A publication of The Samuel Roberts Noble Foundation

Legacy

Winter 2008

A LABORATORY LIKE NO OTHER

Greenhouse staff member Karen Flowers uses a microscope to check for potentially harmful pests.

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On the Cover

The cover of the 2008 Winter issue of *Legacy* depicts the movement of the Noble Foundation's pipeline of discovery from fundamental science to the applied research conducted by the Agricultural Research Team in the Agricultural Division. The team conducts research in a living laboratory – 12,400 acres of research and demonstration land.

Illustration by Doug McAbee, Scott McNeill, Broderick Stearns

Photograph by *Broderick Stearns*

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The art of inspiration

Throughout my years as president, I have discovered that a change of scenery can often be conducive to productivity. The trick is finding the right spot – someplace with a spark of inspiration. I've certainly found mine. On occasion, I'll settle into a high-backed chair or a corner table in the Noble Foundation's library and forge through the latest stack of documents to hit my desk.

During a recent library outing, I set aside my reading for a moment and found myself focused on a painting of Lloyd Noble, our founder. It's a familiar painting to those at the Noble Foundation, hanging prominently near the library's entry. Its colors are rich and warm. Its frame is strong and ornate. As I admired the artistry, I began to think about our founder.

Here was a man born at the close of the 19th century when our horse-and-buggy society was unaware of the innovations the next hundred years would bring. By the time Noble died in 1950, the country boomed with possibility, and he had become one of its most successful oilmen, providing the fuel that powered the nation's exponential growth and prosperity.

But Noble's life defies categorization. He was not simply an oilfield wildcatter, but a man of convictions, a state politician, a humble philanthropist and, most of all,

a faithful guardian of our natural resources. During his life, Noble watched as poor farming practices combined with drought to deplete the productivity of Oklahoma's once vibrant land. Pained by what he saw, he established this foundation just five years before his death to better humanity by assisting agricultural producers.

For the last 63 years we've fulfilled his edict, growing from a single group with a handful of workers to an international organization with more than 360 employees. Each day these employees perform multidisciplinary agricultural consultation and research, and plant science that ranges from fundamental and translational to the applied.

As I looked that painting over, I asked myself: "What would Lloyd Noble think of today's Noble Foundation with its sprawling modern campus and technologically charged programs striving to unlock the great mysteries of plant science?"

I firmly believe he would be proud of all we've accomplished, while challenging us to continually pursue improvement. Today's Noble Foundation may look nothing like the original institution, but we remain true to his vision. I do not believe Noble intended this Foundation to be static, tied to a singular course, but rather to evolve and grow, and build into what he could not even imagine.

Our Board of Trustees, which continues to include a majority of our founder's family, has faithfully stewarded his wishes while having the foresight to respond to the challenges and opportunities presented to the current generation.

Myopic thinking has never shackled our leadership. Instead the board has embraced change and taken bold steps to further the mission. When a proposal to begin a Plant Biology Division was brought before them in the 1980s, they didn't wave off the idea as a far-reaching notion. Instead, they envisioned a possibility to impact production agriculture through science and embraced the endeavor fully.

Then a decade later, they again saw the potential of initiating another division, a Forage Improvement Division, to link our operating divisions and open a pipeline of discovery. Within today's three operating divisions, we can now move plant science discoveries from the laboratory to the farmer's doorstep. Most of all, I'm confident Lloyd Noble would give credit to the great men and women who have filled the Noble Foundation's laboratories, farms and greenhouses.

Their minds conceived and their hands built the programs that continually advance our cause, and he would be most proud of their efforts. I'm certain Lloyd Noble never envisioned today's Noble Foundation, but, in a way, I'm sure he expected this outcome.

Sincerely,

Michael A. Cawley
President and Chief Executive Officer

Sam Noble's legacy of education

Since the inception of the Sam Noble Scholarships in 1998, more than 105 scholarships have been awarded to students studying agriculture and technology; students like Shawn Campbell, Staci Forshee and Kara Nay.

While each scholarship provided a means to an education, they did much more by changing these students' lives and encouraging the next generation of agricultural producers.

Shawn Campbell received the Sam Noble Scholarship in 2003. As the first in his family to attend college, he approached higher education without much preparation. A few hundred dollars in debt later, Shawn discovered the Sam Noble Scholarship and applied. He received the scholarship during his junior and senior years at Oklahoma State University while he worked toward a bachelor's of agricultural business degree. "The scholarship helped out tremendously," Campbell said. "It allowed me to do some things that I wouldn't have been able to do otherwise."

The scholarship freed up funds for Shawn to travel to Honduras, then to Scotland and England a few months later. These agriculturally focused trips broadened his understanding of world production agriculture. After graduation, he went on to Texas Christian University for an additional one-year program in ranch management. His education allowed him to return as ranch manager on his father's farm, where he oversees a ranch with 400 head of cattle.

Staci Forshee is another Sam Noble Scholarship recipient.

"To even be able to go to college was a big feat," said Forshee, a fifth-year senior majoring in animal science and biotechnology at Oklahoma State University. "It would have been so hard to go without the scholarship to help out." Forshee wants to continue her education in graduate school with research in animal genetics.

Kara Nay, a junior majoring in agricultural business at Oklahoma State University, was raised on a farm primarily focused on cow-calf operations. During her childhood, she saw her family receive help from the Noble Foundation's agricultural consultation teams. They provided management information to her family for use on their farm. Her goal after graduation is to implement, throughout her farm and other nearby farms, the knowledge she's gained. Nay said, "I would like to be able to provide the same help for other families that my family received."

Sam Noble was the oldest child of Lloyd Noble, founder of the Noble Foundation. Sam Noble was a well-respected civic leader, businessman and philanthropist. After his death in 1992, the scholarship program was endowed with funds he specifically set aside to support the educational endeavors of future farmers, ranchers and other agricultural producers. It is available for high school seniors through graduate students in the fields of technology and agriculture.

The technology scholarship encourages outstanding students to become highly ▶

proficient in a trade or vocation through pursuit of an associate's degree or other certificate at OSU/Oklahoma City or OSU/Okmulgee. Recipients receive $3,750 per year.

The agriculture scholarship enables outstanding students to study agriculture and work towards an agriculture-related degree at a qualified college or university. Undergraduate students receive $2,500 per semester for up to nine semesters. Graduate students receive $3,125 per semester for up to five semesters. Eligible institutions are Oklahoma State University, Oklahoma Panhandle State University, Texas Tech University in Lubbock, Texas, Texas A&M University in College Station, Texas, or any land grant institution in other states.

To qualify, students must reside within one of 15 southern Oklahoma counties: Atoka, Bryan, Carter, Choctaw, Coal, Garvin, Jefferson, Johnston, Love, Marshall, McCurtain, Murray, Pontotoc, Pushmataha or Stephens. Scholarship applications are available annually beginning in November, and the deadline for scholarship application submission is in February.

Since the first scholarship was awarded, more than $1.1 million in support has been given. "It is remarkable how one man's generosity has forever changed so many lives," said Donna Windel, Director of Granting for the Noble Foundation. "Mr. Noble's thoughtfulness has helped more than 100 students receive one of the most important tools for life – an education."

– Jenifer Biles

Dixon earns state honors

Richard A Dixon, D. Phil., Senior Vice President, was named the 2008 Oklahoma Scientist of the Year by the Oklahoma Academy of Science (OAS). The award is the state's highest scientific honor. Dixon received the honor for his pioneering work in plant metabolism and his 20 years of leadership as Director of the Noble Foundation's Plant Biology Division. Dixon is widely recognized as a leading authority on flavonoids/isoflavonoids, condensed tannins and lignin, the plant cell wall polymer. He is currently an author of more than 360 scientific papers. The Institute for Scientific Information recognized the significance of these publications in 2002, naming Dixon as one of the

15 most cited authors in the plant and animal sciences in the world.

