Increase profitability.**

Learn more at www.phytobiomes.org/Roadmap/Pages/default.aspx



The Phytobiomes Roadmap

The Phytobiomes Roadmap offers a new vision for agriculture in which sustainable crop productivity is achieved through a systems-level understanding of diverse interacting components.

ABOUT THE NOBLE EXPERTS

Both Kelly Craven, Ph.D., and Carolyn Young, Ph.D., helped write the Phytobiomes Roadmap during a session held at Noble Research Institute, and Young is editor-in-chief of *Phytobiomes Journal.* Craven researches how to use plant microbiomes to more effectively provide nutrients to plants for more crop productivity with fewer agronomic inputs, and Young's research includes working with beneficial microbes that can add value to grasses like tall fescue and mitigating microbes that cause pecan scab.

PHYTOVISION: BEYOND A SIMPLE MEASURE

A computer-controlled camera system developed by Larry York, Ph.D., uncovers potential plant traits that could benefit forage growers through improved varieties.

by Courtney Leeper

Some plants naturally tolerate heat and drought better than others, and those are the ones that Xuefeng Ma, Ph.D., wants to use in his plant breeding program for a wheat that can be planted earlier in the fall on the southern Great Plains. To find those plants, researchers go through a "trait discovery" process, where they look for characteristics that may ultimately be helpful to farmers and ranchers. It's a process that once required in-depth manual observation but can now be assisted by technology, including PhytoVision, which is being developed by Larry York, Ph.D., assistant professor, and Anand Seethepalli, computer vision analyst, at Noble Research Institute. "Phyto" is derived from the Greek word for plant.

PhytoVision takes pictures of plants in various growing conditions using a computer-controlled camera with a software program, called Imager, the team has developed. Another software program in development analyzes the images and provides researchers with data related to the plants' growth and health. From the data, researchers can learn more about which plants would make good parents for future forage crop varieties.

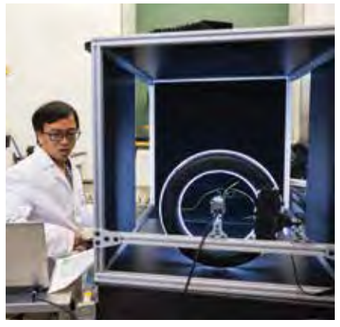
The more data researchers have, the better breeding decisions they can make. York notes that PhytoVision has been used to collect nearly 200,000 plant images, and the application for uncovering beneficial traits for improving crops is endless.

PhytoVision is currently used in three forms at Noble Research Institute:

The PhytoVision system recognizes and cuts out the plant part of a picture, then measures:

- **Greenness (an indicator of health)**
- **Leaf count**
- **Leaf length**
- **Total leaf area**

1 IN THE LABORATORY



Plants are grown in the extremely controlled conditions of a growth chamber to study the effect of a specific temperature on plants. Plants are then taken into a laboratory booth, where PhytoVision snaps a picture of a single plant.

2 IN THE GREENHOUSE

Using the same gantry setup that a movie studio would use to move a camera across a scene, researchers use PhytoVision to "fly" over plants grown in the greenhouse. The camera is set to take photos at regular time intervals, and analysis uses the same principles used in UAV or drone imagery.

3 IN THE FIELD

PhytoVision is attached to a cart that is wide enough to roll over Ma's small plots, where different varieties of wheat grow. Plant size and health will be measured over time for each of the plots focusing on the first few months of growth.

RESEARCH COLLABORATION AIMS TO IMPROVE EFFICIENCY IN CATTLE RANCHING OPERATIONS

Noble Research Institute and GrowSafe Systems have entered into a new research agreement that aims to improve efficiency in cattle production and aid ranchers in making management decisions. The new research collaboration extends a partnership between Noble and GrowSafe that dates back to 2010.

"Collaboration and research are cornerstones to promoting proper land stewardship and regenerative agriculture," said Steve Rhines, Noble Research Institute president and chief executive officer. "We understand the challenges that ranchers face each day. Noble's goal is to partner with like-minded companies to conduct transformational research that promotes efficient use of resources while helping producers stay viable. A producer who is profitable will make decisions focused on regenerating their land. Healthy land, in turn, is good for all of society."

The five-year research commitment embarks on three sequential studies to standardize methods of measurement, demonstrate selection for residual feed intake in both dry lots and pastures, and integrate databases spanning from land stewardship to producer profitability.

The research will focus on the use of GrowSafe Beef, in-pen weighing units that measure individual animal body weights and watering behavior while animals drink at a water trough.

"We are delighted to align ourselves with industry-leading partners such as Noble Research Institute who provide the high-quality research necessary to develop innovations that bring genuine benefit to the producer," said Gareth Llewellyn, GrowSafe Systems chief executive officer.

"The future is in managing animals as individuals across their whole lifetime. I believe it is up to us, the technology providers, to provide the answers for how we will do this in a cost-effective manner. We need to work together to create a common, open ecosystem that enables data to be combined and shared."

Research will use GrowSafe Beef units in studies that focus on improving efficiency in cattle production.

Noble Laboratories Receive My Green Lab Certifications

Four Noble Research Institute laboratories recently participated in the My Green Lab sustainability certification program. Noble is the first research organization in Oklahoma to participate in the program.

Each laboratory was assessed in the areas of electricity, lighting, cold storage, fume hoods and ventilation, water, inventory management, recycling waste reduction, hazardous waste, green chemistry, field work, and community.

"We had two program leaders who helped the researchers along the way," said Michael Udvardi, Ph.D., Noble Research Institute chief scientific officer. "They customized the program specifically to meet our organizational focus and operations, which will provide us the opportunity to add more of our laboratories to the program each year. Everyone's hard work has helped us all be better stewards of our resources."

Noble's Functional Genomics Laboratory and Microbial Symbiology Laboratory reached the platinum level, the Molecular Plant Nutrition Laboratory reached the gold level, and the Molecular Plant Microbe Laboratory reached the silver level.

My Green Lab's certification program is designed for individual laboratories to identify energy-saving and water-saving measures, opportunities for waste reduction, and ways to minimize the use of hazardous materials.

"Laboratories are one of the major frontiers in sustainability," said Eric Dunn, Noble Research Institute facilities coordinator. "The opportunity to reduce waste, save energy and water, and use 'green' products in these environments is enormous. Saving time, water and energy is important to our organization."

Laboratory staff from the four participating research groups hold their My Green Lab certifications alongside Noble's stewardship and sustainability program co-coordinators. Front, from left: Sylvia Warner, Ivone Torres-Jerez and Bikram Pant. Back, from left: Myoung-Hwan Chi, Jie Cai and Paula Barbour.

Kiran Mysore, Ph.D.

AAAS Names Noble's Mysore as 2019 Fellow

Noble Research Institute professor and principal investigator Kiran Mysore, Ph.D., has been named a Fellow of the American Association for the Advancement of Science (AAAS) — the world's largest general scientific society. Fellow is the highest honor bestowed by the organization.

"I'm honored that my research has been recognized by the AAAS and my peers," Mysore said. "I look forward to applying the results of our fundamental research to agricultural problems in our region and around the world."

Mysore was elected as a fellow for his distinguished contributions to the field of molecular plant-microbe interactions, particularly in the area of non-host resistance, and for developing genetic resources for plant functional genomics.

At Noble Research Institute, Mysore's research is focused on finding new disease resistant genes in plants to help reduce crop plant losses.

Coffey Family Receives Oklahoma Leopold Conservation Award

Chuck and Ruth Coffey have been selected to receive the 2019 Oklahoma Leopold Conservation Award. The award recognizes exceptional farmers, ranchers and foresters who inspire others with their dedication to land, water and wildlife habitat management on private, working land.

The Coffeys are fifth-generation ranchers who raise cattle on primarily native range near Springer, Oklahoma, with their three children, Aaron, Seth and Sarah. They regularly use rotational grazing and prescribed fire to improve biodiversity and the overall quality of their soils and water for the benefit of their operation as well as wildlife and the entire ecosystem.

"Chuck is not only a fearless pioneer in trying new things that will protect his soil, grass, enterprise and family, but he is one of the most generous people that I have ever met in sharing his time and knowledge to benefit his neighbors — both near and far," said Hugh Aljoe, Noble Research Institute director of producer relations, who has worked with the family for 24 years.

The Coffey family has hosted tours for students and professionals, demonstrated innovative uses for prescribed fire, and served in various industry leadership roles. Chuck is the immediate past chair of the National Cattlemen's Beef Board, and Ruth is a past president of the Oklahoma Cattlewomen's Association. They recently helped lead the formation of the Arbuckle Rangeland Restoration Association, which is comprised of local producers helping one another with prescribed burning and other ranch management activities. Aaron and Seth both serve as officers for the association.

Ruth and Chuck Coffey

Feral hogs cause an estimated $1.5 billion in damages each year.

Josh Gaskamp Shares Research-Based Perspective With House Subcommittee

Josh Gaskamp, Noble Research Institute technical consultation manager and wildlife and range consultant, provided testimony to the U.S. House Ag Subcommittee on Livestock and Foreign Agriculture in November 2019. During the hearing, "Safeguarding American Agriculture from Wild, Invasive and Non-Native Species," Gaskamp provided information that shows how feral swine populations continue to grow at the expense of agricultural production, wildlife populations and native ecosystems, as well as the need to continue developing advanced tools and strategies that producers can use to control feral swine populations.

To read Gaskamp's and other witnesses' testimonies, go to bit.ly/32FUuHe

Jimmy Davis Receives Excellence in Rangeland Management Award


Jimmy Davis (left). Photo courtesy of OKSRM.

The Oklahoma Section of the Society for Range Management has selected Jimmy Davis as its recipient of the 2020 Excellence in Rangeland Management Award.

Davis oversees approximately 17,500 acres of land, 400 cows and eight employees in Oklahoma and Texas as ranch operations manager for the Flying J Ranches. He has worked to create a defined breeding season for the herds and to implement an aggressive brush management program using herbicides and prescribed burning.

"Davis is able to use prescribed burning more effectively than most," said Steven Smith, Noble Research Institute wildlife and range consultant who has worked with Davis since 2016. "These burns were possible only because he had a stocking rate that allowed him flexibility. Because of his success, he has been able to wait until December to start feeding supplemental protein and until February to feed his first bale of hay."

More recently, Davis has started creating a wildlife hunting enterprise with long-term wildlife goals in mind, generating about $38,000 per year. He also has developed an entire ranch management plan and intends to use the strength of each separate ranch to its maximum potential. Through his leadership, the ranch has saved or generated several hundred thousands of dollars since 2016.

Wells Serves as Secretary-Treasurer for Professional Animal Scientists


Robert Wells, Ph.D.

The Southern Chapter of the American Registry of Professional Animal Scientists elected Robert Wells, Ph.D., Noble Research Institute livestock consultant, as the 2020 Secretary-Treasurer during their annual convention in January. The Southern Chapter includes professional animal scientists from Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas and Virginia.

Ranchers Receive Answers to Pressing Questions Through Noble Facebook Page

Farmers and ranchers were already trying to navigate risk and financial uncertainty. Then COVID-19 hit. Noble Research Institute agricultural consultants have been working to help guide producers through their everyday challenges as well as new circumstances in these unprecedented times.

Producers are invited to send their most pressing questions to Noble Research Institute through a Facebook message. These questions can be on any agricultural topic, from cattle to soil health to backyard gardening. Questions are reviewed by Noble consultants, then the questions and answers are posted on Noble's Facebook page.

To submit your questions, go to www.facebook.com/nobleresearchinstitute and search for the Facebook Messenger icon.

FROM OUR FEEDS

FOLLOW ALONG @nobleresearchinstitute @nobleresinst

We love to connect with colleagues and friends on social media. Join us today to see what people have been saying, and follow #everyNoblestory to see more science serving agriculture through the eyes of Noble researchers.

The cattle industry has been hit by losses estimated at more than $13 billion. Check out our five recommendations for cattle producers impacted by depressed markets. To read more, visit: **bit.ly/depmarket**

What does the early-season freeze mean for your pecan crop? Despite losing pecans in the lower canopy from a freeze, a healthy tree should still produce a few nuts in the lower canopy and a good crop in the upper canopy. To read more, visit: **bit.ly/pecanfreeze**

The U.S. Department of Agriculture will distribute $9.6 billion to farmers and ranchers affected by the #COVID19 pandemic. To read more, visit: **bit.ly/USDAaid**

Tom Krshka switched to no-till methods more than a decade ago. He has watched his forage's roots grow deeper and stronger. His soil has come alive with earthworms and other natural biome workers. To read more about his story and journey with Noble, visit: **bit.ly/nfannualreport**

Check out these five steps for successful pest management. Eddie Funderburg, Ed.D., senior soils and crops consultant, explains these steps in his latest article for *Progressive Forage*. **bit.ly/3aYGpJU**

Did you know that National Agriculture in the Classroom has a free farming app? "Farmers 2050" is an educational game where students grow crops, raise livestock, sell goods and engage with global partners as they practice #Sustainable Agriculture. Designed for middle and high school students, the game is fun for the entire family! **bit.ly/farmers2050**

IN CASE YOU MISSED IT:

HOW DOES SOIL HEALTH PREVENT FLOODING AND DROUGHT?

Jim Johnson, a senior soils and crops consultant at Noble Research Institute, walks us through a rainfall simulation experiment.

To watch the video, visit: bit.ly/rainsimulator

Instagram TOP 5

FOLLOW ALONG @nobleresearchinstitute

5. Happy National Ag Day! To all the farmers and ranchers working relentlessly to care for the land and their livestock, we thank you, today and every day. 4. Noble Learning provides farmers and ranchers with targeted educational opportunities that draw together technology, innovation and best management practices. 3. Happy New Year! What goals do you have for your ranch this year? 2. Jim Johnson, senior soils and crops consultant, spoke at a no-till conference in Kansas about using no-till, cover crops and grazing to feed the soil with nutrients to increase water holding capacity. 1. Calving season is upon us!

3 Things to Look Up

Viral Deer Video

Have you seen the viral video of a deer shedding its antlers? TIME shares the video and cites a Noble Research Institute article about managing for antler size.

To read more and watch the video, visit bit.ly/deershed

BQA Certification

Do you want to become Beef Quality Assurance certified? You can become certified online.

Online classes: bit.ly/bqa-online

COVID-19 and Markets

Noble consultants provide five recommendations for producers trying to navigate the situation.

Check out www.noble.org/depressed-cattle-markets

Q AND A

What is one piece of advice/ information that producers can use to immediately improve their operations?

“It’s important to keep good records on your cattle and land. **You can’t manage what you don’t measure,** and record-keeping is a good management tool to measure success and improvements.”

BECCA MCMILLAN
CATTLE PRODUCER AND
NOBLE RESEARCH INSTITUTE
SENIOR ADMINISTRATIVE ASSISTANT

“**When considering the planting of a new forage for your operation,** always take advantage of genetically improved varieties for your region and choose those that were bred for your conditions. If a forage variety is adapted, it will probably be successfully grown on your farm or ranch.”

MIKE TRAMMELL
NOBLE RESEARCH INSTITUTE
SENIOR PLANT BREEDER

“**One piece of advice about intentional management planning — just start.** Begin with a pasture management plan and a conservative stocking rate. If cows are the factory and calves the product, pastures are the foundation, utilities and resources supporting the factory. Operating at optimal capacity means the factory can consistently operate to produce a quality, marketable product. Taking good care of the pastures first allows one to more easily do that.”

HUGH ALJOE
NOBLE RESEARCH INSTITUTE DIRECTOR
OF PRODUCER RELATIONS AND
PASTURE AND RANGE CONSULTANT

“**Use your resources — the people who can help you.** This could include Noble consultants, universities or someone else with scientific knowledge in the area you want to work on.”

JOSH GASKAMP
TECHNICAL CONSULTATION
MANAGER AND WILDLIFE AND
RANGE CONSULTANT

“Accurate records help you identify and **capitalize on opportunities for profit.** Don’t just assume your feed program, genetics, grazing plan or marketing strategies are profitable.”

CAITLIN HEBBERT
NOBLE RESEARCH INSTITUTE
LIVESTOCK CONSULTANT

SOLVING THE JEFFERSON TREE MYSTERY

Maria Monteros, Ph.D., visits France to identify the genetic history of a 233-year-old pecan tree and learn what makes it so resilient.

BY JESSICA WILLINGHAM

PHOTOS COURTESY OF MARIA MONTEROS

A pecan tree grows in the courtyard of the Chateau Carbonnieux Estate in Bordeaux, France, where Thomas Jefferson visited in 1778 during his time as a U.S. ambassador to the country. Jefferson, a farmer from Virginia, was known to experiment with different agricultural production techniques. One of the crops he was interested in was pecan.

Think of pecans and you might remember Thanksgiving pie or a forgotten snack found in a farmer's pocket. Or — for many who live in the South — you might picture low-hanging fog over a pecan bottom on a cold October morning, right before a sunrise illuminates a series of trees. Pecans represent generations of stewardship and cultivation. The native nut's history is rooted in American lore, frozen in time and partially lost.

In 1846, a master gardener and slave named Antione grafted a superior wild pecan branch to a seedling on the Bon Séjour Plantation — known today as famous Oak Alley — along the Mississippi River in Louisiana. The result was an exceptional fruit: at the end of twisting gray bark and underneath bright green leaves grew a long, narrow nut with an unmatched flavor and remarkable resilience. In 1876, the new tree became known as Centennial and is now recognized as the first grafted pecan — the first named pecan cultivar that started the industry.