Virus research lands in college textbook

This year, thousands of college freshmen across the United States will attend a fundamental class in biology, and Marilyn Roossinck's work will be there to teach them.

A virologist and professor with the Noble Foundation, Roossinck, Ph.D., performed a four-year study on a three-way symbiotic relationship between a virus, a fungus and a plant that was published in McGraw Hill's new college textbook, "Biology: Concepts and Investigations." The textbook entered circulation during the fall 2008 semester.

The research performed by Roossinck and her collaborators, Drs. Luis Márquez, Regina Redman and Rusty Rodriguez, discovered that a virus and a type of fungus (known as an endophyte) enabled a species of grass to survive in the geothermal soils of Yellowstone National Park despite soil temperatures too high for most plants.

Research on how viruses and endophytes assist plants in environmentally difficult circumstances could lead to new crops having valuable, naturally induced traits, including enhanced heat, drought and salt tolerances.

Noble Foundation, BASF begin collaboration

The Noble Foundation and BASF Plant Science entered a research collaboration to enhance crop productivity. The collaboration's aim is to develop traits that help improve plant health and yield by using a model plant, *Medicago truncatula* (commonly called barrel medic). Researchers at the Noble Foundation, a leader in *Medicago* genetics, will seek to develop traits for conveying yield stability and disease resistance in select crops. BASF Plant Science receives exclusive options on specific Noble Foundation research findings.

Medicago truncatula

The collaboration's research will be led by Kirankumar Mysore, Ph.D., Associate Professor, and co-principal investigator Srinivasa Rao Uppalapati, Ph.D., both with the Plant Biology Division of the Noble Foundation. Mysore and his research team are generating genetic resources in *Medicago* and possess extensive experience in plant science research. This research project and collaboration align with the Noble Foundation's mission to assist farmers and ranchers.

Bio-Truck visits Noble Foundation's campus

The Noble Foundation's Ardmore campus was a stop on the recent Auburn University and Renewable Energy Systems' (RES) Coast-to-Coast and Back Renewable Energy Tour.

Wayne Keith, a partner in RES, developed gasification technology that enables regular gasoline-fueled vehicles to be powered with a wide range of biomass materials, including wood, switchgrass and crop residues. Auburn University partnered with RES to tour a biomass-powered pickup – the "Bio-Truck" – across the United States to raise public awareness of renewable energy and its economic, environmental and social benefits. The Noble Foundation was one of the project's sponsors.

During the Noble Foundation stop, Keith demonstrated how the gasification technology worked by taking dried switchgrass from the Foundation's own research plots and stuffing it into his gasification unit, which then powered the Bio-Truck.

Using primarily scrap wood on the tour, but also switchgrass, poultry litter, used paper, municipal solid waste (MSW) and refuse-derived fuel (RDF), the Bio-Truck left the Noble Foundation and traveled to California.

Once on the West Coast, the team competed in "Escape from Berkeley," a three-day road race from Berkeley, Calif., to Las Vegas for vehicles powered by noncommercially available fuels.

The Bio-Truck took second place in the road race.

Web spotlight: Plant Image Gallery

It might be a western ragweed or it might be a common ragweed; either way, deciphering a plant can be a difficult task.

The Samuel Roberts Noble Foundation Web site (www.noble.org) contains a handy tool to help users distinguish between the numerous grasses, trees and vines in southern Oklahoma and north Texas.

Launched in 1997, the Plant Image Gallery identifies more than 600 species of vascular plants in the region. This award-winning site receives more than a million hits per year by botanists, ecologists, natural resource managers, land managers, students and homeowners, and is easily accessed.

The gallery, which allows users to select criteria about an unknown plant from drop-down menus to simplify searches, contains close-up photos of the plant's anatomy as well as multiple pictures per plant. A pictorial guide for items such as leaf structure, flowering and fruit types is included, providing users easier identification.

"We've worked to develop a user-friendly site that provides quick, accurate results," said Chuck Coffey, pasture and range consultant with the Noble Foundation. "While we have several hundred plants in the Plant Image Gallery, we are continually adding more since there are nearly 5,000 species of vascular plants known in Texas and nearly 3,000 in Oklahoma."

As an extension to the Web site, Russell Stevens, wildlife and fisheries consultant and a consultation team manager for the Noble Foundation, along with Coffey, also published "*Grasses of Southern Oklahoma and North Texas: A Pictorial Guide*" containing more than 100 full-color pages of various grasses for easy identification.

In late 2008, the pair published "*Trees, Shrubs and Woody Vines: A Pictorial Guide*," which will help users identify various types of native trees.

For more information or to obtain a copy of either book, call the Agricultural Division Helpline at 580-224-6500 or visit www.noble.org/Storefront.

Discovering the name of this flower is as easy as logging onto www.noble.org and visiting the Plant Image Gallery.

Noble Foundation Honored by National Magazine ... Twice

This fall, the Noble Foundation received high honors from a respected, national scientific magazine.

The Scientist magazine ranked the Noble Foundation as a top 10 scientific institution in its annual *Best Places to Work in Academia* survey. The Noble Foundation ranked 8th out of more than 70 institutions that participated in the magazine's annual survey that was released in the publication's November issue.

The placement marks the second time the Noble Foundation earned a top 10 ranking from the magazine in 2008. In May, the Noble Foundation earned another 8th ranking in the magazine's *Best Places to Work for Postdoctoral Fellows* survey.

"The Noble Foundation is one of only two institutions that placed in the top 10 of both surveys. That is remarkable," said Michael A. Cawley, President and Chief Executive Officer. "These surveys illustrate the high level of scientific and agricultural research the Noble Foundation has achieved. We are dedicated to providing abundant opportunities for those that conduct this research which impacts production agriculture in our state, region, country and the world."

This is the first year the Noble Foundation participated in either of the magazine's annual surveys during the organization's storied 63-year history.

The Noble Foundation employs about 85 life scientists from more than 25 different countries around the world to conduct plant science research and plant breeding at the organization's campus in Ardmore, Okla.

"These results serve as a valuable benchmark against important peer institutions," said Joe Bouton, Ph.D., Senior Vice President and Director of the Forage Improvement Division. "The Noble Foundation has become widely recognized for its ability to contribute to the complete spectrum of plant science – from fundamental and translational research to actual in-field application."

The magazie's Web-based survey garnered 2,300 responses from life scientists at 73 institutions worldwide. Participants were asked to rate their institutions on 41 criteria in eight different areas that make up their working conditions and environment. The Noble Foundation received top scores for research resources and pay.

The Noble Foundation provides more than 500,000 square feet of research and administration space, 12,400 acres of research and demonstration land, dedicated funding and ample support personnel to assist the research staff.

"Since initiating its research programs in 1988, the Noble Foundation has rapidly become a global leader in plant science research," said Richard Dixon, D.Phil., Senior Vice President and Plant Biology Division Director. "The resources and the high caliber of individuals who work here foster an almost unequaled research environment. I can only imagine where we'll be in the next 20 years."

The Noble Foundation topped such recognized research organizations as the National Institutes of Health, United States Department of Agriculture-Agricultural Research Service, Dana-Farber Cancer Institute, Massachusetts General Hospital and the Wistar Institute, as well as two dozen other national research universities, such as the University of Pennsylvania, Clemson University, the University of Oklahoma and the University of California.

Photograph by *Broderick Stearns*

Principal investigators Kelly Craven, assistant professor, (left) and Michael Udvardi, professor, examine fungal isolates as part of Craven's research with endophytes.

Billy Cook, Ph.D., consulting support research manager (left), and James Locke, soils and crops consultant, discuss forage quality during a recent farm visit.

Photograph by *Broderick Stearns*

A Laboratory Like No Other

Scientists at the Noble Foundation use advanced laboratories every day, but they are not the only ones. The Agricultural Research Team performs cutting-edge applied research with 12,400 acres of living laboratories. by J. Adam Calaway

It is an unseasonably warm fall afternoon, and Russ Gentry is navigating his mud-spattered Chevy pickup through a sea of emerald green winter pasture that rolls over hill after hill at the Noble Foundation's Pasture Demonstration Farm.

Gentry serves as research operations manager for the Noble Foundation's Agricultural Research Team. It's a hectic job that includes overseeing the daily workings of the seven farms scattered across southern Oklahoma (a total of 12,400 acres) that house the group's many research projects.

On this particular day, Gentry has added an additional duty to his normal regimen – tour guide. He wheels his truck around the 850-acre farm, showcasing key scientific undertakings that one day soon may directly impact regional farmers and ranchers. He points to fields where researchers are studying the effects of specific

tillage systems on stocker cattle gain. He then drives a little further and points to a smattering of field trials where new cool-season perennial forages are being tested. As the tour rolls on, it soon becomes apparent that the land spread out before this truck is a living laboratory.

"The laboratories used by the Noble Foundation's scientific groups have been recognized as premier facilities by many leading scientists throughout the world," Gentry said. "But these farms and the several others like them are the Agricultural Research Team's laboratory, and they are some of the best in the world as well. Of course, Mother Nature sometimes messes with our laboratories, but that's just part of what makes us unique."

A diverse team

In-field agricultural research has evolved in the Noble Foundation's Agricultural Division since the 1950s. Originally, agricultural consultants conducted research projects in conjunction with their daily duties of assisting farmers and ranchers. In the last decade, however, requests for consultation dramatically increased, leaving little time for research. A solution was sought.

An Agricultural Research Team emerged from within the Agricultural Division – a unique group, but one still driven by the core consultation mission.

"We provide applied research results to our consultants so they can do a better job of assisting the farmers and ranchers they serve," said Billy Cook, Ph.D., consulting support research manager, who leads the Agricultural Research Team. "We receive feedback from the consultation teams about the agricultural issues that are important to area farmers and ranchers, and we give them the ability to get those answers. They ask the questions, then we approach it from a production and economic standpoint. This type of research wouldn't happen if we didn't do it."

To answer questions as diverse as the needs of regional agriculture, the division put in place a team focused on spanning the complete spectrum of agricultural topics, much like the multidisciplinary consultation teams. They assembled a group with expertise in livestock (John Blanton, Ph.D., and Cook, Ph.D.), agricultural economics (Jon Biermacher, Ph.D.), wildlife and fisheries (Ken Gee), agronomy (John Guretzky, Ph.D.), and soils and crops (Jagadeesh Mosali, Ph.D.).

With more than 35 additional staff members, the group now has the personnel and support system to perform applied research to complement the consultation program. Their findings also advance the work of researchers in the Noble Foundation's Forage Improvement Division (FID), which contains similar personnel,

Russ Gentry serves as research operations manager for the Agricultural Research Team.

Photographs by *Broderick Stearns*

such as agronomists, but there are some key distinctions.

The Agricultural Research Team usually (but not always) works on field-scale and farm-scale projects while FID researchers concentrate on small plots. The two groups often work jointly. Once a researcher in FID identifies a new trait, such as drought tolerance, incorporates the trait in improved forage varieties, and develops a management plan for evaluating it under field conditions, the project then moves to the Agricultural Research Team for large-scale testing and evaluation relative to existing forage systems.

"We have to ask ourselves: Is the new system or management practice more economical than what the producers do now?" said Jon Biermacher, Ph.D., research economist. "To get farmers and ranchers to adopt an alternative farming practice or a new plant variety, you have to show them that it is more economical than what they are doing now."

"These farms are the Agricultural Research Team's laboratory, and they are some of the best in the world..."

Russ Gentry, operations research manager

Members of the Agricultural Research Team harvest forages for testing.

Seeking the right answers

Whenever a new project is proposed, the research team asks two fundamental questions: Will the results of the project have a direct impact on agricultural producers? And do we have the resources (i.e., facilities, labor, time and funding) to complete the project? (In addition to implementing and conducting applied agricultural research, the team also manages all the Noble Foundation's land, research equipment and research support staff.)

"If the answers to both questions are yes, the team develops research questions just like any laboratory. These are the points we want to pursue," Cook said. "We put significant effort into the project design. These are designed, controlled experiments focused on collecting data to answer specific questions."

Most projects are conducted over three or more years to reduce the impact of abnormal growing seasons caused largely by unpredictable weather and, most importantly, they revolve around livestock. The cattle industry is the predominant agricultural industry in southern Oklahoma and north Texas with 2.8 million head of cattle and a million more calves continually cycling in and out of the region. The stocker cattle industry utilizes many of these calves in programs that are designed to add weight. This industry has historically been based on small grain forages to achieve this growth.

"Since we live in a region with a heavy emphasis on stocker cattle production, new varieties of forages must improve livestock gain, enhance forage production or quality, and be comparable economically to existing forage varieties or systems before a producer will consider making changes to their current systems," said John Guretzky, Ph.D., team agronomist.

Through a wide variety of projects, the group not only responds to questions posed by area farmers and ranchers, but they also can be proactive and seek answers to broader challenges otherwise not available to the agricultural community.

"We have the ability to initiate necessary projects and to do

long-term applied research," Cook said. "Combine that with our multidisciplinary team approach and you see what makes us unique."

And the projects are as unique as the system and the researchers that create them.

From biofuel to bermudagrass

With the global push for renewable forms of energy, Guretzky and Biermacher find themselves with the arduous task of evaluating production-scale agronomics and economics of switchgrass, a native prairie grass with the potential to be a source for cellulosic ethanol.

Since switchgrass has not been thoroughly studied on this scale, Guretzky is assembling important data on plant responses to nitrogen, phosphorus and potassium fertilizer rates, and harvest management. Cook furthers the switchgrass effort by focusing the project through the livestock lens by studying how the grass might have a dual purpose as an early season forage crop for stocker cattle in addition to a bioenergy crop system.

"Without farmers and ranchers adopting switchgrass into their operations, there will never be a cellulosic biofuels industry," Cook said. "It is very much a chicken and egg type scenario. A company is not going to build an ethanol plant without the availability of the raw materials they need for production. On the other hand, no producer is going to produce this crop without an idea of how to economically benefit from it. We need to show the producers how this crop can fit into their current cattle production system to begin to establish a critical mass of switchgrass that may at a later time be used to produce ethanol."

In another project, Guretzky compares traditional pasture systems, which use nitrogen-fertilized bermudagrass, with a system that incorporates a legume mixture with bermudagrass. Legumes, such as alfalfa and hairy vetch, have the ability to fix atmospheric nitrogen into forms of nitrogen that benefit the legume and that can also be transferred to neighboring bermudagrass.

"With the dramatic rise in the cost of fertilizers, the implications of this study could be significant," Guretzky said. "A pasture system with legumes and bermudagrass might prove to be more profitable than the traditional bermudagrass-only system."