Rewind history again to 1787 and another agronomist fatefully finds a similar, closely-related wild pecan variety, likely from the same region near the Mississippi River where Antoine would later work. Thomas Jefferson,

ambassador to France and future president of the United States, wrote a letter home to America from his trips abroad, asking for "two or three hundred Paccan nuts from the Western country . . . they should come as fresh as possible, and come best, I believe, in a box of sand."

The seeds were shipped and planted on the European Continent, where they would grow for the next 233 years. Until now, that was all the information modern agriculture had: an American tree in France, our Founding Father's letters and a pecan cultivar first described by a plant pioneer we only know by first name.

Thankfully, trees have longer memories than we do.

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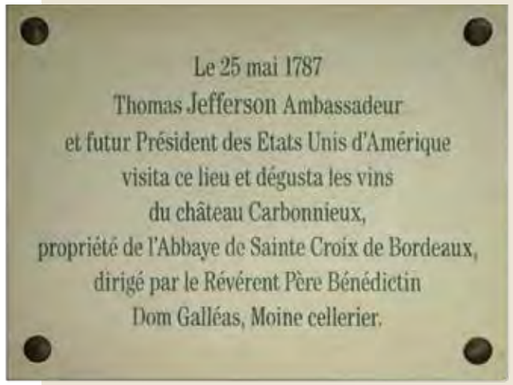

AN AMERICAN IN FRANCE

A plaque at the Chateau Carbonnieux Estate in Bordeaux, France, commemorates Thomas Jefferson's visit to the region. It says:

May 25, 1787: Thomas Jefferson, Ambassador and Future President of the United States of America, visited this place and tasted the wines of the Chateau Carbonnieux, property of the abbey of Saint Croix de Bordeaux, directed by the Reverent Father Benedictin Dom Galleas, Monk Cellarier.

Madame Perrin (middle), whose family has managed the Chateau Carbonnieux Estate since 1956, and Bernard Dalisson, president of the Jefferson Pecaneers, (right) pose with Maria Monteros, Ph.D., Noble Research Institute professor. The Jefferson Pecaneers invited Monteros to take samples of the Jefferson Tree for her research, with permission from the Perrin family.

ABOVE: Bernard Dalisson, president of the Jefferson Pecaneers, holds a pecan from the tree that Thomas Jefferson planted in Bordeaux, France, in 1787. Maria Monteros, Ph.D., collected the nut to bring back to the U.S. for her research study aimed at understanding the tree's genetic makeup.

TOP: Maria Monteros, Ph.D., collects small leaf samples from the Jefferson tree.

THE JEFFERSON TREE

Maria Monteros, Ph.D., professor of legume genomics at Noble Research Institute, made a stop at the Chateau Carbonnieux in southern France in May 2019 during an invited trip to share advancements in genomics and their application to solve practical questions in agriculture.

She didn't come to the vineyard for wine or grapes but to see the Jefferson Tree — a gift to France from Jefferson himself during his 1787 goodwill tour — at the invitation of the Jefferson Pecaneers. The volunteer group is dedicated to planting and caring for saplings grafted from Jefferson's experimental French orchards and to expanding relationships between the U.S. and France.

Monteros found the original pecan tree, and three others, still alive in the courtyard, standing 98 feet tall and nearly 15 feet around, with young leaves emerging after the tree went dormant during the winter. Littering the ground below were a handful of pecan nuts, long and narrow from the previous production season.

A plaque in the courtyard and Jefferson's historical correspondence provided evidence confirming this tree's story and ancient age. The rest of the story, including the likely origin and the modern varieties most closely related to this majestic tree, still standing after more than 200 years, was a mystery — one Monteros aimed to solve.

"Having worked mostly with plants that are productive for only one to five years, I was intrigued by this opportunity to collect fresh leaves from a tree that is still producing nuts more than two centuries after it was planted," Monteros says. "The historical secrets hidden within the tree's DNA, or genetic blueprint, could explain the origins of the Jefferson tree and the unique composition that has allowed it to grow for so many years."

Monteros knew the trees must have come from hardy stock, and Jefferson's letters have fueled her thoughts on what he might have been going through in the 1700s. Jefferson was experimenting with growing pecans in a different environment, and his work could have a farther reaching legacy than he might have imagined.

"The same tools used to identify the genetic blueprint of the Jefferson Tree could be used to identify the specific cultivars grown in existing orchards around the world," Monteros says.

"Unlocking these genetic secrets could help develop solutions to address current and emerging challenges for pecan growers."

A DNA FINGERPRINT

To know where you're going, you have to know where you've been. That's a tough journey to follow in a pecan orchard.

Different pecan varieties express different characteristics. Each pecan nut is a genetic combination of the mother tree and the paternal airborne pollen, which can be sourced from any nearby tree. Together, this random pairing in a tree produces individual nuts with a unique DNA composition.

Pecan trees take nearly a decade to produce nuts, and the unique DNA instructions determine the size, shape and color of those nuts. Right now, growers rely on these physical characteristics to identify what cultivars they have growing in their orchards.

"One of the historic challenges of pecans is the wait," Monteros says. "It can take eight to 15 years for a tree to produce the nuts that are needed for identification of the variety."

The leaves of the 233-year-old Jefferson Tree in Bordeaux, France, hold the secret combination of genetic materials that have enabled the tree to remain productive for so long. Maria Monteros, Ph.D., and her team aimed to unlock those secrets for the benefit of modern pecan growers.

In addition, orchards are often inherited, sold or combined without passing on genetic knowledge through a paper trail. Growing conditions, including the amount of water available, and disease can affect the shape of the nuts from year to year, resulting in potential misidentification.

To bring an orchard's history to present-day growers, Monteros and her team developed a DNA fingerprinting toolkit for pecans. Unlike the visual characteristics of the nut, the order of the four possible letters in the DNA genetic code is more stable and is passed on from generation to generation.

The DNA fingerprint approach uses a young leaf to identify the tree's unique order of letters. Similar to the unique ridges on the fingers of different individuals, the genetic code of a pecan tree can be used to find its closest relatives. Trees that share the highest number of letters that are in the same order are more closely related.

It was this approach that Monteros used to learn whether the Jef-

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AN AMERICAN NUT GROWING IN FRANCE

This plaque is placed in front of the tree that Thomas Jefferson planted at Chateaux Carbonnieux Estate in Bordeaux, France. It says:

This pecan, American nut, tree was planted May 25, 1787, by Thomas Jefferson during his visit to Bordeaux. It is the oldest of its kind present in European soil.

Pecan trees, including the one that Thomas Jefferson planted (not pictured here), grow in the courtyard of the Chateau Carbonnieux Estate in Bordeaux, France. Maria Monteros, Ph.D., and her team used the DNA fingerprinting technique they developed to determine that the tree planted by Thomas Jefferson is most closely related to a variety called Centennial.

LOOKING TO THE PAST FOR THE FUTURE

Discoveries like Monteros' create opportunities to help provide the industry with improved cultivars that reduce on-farm inputs and offer higher international demand.

> "With new genetic tools, we'll be able to develop new trees that improve production in the face of climate variability and generate a greater return for the grower." —CHARLES ROHLA, PH.D.

ferson Tree is related to any known pecan varieties or if it was the only known survivor of a completely different variety.

The answer: The Jefferson pecan trees growing at the Chateau Carbonnieux are most closely related to Centennial when compared to more than 100 other named pecan varieties, providing a thread of connection between the trees that Jefferson brought during historical trips to France with the tree first grafted by Antoine.

LOOKING TO THE FUTURE

Now that Monteros and her team, including Yanina Alarcon, have solved a puzzle from the past, they are excited for the future with new opportunities for research and using the pecan genome to deliver practical solutions to production challenges.

A future industry-wide DNA-identification system could help growers understand the unique characteristics of the trees in their orchards. For example, knowing if the trees are susceptible to fungal pathogens provides information to promptly develop an integrated management plan deploying fungicides with complementary modes of action.

Maria Monteros, Ph.D., records notes and carefully prepares leaf samples from the Jefferson tree so that the DNA within them can be analyzed. The research will provide information that can help develop trees better able to solve growers' challenges.

These same technologies can also inform decisions to develop new pecan varieties with specific disease resistance capabilities as well as more desirable flavor profiles and nutritional characteristics.

"Producers are always looking for the perfect cultivar," says Charles Rohla, Ph.D., pecan and specialty agriculture systems manager at Noble Research Institute.

This new era of research takes time, Rohla adds, but discoveries like Monteros' create opportunities to help provide the industry with improved cultivars that reduce on-farm inputs and offer higher annual production to meet an increasingly higher international demand. It's only a matter of time before the health foods market demands greater production of the original superfood nut.

"We're late to the game and the market compared to other nuts, but we're making huge strides," Rohla says. "With new genetic tools, we'll be able to develop trees that improve production in the face of climate variability and generate a greater return for the grower."

When asked about the pecan tree of the future, Monteros envisions new varieties that survive droughts or flooding and fungal pathogens, and that are more resilient in variable weather conditions. These technologies can also provide insights on pecan flowering and promote more uniform nut yields from year to year or alter a nut to have a more complex depth of flavor.

Through research and the ingenuity of producers, the pecan could be as nuanced as wine.

"We can start thinking of what the ideal tree would look like," Monteros says. "We're trying new things and solving puzzles. That's what drives science today."

Three Oklahoma ranchers share their regenerative agriculture experiences and best advice for those on

THE JOURNEY

BY COURTNEY LEEPER

◀ **RUSS JACKSON, MOUNTAIN VIEW, OK,** began his journey into regenerative agriculture in 2006 by implementing no-till and adding crop rotations to the wheat and stocker cattle operation that he and his father managed. Today, he intentionally keeps the ground covered with a diverse mix of plant species he uses for both grain and grazing.

Some set out on journeys with intention and focus,

while others find themselves on unexpected paths. Sometimes it's out of necessity, while other times out of a driving desire to do better.

When it comes to regenerative agriculture, the road is often paved with uncertainty, risk and a divergence from tradition. Practices that once seemed tried and true may actually contribute to the problem instead of solving it.

Hope for this particular journey is found in those who stepped into the unknown first, who acted on faith early. They speak of what they have seen along the way — of how they have drastically reduced or eliminated their need to buy fertilizer. Of how their soils hold more water for longer amounts of time, even through drought. These are the men and women who are rethinking what has been done in agriculture and reshaping what will be done. They are inspiring a new generation of agricultural producers focused on making decisions that impact the entire ecosystem, not just a singular element.

The regenerative agriculture journey continues along a spectrum, moving individuals from conventional practices to regenerative, which focus on restoring degraded soils. It has no endpoint and looks different for everyone. Those who are on the journey warn that there is no such thing as easy answers, but they don't mind asking the tough questions. And they don't mind failing. They say you can learn as much from your failures as your successes. Most importantly, they will tell you — don't walk alone.

Russ Jackson rented his first farm as a high school junior. More than three decades later, the third generation farmer from Mountain View, Oklahoma, notes he had only been taught to pick up a shovel and take a closer look at the soil within the last 10 years.

When he began his journey into regenerative agriculture in 2006, soil health was not on the agenda. He and his father were primarily growing wheat and stocker cattle, and they realized they needed to figure out a way to reduce costs with the price of fuel and other inputs rising and the labor pool shrinking.

The father and son decided to rotate in some additional crops, starting with

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DIRECTION OVER PERFECTION

What is Regenerative Agriculture?

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 change.

Regenerative agriculture is a journey, not a destination. It's about moving in the right direction, not perfection. Noble is working to help producers find research-based answers to the questions they face when improving the land.

Learn more at www.noble.org/direction-over-perfection.

NOBLE NETWORK

Find Others on the Road

The most valuable resource you can have when beginning the regenerative agriculture journey is other people. One way to find people is to reach out to organizations, like Noble Research Institute, that already have relationships with a network of like-minded producers as well as subject-matter experts. Connections can be built through conversations that take place during educational programs and other meetings or even online.

"We may be reluctant to go to a meeting when someone might tell us we're doing it wrong, but go anyway," says Russ Jackson, who says connections made through Noble's network are beneficial for both the farm and friendship. "In the beginning, I was bound and determined to make all the mistakes on my own. You don't have to do that."

Instead, tap into the knowledge of those who are further along the road.

"It took me 10-12 years to get to where I am," Jackson says. "With what we know now about cover crops and grazing, you could get there in half the time."

LOOK LOCALLY

"I spent a lot of time looking at what other people were doing in my area. Look around locally. Go to your conservation district, to NRCS or to Noble Research Institute to find other producers. Ask if you can shadow them for a day. You can learn a lot just driving around with them." —Shane O'Daniel

GET INVOLVED

"Get involved with organizations and meet people who are finding success with what you want to be successful in. Know that most people you're interested in are interested in sharing with you, so ask questions. I start with, 'Tell me everything you know.' I may get one lead out of it and then I can follow it. But follow up within 48 hours, or you likely won't." —Bruce Reynolds

Integrating livestock is an essential principle in building soil health.

Farmers and ranchers, including Russ Jackson, who apply soil health principles to their operations have been able to gradually reduce applications of fertilizer and chemical pesticides. This saves them time and money, and reduces pollution.

> “Find someone who knows what they’re talking about. It really helps when you have someone early on with a shovel who can show you that you’re making gains. I also wish I would have put some soil in an air-tight bag when I started so I could see how much it has improved. I know there has been a world of difference.”
>
> —RUSS JACKSON

canola then cotton, and to try no-till. They had seen the two practices used in South Dakota, where Jackson’s father had traveled to help harvest fields since he was a teenager. They figured if it could work in a place that received half the rainfall as their part of Oklahoma, they could give it a try.

The first two years of no-tilling were tough, Jackson recalls, but they began to see definite changes. The first was slowed erosion. They continued by pushing double crops of milo or soybeans after harvesting wheat, keeping a live root in the ground.

“It took five years to get in the right mindset and headed in the right direction,” Jackson says. “But still, we weren’t thinking much about soil health.”

In 2014, Jackson saw that his yields had plateaued again. He heard about the No-Till on the Plains conference and, after more than a year of considering it, he decided to book a hotel room and go. He intended to find a product he could buy to improve his crop, he says. What he found was that much of the conversation was on soil health, including cover crops and backing off from fertilizer.

“It was like trying to drink out of a fire hose for someone who hadn’t been around that much information since college,” Jackson says.

One of the speakers was Jimmy Emmons, who farms in northwestern Oklahoma, or what Jackson calls “far from premier farm country.”

“He had done all this research on what improving soil health was doing for water infiltration,” Jackson says. “He had lots of data. It woke me up to the change I needed to make.”

Jackson began incorporating cover crops, which he now considers part of his regular crop rotations. His goal is to never leave ground bare, one of the foundational principles of soil health, and he is always working on tightening those rotations so that he can get the right timing down for moisture while also getting dual use out of the crops.

For example, in February, a few cows grazed in a field with volunteer rye starting to sprout green growth amongst corn residue. The corn, which had been harvested for grain in December, was planted behind rye that had been harvested in June. Before that, the field grew cotton and then triticale. Heifers had given birth to their first calves on that triticale. And this June, Jackson plans to plant soybeans or cowpeas in this field.

“I like crops that have dual purposes — grain and grazing,” Jackson says. “If something fails, I like to be able to have another use for it.”

Increasing soil health has enabled Jackson to gradually reduce fertilizer and chemical pesticides, which has saved him time and money. It also contributes to — and is a direct result from — rebuilding a more resilient land resource that depends on what nature already provides.

“Right now, I could order a semi-load of chemical every day. But the way the times are, I don’t think it’s always going to be that way,” Jackson says. “It’s time to plan for managing weeds and pests in a different way. That’s not going to happen overnight, so we have to start somewhere.”

One way Jackson believes he can manage weeds and pests is to use his cattle more strategically. He currently plants a mix of species — often including oats, triticale, peas, turnips and radishes — in his pastures, which adds biodiversity, and he rotationally grazes cattle on the cropland covers. In the future, he plans on making rotational grazing a more prominent part of his program across both cropland and pastures. The challenge is ensuring he has enough water for cattle in smaller paddocks.

“I may have to cut back hard on cattle numbers to get to where I’m going,” he says. “That’s a big decision. Change doesn’t get any easier.”

After more than 12 years on the regenerative journey, though, the changes have resulted in a stark improvement. The soil has darkened as it stores away more carbon, and today it sticks to the roots — becoming almost as one with the plant, a sign that living associations between the two are gaining strength.

“This soil used to be compact,” Jackson says, taking a shovel to the ground, which he says has become a daily addiction in the past six years. “Now it’s something you might find in your flower bed. I couldn’t have gotten here, though, if it weren’t for searching out help and just going for it.”

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COVER CROPS

A Tool for Soil Health

“Cover crops can be useful tools for improving the land. They can help us directly or indirectly satisfy any or all of the soil management principles: increasing plant diversity, covering the soil, minimizing disturbance, keeping a living root in the ground and integrating livestock. It’s important to remember that planting cover crops is a practice that helps us follow principles, not the principle itself. So, we need to use this tool with purpose and strategy. One of the first questions we often get is, ‘What cover crop do I plant?’ When deciding to plant cover crops, look at what has worked for other people in your area and be adaptable. Also, know your goals and your unique situation. Consider when you need forage. Cattle love oats, which can be planted in fall and late winter. Think about what your next crop will be and what could benefit it. For example, you could add nitrogen to the soil with legumes like vetch or peas. Do you want to attract pollinators? You might consider including vetch, brassicas or sunflowers.”