The various locations of the seven research farms play a role in each project by providing the team with a variety of growing conditions (soil type and rainfall) that mimic those that area agricultural producers might face. This diverse geography allows the team to accurately address a full range of challenges farmers and ranchers face each day.

"No two soils are alike in their morphology and other properties," said Jagadeesh Mosali, Ph.D. "Each soil type responds differently to fertilizer inputs. We need to understand the spatial and temporal variability, and use variable rate technology research to determine actual key factors, such as fertilizer rates."

Once a project has proven its mettle in production-scale field trials, the group moves it into the hands of farmers and ranchers. This provides a twofold opportunity.

"This allows us to see how they manage the trait. Can they get it established? Can they work with it?" said John Blanton, Ph.D. "So we're seeing it from the producer's point of view, but we're also continuing to collect data, while looking at the economics under real-world conditions."

Stewards of the land

The Agricultural Research Team not only solves production agricultural problems, but works to fulfill the original mission of Lloyd Noble, who established the Noble Foundation in 1945. Noble wanted his organization to help keep the land healthy and productive after watching the devastating effects of the Dust Bowl and poor farming practices in the early 20th century.

"We're not just looking at stocker cattle and forages, we're looking at how to perform production agriculture while managing the natural ranges responsibly," Guretzky said.

"We have the ability to initiate necessary projects and to do long-term applied research. Combine that with our multidisciplinary team approach and you see what makes us unique."

Billy Cook, Ph.D., consulting support research manager

Photograph by *Broderick Stearns*

Tresa Runyan, field mapping and tracking specialist, works on mapping a field in the Oklahoma Panhandle that contains a biofuels research project.

"Production makes money and that's important, but what about the sustainability? We're looking at where we can be profitable, but still conserve the land. This is where the wildlife research comes into play."

Wildlife projects fall under the purview of Ken Gee, who, for almost three decades, has conducted deer management and prescribed burning studies vital to sustaining regional natural habitat.

Gee's prescribed burning has proven effective for controlling brush and invasive eastern red cedars while also rejuvenating vegetation growth. One of his more recent studies uses patch burning, where one-third of a pasture is burned annually to promote new growth and provide better forages for livestock and wildlife. The 10-year burning project will help Gee and Guretzky evaluate vegetative response and productivity, as well as its impacts on wildlife and livestock. The study is a forward-thinking attempt to show the positive combination of patch burning and proper grazing management.

"We have to predict what's important in the future," Gee said. "That's also part of being a good steward of our land resources."

Providing for the basics

Underscoring each field project, including those by the Agricultural Research Team and FID, is Gentry's crew. They prepare soil and build fencing for the small plots and help manage the larger scale projects. They maintain more than 300 major pieces of equipment, oversee irrigation and tend to the health of the Noble Foundation's livestock. When genetically similar cattle were needed for forage tests, they bred them. When data needs collecting, they are there with clipboards and laptops. And when tours need to be led, they swing open a pickup door and head to their laboratory.

As this tour came to an end, Gentry steered his truck back toward the main road and headed for home. Silence filled the cab for just a second and then Gentry said, "The way I see it, this all starts with a question, and then we go through this process and these resources provide the answers."

Andy Hopkins can draw a few parallels between his life and the classic baseball movie "*Field of Dreams*." As a teenager, he found his calling in a cornfield. In his current role as plant breeder, he faces his fair share of infield sagas. And he loves – maybe loved is a better way to put it – baseball. Unfortunately there are no mules in his story. Confused? Continue reading about Hopkins, who has led one of the Noble Foundation's 18 laboratories for the past 11 years, but has spent a lifetime dreaming about his fields of plants.

On discovering his "*Field of Dreams*"
I am from the St. Louis, Mo., area, and there just so happened to be a corn breeding station nearby. A friend of mine worked there and told me about it. I thought it sounded interesting. I spent three summers during high school working there and continued studying plants in college. I focused on forages in graduate school. After 10 years and a Ph.D., I finally decided I could call myself a plant breeder.

On developing cool-season perennial grasses
I work with a number of cool-season perennial grasses like tall fescue, tall wheatgrass, orchardgrass and hardinggrass. Currently farmers and ranchers use cool-season annuals for high-quality forages for livestock. If we develop perennial forages to replace the annual systems, it could save agricultural producers time and money. Instead of needing to plant an annual each year, you plant a perennial one time and it's there for possibly decades.

On his hobby being ironically similar to his job
In my spare time, I enjoy gardening. What can I say? I like growing plants. People tell me I'm "out" "standing" in the field.

On Beekeeping 101
I took a college course in beekeeping. It was pretty funny because you could mail-order bees and set up hives at your house. I did that for a few years, not successfully, but I got a kick out of it and only a few stings.

On his lost love
I used to eat, sleep and breathe baseball. Player strikes, interleague games, the designated hitter rule, steroids and wild card teams have damaged the sport. I used to follow it closely, but haven't had the time to keep up with it for many years.

On what makes a great movie
I believe the three elements a movie needs to be great are trains, baseball and mules. "*Fried Green Tomatoes*" meets these criteria. "*Field of Dreams*" is another terrific movie, but needs mules. - Calley Tierney

Photograph by *Broderick Stearns*

Jin Nakashima, Cellular Imaging Facility Manager, observes living plant cell samples.

Photograph by *Broderick Stearns*

More Than Just Microscopes

The amazing technology that powers the Noble Foundation's Cellular Imaging Facility enables researchers to study living cells. But that's just the beginning. by Andrea Perry

Studying living plant cells requires a few key items: highly trained individuals, practice and patience, and – in the case of the Noble Foundation – an entire facility filled with amazing microscopes.

The Noble Foundation's Cellular Imaging Facility is a vital resource for the organization's research staff. Cellular imaging is an indispensable tool to study the inner workings of cells and answer fundamental questions about plant function.

"Observing a cell's building blocks, such as proteins, fatty acids and carbohydrates, helps us answer questions about growth and cell development," said Jin Nakashima, facility manager. "We also work to explore chemical interactions within cells; it is at this detail level that scientists must work."

The Noble Foundation's Cellular Imaging Facility is a 10-room suite with about 3,500 square feet of modern light microscopy and biological imaging equipment.

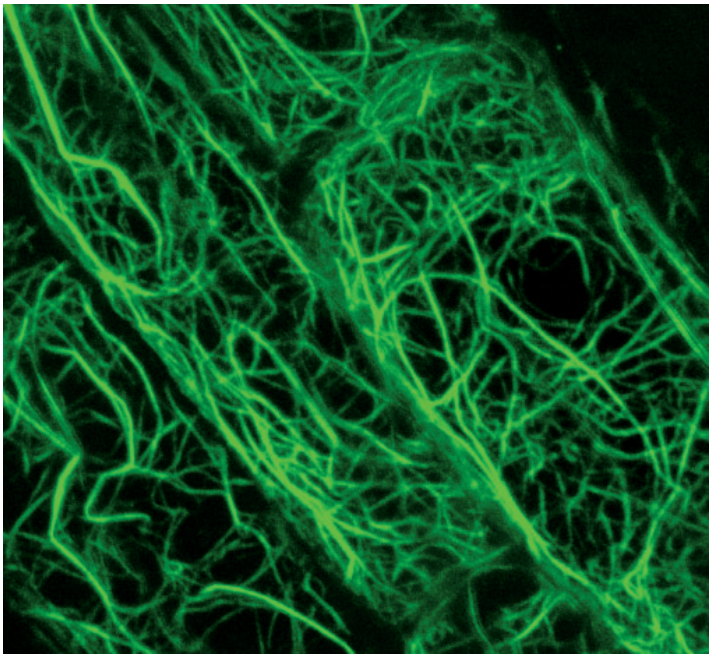
The resource fulfills a twofold mission: conduct original research under the guidance of lead scientist Elison Blancaflor, Ph.D., and provide microscopy resources to other Noble Foundation researchers. As part of their support of the Noble Foundation scientific staff, Elison Blancaflor and Jin Nakashima train fellow researchers to operate ▶