—JIM JOHNSON, senior soils and crops consultant

BRUCE REYNOLDS, DAVIS, OK, manages 5,000 acres of native grasses and cereal rye pasture for cattle as well as alfalfa and sudan for high-quality hay. He is conscientious of incorporating soil health principles to boost soil organic matter and improve the overall quality of the land, air and water for the benefit of his operation and future generations.

PRESCRIBED FIRE

Essential for the Land

"Part of minimizing soil disturbance, one of the five soil health principles, is to actually 'optimize' the timing, frequency, intensity and duration of management practices that disturb the soil. One such practice that is both a disturbance and an essential process for the land's health is fire. The Great Plains evolved under a combination of fire, grazing and rest, and land managers who use a combination of all three will find the greatest success. The amount of fire you apply depends on your goals. You should constantly monitor your plant community diversity and structure and apply prescribed fire, in coordination with grazing and rest, accordingly. The 'prescribed' aspect of fire is critical, as it means you have a plan that encompasses both how you will implement the burn and how you will do it in a manner that is safe for both you and your neighbors. One of the best ways to get started learning how to safely conduct prescribed burns is to help someone more experienced. You can meet people with prescribed burning experience through a local prescribed burn association. If there is not an association in your area, contact your local NRCS or county extension office for information on how to start one."

—**RUSSELL STEVENS**, strategic consultation manager and senior wildlife and range consultant

Bruce Reynolds has written software code for companies like IBM, Hewlett Packard and QuikTrip during a career that has taken him to seven different states, from Oklahoma to Connecticut. But, today, what he wants to do most is invest in insurance. The best kind, he says — soil organic matter.

"I've always known I wanted to farm," says Reynolds, who purchased the home his grandfather built and 75 acres near Davis, Oklahoma, about 10 years ago. "There has always been that part of me that wants to take care of the earth."

The return to his home state has set Reynolds on a path to regenerating the land's health. Today, he manages 5,000 acres of native grasses and cereal rye pasture for cattle as well as alfalfa and sudan for high-quality hay. But the journey has not always been easy.

When Reynolds leased one plot of land nestled into the Arbuckle Mountains six years ago, it was covered in eastern redcedars and ashe junipers. You couldn't even see a clear path through the invasive trees, he says. He learned about the Natural Resources Conservation Service's EQIP program, which would help him clear the land in exchange for turning it into a safe haven for Monarch butterflies.

"I didn't factor in how slow the process would be," Reynolds says.

He came in with a dozer and Bobcat one spring, then let the land rest for a year before prescribed burning it the following spring. After another full year of rest, the land was finally ready to be included in his cattle grazing rotation. His goal is to burn a particular area every three years. He has accomplished this with the prescribed burn association he helped start in his area with assistance from Russell Stevens, a Noble Research Institute consultant.

To help the Monarchs, Reynolds doesn't spray pesticides in designated areas and plants cover crops selected with the goal of providing blooms

A burnt tree and neighboring hill covered in eastern redcedars serves as a reminder of what the land looked like before prescribed fire controlled the brush.

throughout the year. His wife, Julie, also manages 40 bee hives on the properties.

"I'm trying to get this place as biodiverse as I can through fire and grazing," he says. "I'm sorely afraid two or three generations from now we won't see the earth as we know it today."

Reynolds focuses on proper grazing management and on keeping the ground covered with a living root in it as much as he can. Eight years ago, he completely converted to no-till and started incorporating cover crops. While the cover crops have been beneficial for the pollinators, he says he has had trouble with establishment.

as a fertilizer source and retaining ownership of his cattle through the feedyard.

Reynolds' desire to take care of natural resources drives much of his decision-making, but he knows it has to work financially in order to be truly sustainable.

"It takes time and patience," Reynolds says. "You can have all the know-how and want-to, but we're learning to work with Mother Nature, and that takes rethinking practices and being willing to try new things. At the end of the day, though, I do this because I enjoy it and because it's the right thing to do."

> "Organic matter is critical for moisture conservation. It's the best insurance we can have for a growing crop."
>
> —BRUCE REYNOLDS

"I give myself a 'D' grade with cover crops," Reynolds says. "I can't seem to consistently get a good stand, so I'm always talking to different people about what I could be trying. And I tell myself I'm going to do better next year."

Still, his combination of cover crops, no-till and other regenerative practices, has resulted in a 2-4% increase of soil organic matter in some of his fields. It's a huge win considering a 1% increase can help soil hold about 20,000 gallons of additional water per acre. His pastures are producing more forage, which has meant he has been able to add cows to the herd while decreasing the amount of hay he feeds — using it only to supplement his fall-calving herd.

For now, Reynolds continues to use his programming skills to pay what bills the operation can't yet sustain. He has a part-time employee who feeds cattle when he needs to travel for business, and he buys breeding stock from a family in Gainesville, Texas, rather than raising his own — another goal for later down the road. He has also looked into composting

Shane O'Daniel remembers when he used to spend more than 24 hours at a time out on the farm, mostly in a tractor, while baling hay then planting wheat. When he finally got home, there would be bills to pay and thoughts of needed equipment repairs hanging in the back of his mind.

"I had so little time for my family," O'Daniel says. "I was tired of spending all that money. I just knew there had to be a better way."

O'Daniel didn't grow up farming. In fact, he moved to Weatherford, Oklahoma, in 1994, with plans to go to pharmacy school. To pay for his undergraduate degree, he took a job baling hay for Ivan Harrall, a farmer outside of town. O'Daniel realized he preferred being out in the field, and Harrall quickly became a father figure. By 2007, O'Daniel began buying into the operation as the elder man approached retirement.

O'Daniel's biochemistry inclinations predisposed him to a curiosity of the soil

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SHANE O'DANIEL, WEATHERFORD, OK, raises cattle alongside his wife, Kim, and sons, Caleb and Hunter, (left to right) while improving the land. O'Daniel began converting to no-till and incorporating cover crops in 2014. He is intentional in planning his cattle grazing rotations, which has benefited the land and enabled him to expand his herd.

NO-TILL

Save Time and Fuel

"No-till is an attractive practice because it offers savings in time and horsepower required to produce a crop. It does require additional management and some special equipment, such as a no-till drill (planter) and sprayer. However, you'll save on fuel costs and time as you'll cut down the number of times you drive your tractor across the field in a season. It is common to expect yields to go down in the first few years of committing to a no-till system, but these yield losses are often mitigated by lower production costs. One should also start seeing increased water holding capacity, reduced erosion and a return to, at least, normal yield expectations within a few years of adopting no-till practices. As with any practice, remember that no-till is a tool that should be used in conjunction with other best management practices that help you follow good production and soil health principles. Producers should understand that no-till systems are not easier than tilled systems; they just substitute specific crop/forage management practices for tillage, resulting in lower production costs and a more sustainable production system."

—**JAMES LOCKE**, planned consultation manager and senior soils and crops consultant

Shane O'Daniel strategically grazes his cattle on pastures and fields with cover crops to improve soil health.

and how it works. He became interested in trying new techniques, like no-till, on the primarily crop-based operation. No-till promised to help them cut back on fuel and equipment repair costs while saving time and building soil health. But Harrall, whose family had farmed the land since 1904, was not easily convinced.

"I had to prove to him that this could work," O'Daniel says. "That wasn't always easy. Change is never easy."

O'Daniel began converting to no-till and incorporating cover crops in 2014 with Harrall's reluctant blessing. Eventually, Harrall started seeing the positive changes, too, before his death in 2019.

"It used to be that when we got 3 inches of rain, we wouldn't be able to drive across a field," O'Daniel says. "When the soil organic matter started building up, that didn't happen. Now we see 8-12 hours of rain infiltration without runoff."

Adding biodiversity with cover crops twice each year has brought soil organic matter up more than 1%. Native plants, including milkweed for pollinators, are slowly returning. And as many as 21 earthworms, in addition to dung beetles, have appeared in one shovel-full of soil.

O'Daniel has gradually reduced his fertilizer and pesticide use as a result of these gains. Last year, he did not use fertilizer at all. It is noticeable in some spots, he says, but, each season, he weighs potential yield losses against what he could save in time, money and equipment. Then he reinvests those financial savings into soil health through the cover crops, which do double duty by serving as an additional forage source for cattle and boosting soil fertility. After five years of incorporating cattle on the covers, he's seen as much as 70-bushel wheat in those fields. Letting the pastures rest does them good, too, and he has been able to add cows — now his No. 1 income source.

It's challenging to control weeds without the help of a plow or pesticides, but he is working on placing his cattle strategically so they can eat those plants. He's also considering adding sheep to his rotation, but he says he needs to get water systems and fences up first.

Most recently, O'Daniel bought 170 Corriente cows to cross with South Poll bulls. The Corriente, which are more commonly used for rodeos than beef production, are smaller framed and not as picky about which grasses they'll eat. He hopes the South Poll will provide good maternal traits, like milk production, while the Corriente will provide a hardiness suited to the land. Either way, he says, he'll make a profit because his costs are so low.

"It doesn't matter what your cattle bring if you're spending too much," he says.

It's these financial savings that continue to make change possible, O'Daniel says. In two years, he hopes to be debt free. He's already paid off millions. And his family was able to take their first vacation together last year.

He admits not everyone is comfortable with some of his ideas, but he's not afraid to try the things that stir up the neighbors in the coffee shop.

"I'm OK with them talking," O'Daniel laughs. "There is no such thing as perfection on this journey, but it's working."

"Every farm is like a puzzle. You've got to find out what works best for you, so go to seminars and workshops. Noble offers some great ones and helps organize other farm tours. ... I like the events that have multiple speakers best. That way you get different perspectives. Most importantly, never stop learning."

—SHANE O'DANIEL

FOR MORE RESOURCES

Prepare for the Regenerative Journey

Regenerative agriculture is a journey that will look different for each person who sets out on it. However, the road is more easily traveled with the help of friends and guides who have been on the path longer. Gain from their experience by using the resources below.

EDUCATIONAL EVENTS

You can find upcoming educational events at **www.noble.org/events.**

COVER CROPS

Find more resources for getting started with cover crops at:

- www.noble.org/want-to-grow-cover-crops
- www.noble.org/tool-in-ag-production
- www.noble.org/cover-crop-species-observations

PRESCRIBED FIRE

For more information and help finding a prescribed burn association in your area, visit:

- Oklahoma Prescribed Burn Association: www.ok-pba.org/links
- Kansas Prescribed Fire Council: www.kglc.org/kansas-prescribed-fire-council.cfm
- Prescribed Burn Alliance of Texas: pbatexas.org
- Coalition of Prescribed Fire Councils: www.prescribedfire.net
- The National Wild Turkey Federation: www.nwtf.org
- Noble Research Institute: www.noble.org/news/prescribed-fire

REGENERATIVE AGRICULTURE

Visit **www.noble.org** for more resources to help you along your regenerative agriculture journey.

Researcher Profile:

XUEFENG MA, PH.D.

Thousands of miles away from the small Chinese village where Xuefeng Ma, Ph.D., grew up, his work at Noble Research Institute has brought him full circle to lessons learned as a child.

Technology arrived as tiny seeds of hybrid vegetables in the village of Xuefeng Ma's youth. Using current technology, Ma is working with others at Noble to develop new, improved small grain cultivars for winter pasture through field testing and selective breeding. Noble's small grains breeding laboratory and test plots are thousands of miles away from his home village, but life has a way of taking people back to their roots. Working in the soil as a child, then pursuing an interest in agronomy and crop science, Ma's work has reminded him of the simplest rule: Plant what works.

SMALL GRAINS BREEDING LABORATORY

Xuefeng Ma, Ph.D., leads the Noble Research Institute Small Grains Breeding Laboratory, which has the goal of developing rye, dual-purpose wheat, triticale and oat with improved grazing tolerance, winter hardiness, forage yield and forage quality.

> "Families that bought these seeds produced more crops. Others then realized the value of these new varieties. People were suddenly able to grow more food. I saw this and thought agronomy would be a good area of study for me."
>
> —XUEFENG MA, PH.D.

BY DENICE RACKLEY

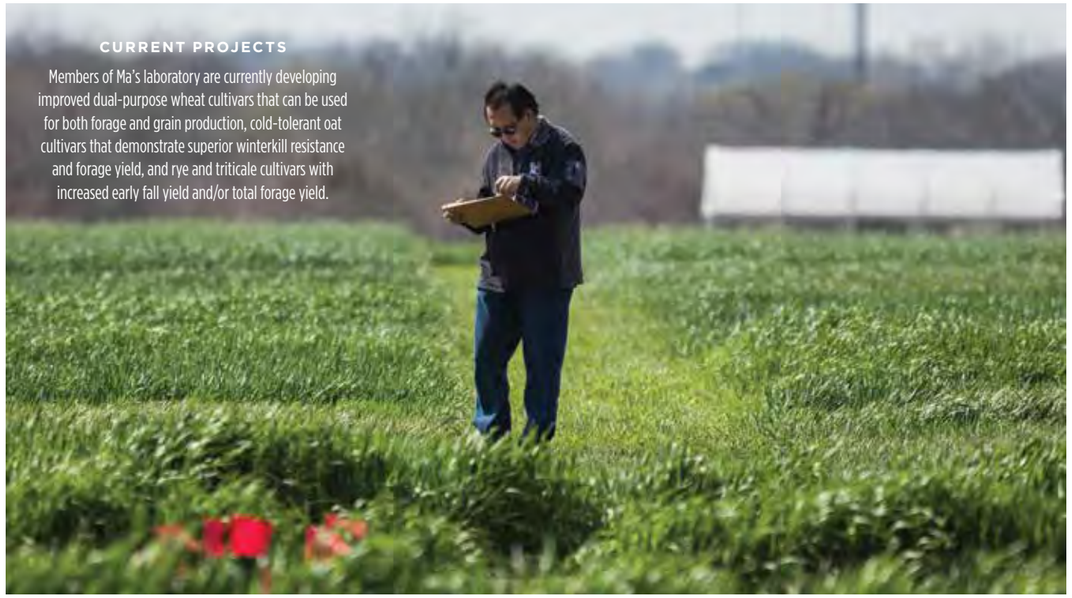
Q: What sparked your interest in agronomy?
I have been interested in agronomy since childhood. In my village, each family needed to grow enough food to sustain them. It was hard work. Sometimes there was barely enough food. We grew many vegetables like tomatoes, potatoes, corn and sorghum. Yields were low, and everything was weather dependent. There was no irrigation or livestock. We kept seeds to plant the next year. I remember when I was in middle school, commercial hybrid seeds became available.

What impact did the commercial seeds have?
Hybrid seeds represented new technology to people struggling to produce enough food for themselves. Families that bought these seeds produced more crops. Others then realized the value of these new varieties. People were suddenly able to grow more food. I saw this and thought agronomy would be a good area of study for me.

After attaining your bachelor's degrees in agronomy and crop science, you continued your studies to attain a master's in crop breeding and genetics in China. Why did you choose to pursue your Ph.D. in plant genetics and genomics at the University of Missouri?
I started as a visiting scientist at the University of Missouri. The lab I visited did genomics research work with cereal crops (wheat, rye and triticale), and I found it very interesting. I started my Ph.D. program after finishing my visiting program.

At what point in your studies did you become interested in genetics?
I saw chromosomes under a microscope during my studies in China, and I did lots of genetic work during my master's program. However, the first time I saw DNA and extracted DNA was at the University of Missouri, which was exciting.

Was there a particular professor who inspired you?
Perry Gustafson, Ph.D., a retired Agricultural Research Service (USDA-ARS) cereal geneticist, a very nice, kind gentleman who I worked for in Missouri. I learned his hands-off lab managing style, which I liked. I use the same style in my lab at Noble.



CURRENT PROJECTS

Members of Ma's laboratory are currently developing improved dual-purpose wheat cultivars that can be used for both forage and grain production, cold-tolerant oat cultivars that demonstrate superior winterkill resistance and forage yield, and rye and triticale cultivars with increased early fall yield and/or total forage yield.

> "Field testing is always needed regardless of how advanced our technologies are. For my village in China, field testing meant we could raise enough food for our families. Testing at Noble is far more scientific, but the final lesson is the same: We have to plant what works."
>
> —XUEFENG MA, PH.D.

You were a postdoctoral fellow at Noble after your time at the University of Missouri. Why did you choose Noble for your postdoc work and what work were you involved in?

Noble was well known to me because one of my faculty members was a scientific advisor of Noble. As a postdoc, I researched gene transformation in alfalfa and white clover for improving phosphate use efficiency. After my time as a postdoc, I went to work in California at Ceres, a commercial seed company, for eight years before the opportunity came open to return.

What was it that made you want to come back to Noble?

One of my children was born here, so it was easy to come back to Oklahoma. We all feel this is home. It is not crowded here like in China. There is no traffic in Ardmore like there is in California, and neighborhoods are friendly. You see people you know at the grocery stores. We socialize with people we work with at Noble, which is very different from life in California. Of course, I was also interested in the position for improving small grains cultivars. Most of the experiments are done in field trials, which I enjoy.

What excites you about the future?

All three of my kids are growing up. Right now, we are busy with soccer and academic activities, but it is exciting to see their interests develop and to think about how they might use those in the future. From my work perspective, I am excited that we are planning to release a few wheat and rye cultivars. These cultivars have performed better than commercial controls in our trials in the last few years.

What makes your research unique?