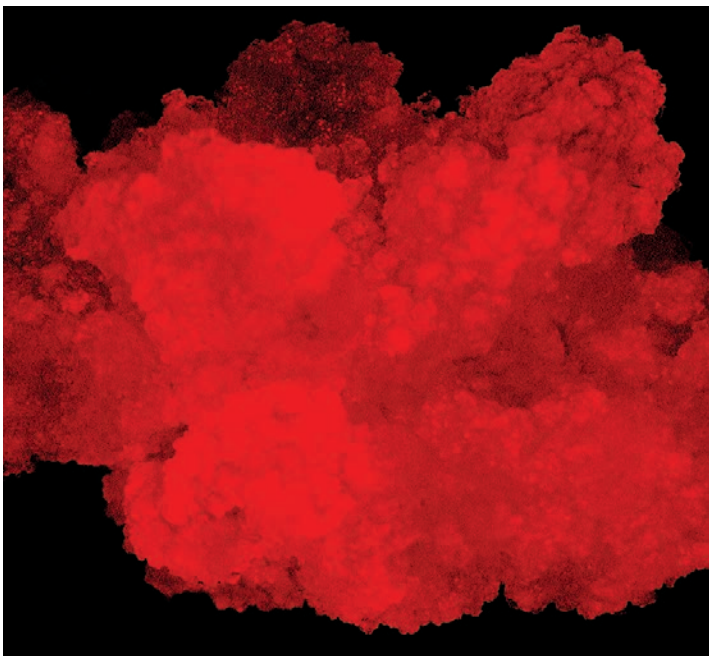
various conventional and advanced fluorescence microscopy systems, and provide advice on how to interpret data that they obtain, which in many cases is more important than just microscopy.

"Often, other departments are looking for answers and they find them on a plant level, but their questions may run deeper. They may need answers on a sub-cellular level," said Julia Dyachok, a postdoctoral fellow with the group. "That is where our department comes in."

The group also assists with operating confocal laser scanning microscopy, wide-field fluorescence microscopy, image process-ing and analysis, immunolocalization and microtomy.

"The equipment and uses for that equipment sound intimidating and, in reality, the capabilities are far beyond an ordinary microscope," Nakashima said. "But this equipment provides an avenue into a living organism, a road that our predecessors were unable to travel."





In the not-too-distant past, cellular imaging was limited to pre-prepared slides called "bio-dead" slides. However, today, microscopes (for example, spinning disk confocal microscopes) enable researchers to study live cells. The addition and use of such microscopes have been beneficial to Noble Foundation research.

"Looking at a living cell compared to a fixed or prepared slide is like watching television compared to reading a magazine," Dyachok said. "With a television show, you watch the interactions and movement. Magazines are static. Living cells open up a whole new world of research."

The observation and study of living cells present many challenges, including keeping the cells alive. Not only are cells sensitive to temperature, pH and CO_2 levels, they can be easily damaged by the very light needed for their observation, making live-cell imaging a constant balance between sensitivity of the emitted fluorescence signal and phototoxicity.

"Strict control of the photo bleaching is one of the most critical factors in successful live-cell imaging experiments," Nakashima said. "Working with live cells can be very reward-ing, but that does not mean it is easy."

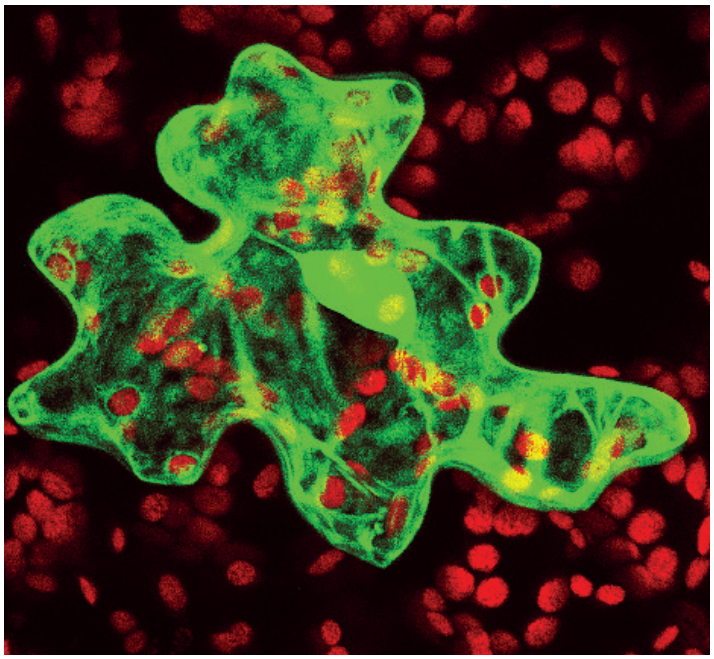
The Cellular Imaging Facility staff also performs their own independent research with a special focus on how plant cells grow and acquire their diverse shapes. Such studies have an impact on plant development and architecture, which are key factors in production agriculture.

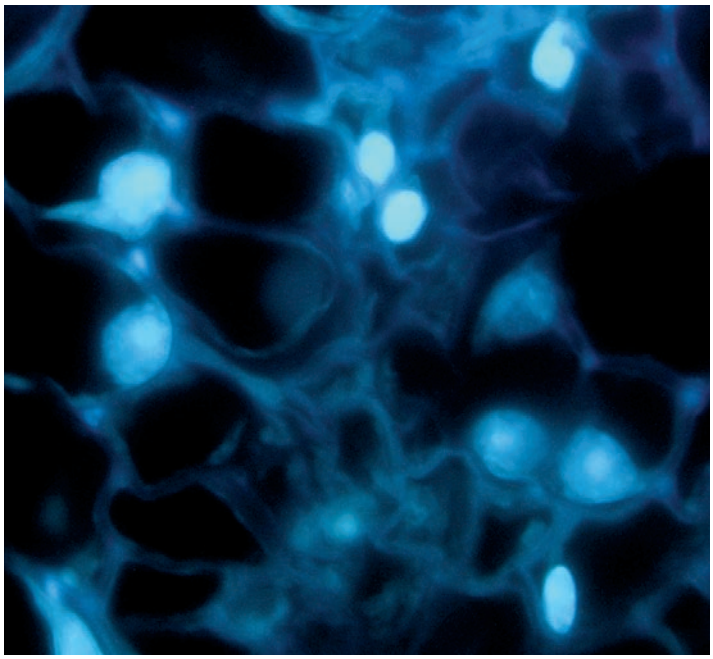
Researchers in the facility are interested in studying a component of the cell called the cytoskeleton (the cell skeleton), a network of filaments made of proteins. Studying the cytoskeleton is important because it regulates a number of important processes in the cell including specifying the direction of cell growth, transporting materials within the cell and between cells, and making sure that a cell divides correctly. The filaments that make up the plant cytoskeleton are also dynamic, making it an attractive subject for live-cell imaging work.

The work of the Cellular Imaging Facility staff extends beyond the Noble Foundation's doors as well. In recent years, there have been many requests from external scientists for collaborative research requiring cellular imaging. This has led to a number of joint publications between Noble Foundation scientists and

“Working with living cells is very rewarding, but that does not mean it is easy.”