Research here is different because we are working to improve forage yields of small grains. Most research elsewhere is to improve grain yield. We study early plant growth, grazing tolerance, forage quality and how to improve the plant to grow best in a particular environment. We focus on filling the fall-winter forage gap after summer perennials or native plants go dormant. Improved small grains are an advantage nutritionally to livestock and economically to producers since they maximize the grazing period and save producers from purchasing hay.

What is the most important lesson you have learned in your research?

After eight years of genomics and molecular breeding work in California and now at Noble, I am remembering and proving to myself again that field breeding and field performance tests are fundamental. Field testing is always needed regardless of how advanced our technologies are. Any single cultivar is only useful in certain regions. This is not known unless testing is done in that region. For my village in China, field testing meant we could raise enough food for our families. Testing at Noble is far more scientific, but the final lesson is the same: We have to plant what works.

INGREDIENTS FOR SUCCESS

Successful farming and ranching operations start with the right ingredients: hard work and persistence, openness to new ideas and innovation, planning and intentional management, and, don't forget, healthy soil. To learn how to test your soil for what nutrients it needs, turn to page 42. Good soil grows good foods that become great ingredients to use in the kitchen. Turn to page 40 for a recipe that turns pecans and oranges into a delicious quick bread.

For tips on when you should be planning for different pecan management tasks throughout the year, check out our Pecan Management Calendar at www.noble.org/pecan-management-calendar.

Orange Pecan Bread

Try this award-winning recipe for a citrus-infused quick bread loaded with America's native nut.

INGREDIENTS

- 1 ¾ cup all-purpose flour
- ½ teaspoon salt
- ½ cup sugar
- 2 large eggs
- 2 teaspoon baking powder
- ½ cup butter, softened
- ½ teaspoon baking soda
- ½ cup orange juice
- 2 tablespoon grated orange peel
- 1 cup chopped pecans

MORE THAN JUST PIE

Pecan pie will always be a classic, but there are many ways to use pecans as part of a balanced diet. They're a great addition to salads and green beans. They can even add a crunch to the crust of a rib-eye steak coating. To learn more about pecans and find recipes, go to americanpecan.com.

DIRECTIONS

Step 1: Preheat oven to 350 degrees and grease a 9-by-5-by-3 loaf pan.

Step 2: Mix flour, sugar, baking powder, baking soda and salt in a large bowl, and set aside.

Step 3: Use a mixer on low speed to blend together eggs, butter, orange peel and orange juice in small bowl.

Step 4: Stir the orange mixture into the flour mixture just until blended.

Step 5: Fold in the pecans.

Step 6: Spoon the batter into the loaf pan.

Step 7: Let bake for 50 minutes then cool in pan 10 minutes.

Step 8: Remove the bread from the pan and let cool completely on a wire rack.

Step 9: Enjoy!

ABOUT THE NOBLE EXPERT

Charles Rohla, Ph.D., serves as pecan and specialty crops manager. He works with other researchers across Noble Research Institute to study new pecan growing methods, technologies and ways to increase production. This orange pecan bread recipe comes from his mother-in-law, Linda Bryant, who adapted it from an older recipe. She and Rohla's wife, Andrea, use homegrown pecans when entering their baked goods in pecan food show competitions across Oklahoma and Texas.

How to Take a Soil Sample

If you're ready to start soil testing, but aren't sure where to send your samples, you can send them to Noble Research Institute's Ag Testing Services.

WHY GO TO THE TROUBLE AND EXPENSE OF TESTING YOUR SOIL?

Soil testing measures the soil's pH and nutrient levels and provides a basis for developing optimum fertilizer and lime recommendations.

Without soil testing, determining your correct fertilizer and lime recommendations is just a guess. Not knowing your soil's nutrient status can result in either overspending for excess fertilizer or lime, or losing plant health and productivity.

Here is a step-by-step guide on how to collect a good soil sample, which you can send to Noble Research Institute. We process the samples and send them to a contract lab, which conducts the analyses. Noble Research Institute soils and crops consultants receive the lab data and make appropriate lime and fertilizer recommendations.

WHEN TO SAMPLE

Sample most soils every two to three years. Sampling should be done more frequently for crops that remove large amounts of nutrients (hay or silage crops) or if nitrogen recommendations will be adjusted depending on soil nitrate levels. Soil nitrate levels are relevant for only a few months, where the other analyses are useful for several years.

Try to sample at the same time each year. Analyses data can vary depending on when the samples are taken. For example, soil test phosphorus and pH levels are higher in the spring than in the fall. Late winter is a good time to collect soil samples for summer crops, and summer is a good time to sample for fall and winter crops.

SUPPLIES

- Clean plastic 5-gallon bucket
- Clean spade, sharpshooter, shovel or soil probe.* Do not use galvanized tools because the metals can contaminate samples.
- Sample bags and information sheets

**A spade or shovel will do, but we recommend a probe because it saves time by collecting samples more quickly and efficiently, and collects a continuous core through the entire sampling depth with minimum soil disturbance. Here is a partial list of retailers that sell soil-testing probes: http://bit.ly/soil-probe-listings.*

DIRECTIONS

Step 1: Order soil sample bags and sample information sheets by calling Noble Agricultural Testing Services: Soil Sampling at 580-224-6500 or print a form at bit.ly/soil-sample-form.

Step 2: Make a map of your property, note where each sample will be taken, and give the different fields unique names. Use the same field names each year so you can compare your results across time.

Step 3: Divide your property into sampling units in the following manner: Sample each field separately, no matter how small it is. For fields larger than 40 acres, subdivide these fields into smaller units. Sample areas separately if they are obviously different (bottomland vs. hills, areas that have been fertilized differently, etc), and sample problem areas separately.

Step 4: Confirm that your bucket and tool(s) are clean. Collect a core of the top 6 inches of soil at 15 to 20 random locations across each sampling area. Do not sample when it is too wet or dry because this can affect the depth of your sample. Make sure you collect the samples at random and do not sample just on ridges, sandy spots, etc. If you don't have a soil probe, dig down 6 inches or more with a shovel, sharpshooter or spade. Trim the slice of soil that is collected with a knife or other cutting implement to a 6-inch depth and make sure the sample is the same width as its entire length. Remove any stones or sticks. Place the soil into the plastic bucket.

For additional information on collecting a soil sample with a shovel, watch our "How to Take a Soil Sample" video at www.noble.org/videos/soil-sample.

Step 5: Place all 15-20 soil cores collected from the field into the bucket and thoroughly mix to create one homogenous sample. Write the ID from your field map and other required information onto the sample bag, then put about a pint of the mixed soil into the bag. Simply scatter the remainder of the soil back into your field.

Step 6: Repeat sampling steps for each field.

Step 7: The following information is required for each sample: your name, address, email, field name and crop to be grown. If you want more customized recommendations, include your yield goal with this information.

Step 8: Mail your samples and completely filled information sheet(s) to: Ag Testing, Noble Research Institute, 2510 Sam Noble Pkwy, Ardmore, OK 73401

For more details on submitting your soil samples, go to www.noble.org/soil-sampling.

ABOUT THE NOBLE EXPERT

Eddie Funderburg, Ed.D., is a senior soils and crops consultant. Funderburg has broad experience in agriculture, soil testing, fertilization of forage crops and improved pasture management. He has conducted numerous research projects examining herbicides, fertilizer rates, sources, timing and soil test calibration.

STATEMENT ON EVENTS
Noble Research Institute continues to monitor the COVID-19 situation and will cancel or reschedule events accordingly. All events are subject to change in format, location and date in order to accommodate COVID-19 best practices.

JULY

21 UNDERSTANDING THE IMPACTS OF FIRE ON YOUR PROPERTY

9 a.m.-4 p.m. | Tues., July 21, 2020
Noble Research Institute
Coffey Ranch
16877 State Hwy. 32
Marietta, OK 73448

LEVEL 2 BUILDING

Prescribed fire is a natural process in the southern Great Plains, where the landscape evolved under fire and grazing. Fire can improve wildlife habitat, reduce woody plants, remove thatch, and improve forage quality and quantity for livestock.

The most important way to safely burn is to gain experience conducting burns. If weather parameters are within prescription during the field day, we will attempt multiple burns to give you real experience conducting prescribed fire management.

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

AUGUST

4 IMPROVING YOUR PECAN PESTICIDE UTILIZATION

8:30 a.m.-noon | Tues., Aug. 4, 2020
Noble Research Institute
Kruse Auditorium
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 3 ADVANCED

A major part of any pecan orchard management is the utilization of pesticides. The success of the orchard is dependent on the proper selection and application of pesticides. This includes your economic and efficacy considerations. This course will help you improve your pesticide management plan to increase the economic viability of your orchard.