Jin Nakashima, facility manager



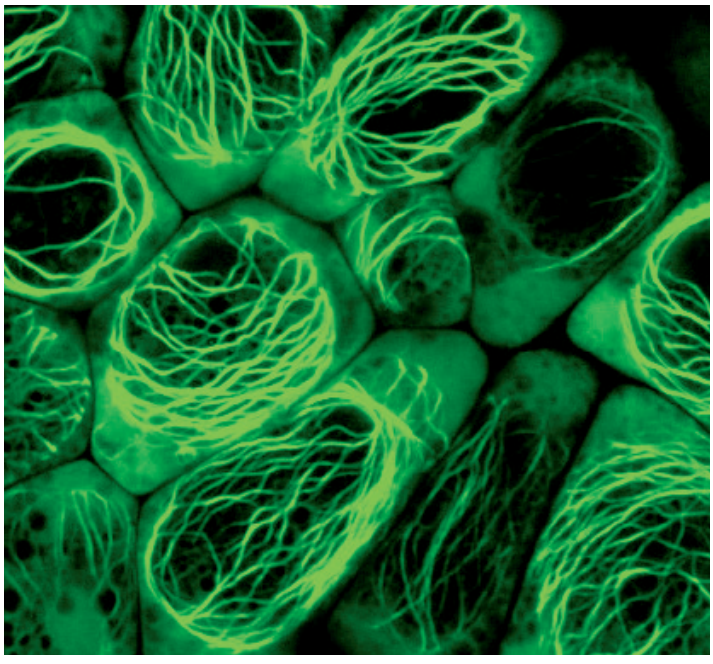


faculty at research universities and institutes.

The Cellular Imaging Facility does more than contribute to the plant science community – it offers an avenue to introduce hundreds of future scientists to the world of plant science. The group performs educational outreach through dozens of presentations to hundreds of students from Oklahoma’s public and private schools.

“They arrive thinking that microscopes and cells are going to be boring,” Blancaflor said. “But after the first few slides, they’re hooked.”

As cellular imaging technology continues to grow and change, the scientists who staff the Cellular Imaging Facility continue to make new discoveries about life in its most basic form. “Working in cellular imaging at the Noble Foundation makes you appreciate the ‘how it happens’ in cell development, movement and function,” Dyachok said. “What makes it really special is that ‘wow’ moment when something comes together. Suddenly, you understand and see the ‘how’ happening right in front of your eyes.”



If you could have dinner with any historic or fictional character, who would it be?

Countless times, the course of human history has been redefined by a single person, and sometimes that individual only exists in our imagination. Whether it's a president who chopped down a cherry tree, a civil rights leader with a dream or a certain talking mouse, the individuals from our past and the characters from our stories have inspired our collective culture. Below, four Noble Foundation scientists select a historical figure or fictional character to be their dinner guest. The results stretch from the genes of a pea to an undiscovered galaxy.

Zeng-yu Wang
Associate Professor
Forage Improvement Division

If possible, the past figure I would like to have dinner with is Gregor Mendel because of his pioneering work and contribution to modern genetics. Mendel, who is known as the "father of modern genetics," discovered the inheritance patterns of several traits in pea plants and their offspring. He would be happy to learn about the tremendous progress achieved in genetics and genomics after his initial discovery. In particular, the gene responsible for seed color trait – which he described – has recently been identified and shown to play a fundamental role in chlorophyll catabolism.

Rangaraj Nandakumar
Postdoctoral fellow
Forage Improvement Division

My only choice for a dinner companion would be Mother Teresa for her self-sacrifice and humanitarian work. She is an amazing figure to have accomplished such work while facing many obstacles. She served all human beings, inspired courage and gave those she helped a sense of their worth. Mother Teresa will remain an unforgettable example of selfless caring, energy and bravery.

Mustafa Morsy
Postdoctoral fellow
Plant Biology Division

I would love to have dinner with Mahatma Gandhi. He was a magnificent leader who fought for civil liberties and political rights with a non-violent strategy leading to the independence of India. One of his best sayings is "To forgive and accept injustice is cowardice."

Marilyn Roossinck
Professor
Plant Biology Division

I would have dinner with Mr. Spock from "Star Trek." I would love to probe his incredible intellect, experience of the galaxy and knowledge of the arts. I have always been a sci-fi fan, but I guess part of the appeal is the optimistic future he represents. Of course, I also like the idea of space travel. If the price comes down to $10,000 or so, I will probably go up on the shuttle.

Photograph by *Broderick Stearns*

The Evolution of William Schneider

William Schneider, Ph.D., grew up in an everybody-knows-everybody town of 57 people in northern Minnesota, so when he arrived at The Samuel Roberts Noble Foundation, he experienced southern hospitality for the first time.

Schneider, who now works in the counter-bioterrorism field with the United States Department of Agriculture (USDA), served as a postdoctoral fellow at the Noble Foundation with principal investigator Marilyn Roossinck, Ph.D., from 1997 until 2001.

It's fair to say that Schneider learned a lot both inside and outside of the laboratory.

"In Minnesota, we are a bunch of stoic Norwegians and Germans. We don't necessarily go out of our way to smile or to wave at people," he said, chuckling. "I drove around here and people I didn't know would wave at you as you drove by."

Beyond the regional culture experience, Schneider joined the Noble Foundation's community of postdocs – which consisted of individuals from more than 25 countries – and a world of experiences opened up before him.

"I developed an appreciation for entirely new cultures," he said. "I learned a lot. It really opened my eyes." ▶

by Shelia Robinson

Evolving virus research

Schneider received his bachelor's degree in biology from the University of Minnesota at Duluth and a doctorate degree in genetics from Michigan State University in 1997.

He came to the Noble Foundation from graduate school where he worked on viruses and became fascinated with how they evolve. He wanted to continue work on virus evolution, but needed an organization where he had resources to perform his particular research.

"I would not have been able to get funding for this type of research because it was too new and too novel," he explained recently. "The Noble Foundation afforded me the resources and Marilyn provided me a venue to focus specifically on my projects. That was a pretty unique situation."

Schneider and Roossinck honed in on cucumber mosaic virus, tobacco mosaic virus and cowpea chlorotic mottle virus. They compared these plant viruses for population diversity.

"What's hard about fighting viruses and creating vaccines to fight them is that viruses are good at making a lot of mutants and one of those will usually survive no matter what is done to thwart it," Schneider said. "By working with viruses in plants, we could complete population-level work that other researchers were not able to do. We worked at sorting out what controlled the variation within the population. We can do large population studies in plants without affecting humans."

Roossinck and Schneider co-authored several papers on their findings, including two that were published in the *Journal of Virology*. Roossinck remembers Schneider for his ability, friendliness and lab bench.

"Bill was very productive while he was in my lab, and he helped other postdocs with their projects as well despite having the messiest lab bench I have ever seen," said Roossinck with a laugh. "Somehow, in spite of the piles of papers, petri dishes and other lab paraphernalia, he was always organized by the time I saw the results."

The work Schneider and Roossinck did on population diversity in viruses fueled research that has continued at the Noble Foundation for the last seven years, Roossinck said.

"I was able to try experiments that I would not have been able to try anywhere else," Schneider said. "The Noble Foundation really provided me tremendous freedom and opportunity. I am glad to know that I contributed to the overall efforts there as well." Schneider completed his term as a postdoc at the Noble Foundation in 2001.

Schneider's evolution

Schneider continues his work on virus evolution and develops new diagnostic technologies at the USDA's Disease/Weed Science Research Unit at Fort Detrick, Md.