What You Will Learn:
- The pitfalls of chemical management using pesticides
- How to develop a chemical management plan
- Economic viability of different pesticides

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

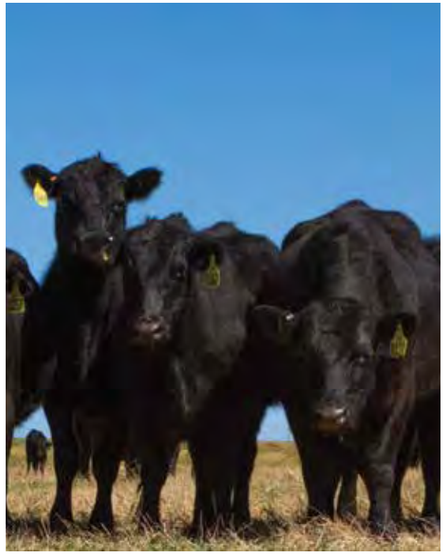
13 IMPROVING PECAN PROFITABILITY WITH MARKETING STRATEGIES

8:30-11:30 a.m. | Thurs., Aug. 13, 2020
Noble Research Institute
Kruse Auditorium
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 4 MASTER

Pecan growers who have successfully managed their crops can take their operations to the next level by learning alternative ways of marketing their pecans to increase the potential profits. However, understanding what it takes to diversify the ways of marketing pecans can be overwhelming. This workshop will provide information on strategies you can use to market your pecan crop outside of the wholesale market and give you a better understanding of how the sheller/accumulators determine the price they are paying for your pecans. You'll also learn about regulations and food safety requirements for selling directly to consumers.

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



18 PRECONDITIONING CALVES FOR SUCCESS

9:30 a.m.-2:30 p.m. | Tues., Aug. 18, 2020
Noble Research Institute
Pavilion
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 2 BUILDING

During this seminar, we will address the principle areas of health, nutrition and marketing, as well as what measures to take pre-weaning to ensure a successful preconditioning period. Cow-calf producers who retain their own calves and want to gain a better understanding of the preconditioning phase should attend this event.

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

SEPTEMBER

1 INTRODUCTION TO INTEGRITY BEEF

4-7:30 p.m. | Tues., Sept. 1, 2020
Noble Research Institute
Pavilion
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 1 ESSENTIALS

Connect with Noble Research Institute consultants and Integrity Beef Alliance members to learn more about the Integrity Beef Alliance terminal calf program and replacement heifer development program. Integrity Beef members typically see at least a 50-pound increase in weaning weights and even higher sale weight advantages when compared to their own herd prior to entering the program.

What You Will Learn:

- What record-keeping and protocols are required for Integrity Beef programs
- The purpose and details of these requirements
- How to join the Integrity Beef Alliance
- Differences between the terminal and replacement programs
- Advantages of being associated with a marketing program

There is no registration fee for this event, but a meal is included. We ask that you preregister prior to the event.

3 SO YOU WANT TO GROW PECANS

6:30-8:30 p.m. | Thurs., Sept. 3, 2020
Noble Research Institute
Kruse Auditorium
2510 Sam Noble Parkway
Ardmore, OK 73401

INTRODUCTORY

Fueled by an ever-increasing demand for pecans (the original "supernut"), prices received by growers for improved cultivars and native pecans have increased over the past few years and continue to remain strong.

Pecan culture presents unique management challenges due to factors including tree size, nutrient and water requirements, and the need for specialized equipment. At the end of this program, you will have a basic understanding of the various practices utilized in producing pecans.

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 Noble account.** To learn more or to create your free account, visit www.noble.org/about-myaccount/.

OCTOBER

27 BUILDING A BETTER HOOP HOUSE

1-5 p.m. | Tues., Oct. 27, 2020
Noble Research Institute
Protected Ag Area
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 2 BUILDING

Hoop houses, also known as high tunnels, continue to be market gardeners' tool of choice when managing weather-related production risks. Some growers purchase prefabricated hoop house kits and pay extra to have them erected, while others elect to build the structures themselves. Still other growers fabricate and construct their own structures. This workshop is designed to introduce the novice grower/hoop house builder to the various tools and techniques used in constructing a wide range of hoop houses models, including prefabricated kit houses and home-built structures.

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

29 IMPLEMENTING LAND STEWARDSHIP PRINCIPLES

8:30 a.m.-noon | Thurs., Oct. 29, 2020
Noble Research Institute
Coffey Ranch
2510 Sam Noble Parkway
Ardmore, OK 73401

LEVEL 2 BUILDING

Land stewardship is more than a land ethic, it is the steward's ability to read the land, interpret metrics, and implement measures that provide both ecologic and economic return on investment. Understanding how soils interact with plant communities and how the management of those plant communities impact soil resilience is foundational to land stewardship. This course will demonstrate how to recognize those relationships, discuss how and what to measure, and ultimately how best to quantify the impacts of your land-stewardship-focused management.

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

THE STORMY PRESENT

by J. Adam Calaway, editor

One month before issuing the Emancipation Proclamation, Abraham Lincoln sent his annual message to Congress. Lincoln wrote only 403 words, but he articulated his soul's deepest convictions and cast a vision to confront the uncertainty of his time.

"The dogmas of the quiet past are inadequate to the stormy present," he wrote. "The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew and act anew."

Lincoln's words spoke to the inescapable responsibility of leadership in crisis. They also speak directly to our current experience as we grapple with the ramifications of a global pandemic. This is our stormy present.

As we seek the backside of a flattened curve, praying the worst is behind us, we take stock of COVID-19's impact. The loss of human life. The economic tire fire. The body blow to our collective spirit. Uncertainty seems a constant companion, and we are plagued by questions: How do we recover? Will the virus worsen? What comes next?

For those with adult memories of 9/11, we know we are witnessing history. Touchstone events like this irrevocably change society. There's no going back. Only forward. We cannot control the situation only how we respond. So how do we proceed? Do we allow fear to freeze our every movement? Do we walk blindly with hubris ignoring the practical and safe? No. Banishing uncertainty requires concerted effort and — as Lincoln said — thinking anew.

This pandemic — like most trials — has brought perspective, wiping away the fog of routine and highlighting what is essential: health, family and food. This mindset clarifies our purpose, and purpose empowers our service.

We have seen the unlimited capacity of human compassion throughout this chaotic season. We have witnessed the unquestionable courage of our first responders and frontline healthcare workers, whose scrubs and uniforms cover S-shaped emblems on their chests.

We have also borne witness to the countless allied fields essential to making this nation tick. Mechanics, shelter volunteers, those who stock the grocery store shelves, and countless others have faced unknown risk in service of us all. Society may look only at the reliable hands on the watch face of our country, but these individuals are the gears who make it run.

Likewise, this pandemic has demonstrated the immeasurable value of our agricultural producers, who continue to deliver our most basic need — food. So often, when sectors function uninterrupted, they receive little fanfare or go unnoticed altogether. However, society is built on the foundation of a safe and plentiful food supply chain. Existential thought takes a backseat when people are hungry.

Agricultural producers are equipped for seasons of uncertainty because they have been forged in its fire. They face daily trials against Mother Nature's whims, fluctuating markets and variables beyond their control. Yet they endure for the benefit of others, and they are able to do so because resiliency is born from struggle. Time and again, history proves this truth.

The Dust Bowl of the 1930s and '40s devastated ecology and economy in equal measure. More than a quarter million people fled the region. Naysayers said the Great Plains would never recover. Fear gripped a nation. But uncertainty is the catalyst for change, and change requires great courage.

Philanthropist Lloyd Noble spoke to the fundamental truth that the soil and the farmer are the cornerstones of society. He rallied the pioneers of land stewardship and soil conservation to action. He endowed Noble Research Institute to walk alongside farmers and ranchers while providing good information so producers could make confident decisions.

Now this generation has been shaken by COVID's calamity and awakened to threats lurking on the periphery of society's awareness. New thinking and new approaches are the cure for the uncertainty of this stormy present.

For all the hardship, let this pandemic's legacy be that it built humanity's resilience. Let it be motivation for proactive thinking and bold solutions. Let us embrace discernment and relinquish inadequate past practices. Let it prioritize our actions so that we may safeguard the everyday things, the cheeseburger and apple pie things, the things we have taken for granted.

For many, COVID has swept away the inconsequential. It has enabled us to look at our world with unfettered eyes. It has reminded us of what is truly essential, and we must be intentional in the stewardship of these priorities.

Lincoln challenged a nation to rise to the occasion. Noble modeled this courage during the Dust Bowl. Now we must live it.

NOBLE RESEARCH INSTITUTE

Noble Research Institute, LLC
2510 Sam Noble Parkway
Ardmore, OK 73401

PLEASE DELIVER TO:

LEGACY | Spring 2020 | Vol. 14, Issue 1

Cattle graze on Shane O'Daniel's farm near Weatherford, Oklahoma, in February 2020. O'Daniel raises cattle and grows crops using regenerative agriculture principles, which improve the quality of the land. O'Daniel is one of three producers who share their experiences in regenerative agriculture in "The Journey," beginning on page 24.