Emerging diseases pose a major threat to human health and agriculture. In recent years, the incidence of emerging diseases has escalated with the increases in global travel.

Schneider's work uses new and adapted technologies as tools for improved diagnosis of plant viral and bacterial diseases that could be used as weapons of bioterrorism. Schneider is currently involved in multiple projects that include identification, characterization and biology of foreign and emerging insect-transmitted plant pathogens.

"A lot of the ideas that I carried forward and built my research program on came from interactions that I developed at the Noble Foundation," he said. "I'm still thankful I had such a worthwhile postdoc experience."

"The Noble Foundation afforded me the resources and Marilyn provided me a venue to focus specifically on my projects. That's a pretty unique situation."

William Schneider, Ph.D. former Noble Foundation postdoctoral fellow

Keeping the Science Growing

A handful of dedicated plant care specialists and greenhouse staffers keep one of the largest research greenhouses in the United States running smoothly. by Amy Thorn

At the Noble Foundation, greenhouse space is divided into "cells" – environmentally controlled rooms where scientists conduct their various experiments. Each cell has a unique character based on the ever-changing plant science experiments contained within its walls and the individual who maintains it.

Seven of the greenhouse's 34 cells fall under the watchful eyes of Janie Gallaway. While six of them are tediously organized with flawless rows of thousands of perfectly potted *Medicago truncatula* plants, today she's staring into Cell No. 7 with a slight frown on her face. The plants, while organized and vibrantly green, droop over their pots a bit, not tied neatly to stakes like their counterparts in other cells.

"Because of the Thanksgiving holidays, this one has gotten away

David McSweeney, greenhouse manager, assists Lark Boyd, greenhouse staff member, with trimming alfalfa plants.

Photograph by *Broderick Stearns*

"I don't believe there are many facilities like this in the world, but it's only brick and computers without the people."

David McSweeney, greenhouse manager

from me a bit," she said. Then she smiled and added, "But I'll have her in tip-top shape by Friday."

Gallaway exemplifies the Noble Foundation plant care specialists, a dedicated group of individuals who keep careful watch over the experiments within the greenhouse. They are not just plant aficionados or expert gardeners. They possess skills that critically support the scientific research process, and they do not take their charge lightly. As Gallaway said, "The scientists cannot be here to handle this part of the project, so they rely on us to keep things moving efficiently. We're responsible for these plants and we take that seriously."

Janie Gallaway, greenhouse staff member, tapes *Medicago truncatula* plants to stakes.

Working under an acre of glass

The Noble Foundation's greenhouse facility is unparalleled in both structure and support. It is one of the largest research greenhouses in the United States with more than 47,000 square feet of continuous space (larger than an acre of land), and it boasts the largest air-conditioned greenhouse range in North America with 17, 20-ton air conditioners cooling 18 of the cells. Each of these cells allows the scientist to independently control temperature, humidity and artificial light according to the parameters of the current experiment.

"I don't believe there are many facilities like it in the world," said David McSweeney, greenhouse manager. "But it's only brick and computers without the people."

The heart and soul of the facility are the plant care specialists. Lead scientists (called principal investigators) within the Noble Foundation's Plant Biology and Forage Improvement divisions employ plant care specialists to work in their specific laboratories. These specialists represent that principal investigator's laboratory inside the greenhouse, ensuring that the experiments run with minimal bumps. The specialists are supported by McSweeney's greenhouse staff, who serve as daily administrators and provide plant maintenance, such as trimming and repotting plants. They also maintain the automated systems. But it is the plant care specialists who stay focused on their laboratories' projects.

No leaf unturned

Each plant care specialist develops a knack for the work needed by their scientist.

"After a while, you begin to understand the plants and what the researcher wants to achieve with the experiment," said Gallaway, who has been a plant care specialist for the Plant Biology Division for almost a decade. "You begin to anticipate what they're going to need. It's all part of being an effective team."

In a facility dominated by technology, much of the work is still conducted by hand. Cells are carefully kept, the contents dutifully overseen and each experiment checked and rechecked.

For example, Judy Grider, a Forage Improvement Division specialist who has been a part of the greenhouse for 14 years, checks the plants under her care daily for water or nutritional issues, performs repotting or grooming requirements, and looks for signs of pest or disease outbreaks. She can spot the tiniest of insects that become trapped in insect traps and, according

to the number that are collected, Grider can gauge the future health of the plants and the possible need for intervention.

Grider spends many hours with the plants under her charge and notices even the slightest change in the color of the leaves. By informing the principal investigator of any slight changes, the entire project stays on track.

Not only do plant care specialists maintain the cells to the scientists' specifications and execute the necessary research tasks, they keep in mind the heart of the project as well as its potential future needs. Carla Welch, plant care specialist with the Plant Biology Division, says, "We do our best to keep the researchers happy with our work while at the same time doing what is needed for the plant or even sometimes its genetic line. Because of our experience, we often have the best solutions for keeping the plants, seedlings or seeds ready for the future collection of successful data."

Growing a better greenhouse

Plant care specialists also serve as conduits between scientists and greenhouse associates, keeping the laboratory staff – research technicians, scientists and postdoctoral fellows – integrated with activities and project status in the greenhouse.

Karen Flowers, a greenhouse staffer for 13 years, said, "When we see a problem, such as a pest infestation, we can propose solutions and give input to the plant care specialist."

The plant care specialist then takes this information to the scientist. McSweeney added, "We catch problems and solve those problems in a line of cooperation from greenhouse staff to the plant care specialists to the scientist and back again. Everyone is accountable for the success of the project."

And everyone works the tough shifts.

Plant care specialists and greenhouse associates rotate the responsibility of checking automated systems in the cells on weekends, freeing the principal investigator and laboratory staff from this worry.

McSweeney explains that the collaboration between groups is a vast improvement to the scientific process. "We're not just potting plants," he said. "We enjoy creating innovative solutions like how we work together or how we use beneficial insects to control bothersome pests."

Flowers knows all about insect control. She's the pest control expert in the greenhouse. One day she might work inside a cell using a magnifying glass to check for pesky insects, and the next day she might be dressed head-to-toe in a protective plastic suit spraying pesticide.

Even though the insects can be bothersome, she enjoys solving plant-related problems that invariably arise. She simply noted, "We're supporting important research so our work is important."

When McSweeney looks inside one of the cells, he sees not just plants and experiments, but the very essence of the mission of the Noble Foundation outlined by Lloyd Noble in 1945. "I know that any one of these plants might be used for production agriculture to help farmers and ranchers," he said. "So we all set our focus on that conclusion. We feel like we are an important part of making scientific and agricultural history. That's why we get excited about our work."

Photographs by *Broderick Stearns*

Twain's Mark on the World of Forages

Significant work goes into developing new varieties of forages for area agricultural producers. Once the plant science and breeding are completed, then Twain Butler and his team take over. by J. Adam Calaway

Twain Butler is a simple guy with a complex task.

After scientists, researchers and plant breeders develop a new forage variety, Butler outlines a specific management plan to fully capitalize on the plant's unique traits. In essence, he's the guy who writes the how-to book for each novel forage crop developed at the Noble Foundation.

This complicated work hinges on deciphering countless variables (e.g., establishment procedures, herbicide usage, fertilizer rates and planting dates, among many others) and understanding how they interact to impact the life cycle of each plant.

Of course, Butler is not without resources. In the corner of his office hangs a white grease board. Here, he carefully tracks important dates, upcoming tests and new ideas for a slew of forages from tall fescue to important legumes like alfalfa, medics, vetches, peas, beans and clovers.

In a technology-driven research institution where computers outnumber people two to one, Butler's hieroglyphic-like scribbles represent key steps in his methodology. It's a system that has well served him and the agricultural producers who benefit from his work. For almost a decade, Butler's low-tech tracking system and, more so, his keen understanding of what makes forage crops tick have produced successful management plans for dozens of projects.

His latest charge, however, requires him to utilize all his fundamental knowledge about forages, but yet not depend solely on past experience. He has also cleared a large spot on his

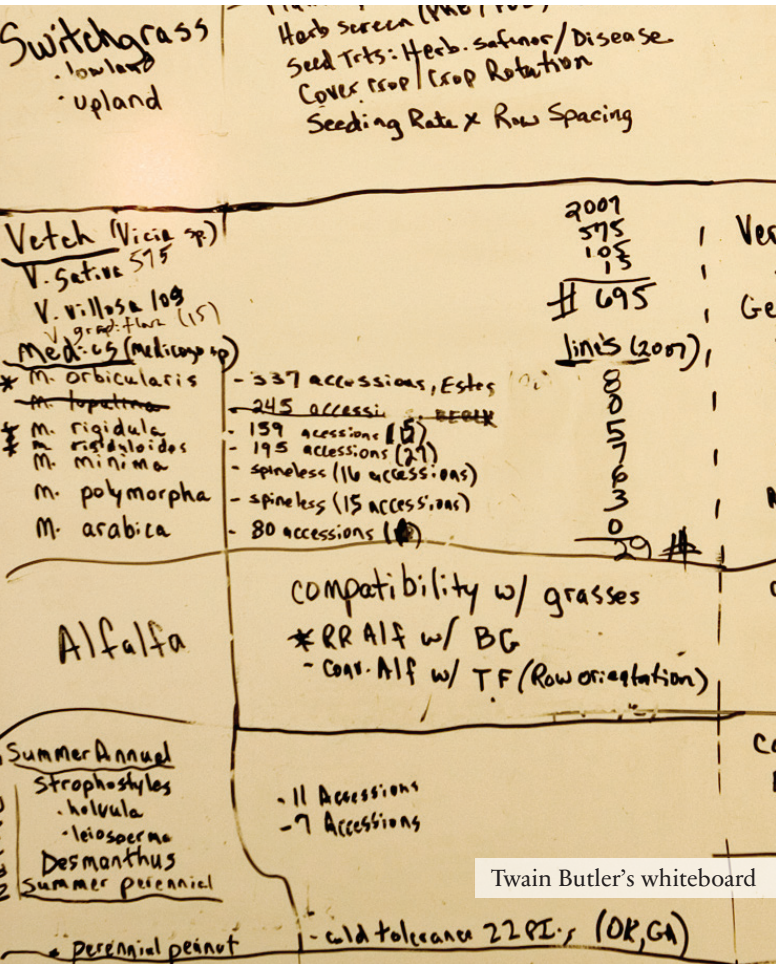
Photograph by *Broderick Stearns*

whiteboard.

As part of the Noble Foundation's efforts to advance switchgrass as both a potential bioenergy and forage crop, Butler must take this relatively unstudied prairie grass and turn it into a cultivated crop.

It's a wholly unique experience, not just for Butler's team and the Noble Foundation, but for anybody, anywhere, since these are considered the pioneering days of developing bioenergy crops.

"Switchgrass is unique," said Butler, Ph.D. "I've faced challenges with this plant that I've never experienced before." He pauses, "That's the fun part though."



Twain Butler's whiteboard

Answering the switchgrass questions

The process to transform switchgrass into a viable bioenergy crop begins with a question – or more accurately – dozens of questions, such as: What's the best method for planting switchgrass? or Should we use herbicides? or What machine can you use to harvest switchgrass?

"Because switchgrass has yet to be used as a cultivated crop, little information is known regarding establishment, management or harvest," Butler said. "No one has ever used switchgrass in this capacity, so we need to be able to answer these questions for the agricultural producers."

Butler is not alone as he attempts to develop the entire spectrum of a management plan. He collaborates with many team members in the Forage Improvement Division, as well as John Guretzky, Ph.D., a fellow research agronomist with the Agricultural Research Team in the Agricultural Division.

"Our collaboration is an invaluable resource," Guretzky said. "It greatly advances the research."

While Butler focuses on establishment – selecting the best seeding rates, herbicide usage and potential cover crops which provide temporary protection for fragile seedlings – Guretzky examines nutrient accumulation, harvest management effects and fertilizer inputs, specifically nitrogen.

Butler and Guretzky manage a handful of separate field trials, but share a series of tests that seek to understand the best planting time for switchgrass, the amount of seed required and how the two factors impact each other. Butler and Guretzky planted several fields during last fall and winter, and then again in spring 2008, using between 2 and 10 pounds of seed, looking for the highest yield with the lowest economic input.

The first steps

Of course, there were some practical challenges to overcome along the way. Butler quickly discovered switchgrass seed germination

"Switchgrass is unique. I've faced challenges with this plant that I've never experienced before. That's the fun part though."

Twain Butler, Ph.D., research agronomist

"Using switchgrass as a spring forage may provide an economic opportunity. This will be important for the integration of the plant into existing livestock-based production systems ...."

John Guretzky, Ph.D., research agronomist

was more challenging than he initially thought.

"You usually get a 95 percent success rate with seed germination in other forages; but with switchgrass, it's a 50:50 shot," he said, "The new improved cultivars we've developed are better."

Even after germination, switchgrass requires intense management during its first year. "It's a little cranky," Butler said. "Switchgrass starts slow and puts roots down first like many perennials, so there is not a lot of top growth."

Weed control becomes paramount as competing plants often choke out the slower-growing switchgrass. Butler's group tested pre- and postemergence herbicides in various forms before finally selecting a few methods for advanced testing. No matter the delivery system for the herbicide, Butler said weed control improves switchgrass establishment by 90 percent, making it a cornerstone of the management program.

Moving to the other end of the spectrum, Guretzky's research examines how frequency and timing of harvest affect biomass yield and nutrient uptake. The key question remains: What benefits exist for one or two cuttings per year? A one-cut system maximizes biomass yields which can be refined into fuel. A two-cut system, however, may be favorable for farmers and ranchers in the southern Great Plains. The first cut provides a suitable hay crop for livestock. Material from the second cutting could then be shipped to a biorefinery.

"Using switchgrass as a spring forage may provide an economic opportunity," Guretzky said. "This will be important for the integration of the plant into existing livestock-based production systems because farmers and ranchers growing switchgrass may use it as a source of income or a forage as the bioenergy industry develops."

In the end, the trial data generated from Butler and Guretzky's research will result in a proven method for switchgrass management, one that will serve as a guiding force for agricultural producers.

"All of this research goes back to helping the farmer and rancher," Butler said. "That's the whole point of this. So we're going to keep going. We're going to have some successes and failures, but we're going to figure it out."

Which means: Back to the whiteboard.

Photograph by *Broderick Stearns*

Chengjun Huo, Ph.D., a postdoctoral fellow with Butler, sifts seeds as part of an experiment.

What Alternatives Do Agricultural Producers Have to Expensive Fertilizer?

Noble Foundation agricultural consultants discuss why prices have increased and what farmers and ranchers can do to offset them. by Martha Garrett

According to the National Agricultural Statistics Service (NASS), fertilizer prices have been increasing steadily since 2002 with prices as much as 30 percent higher this spring than a year ago. One only needs to talk to a few producers in any area of commercial agriculture for a practical validation of NASS's data. The high price of fertilizer is putting a financial squeeze on the industry as a whole. In this edition of *Legacy*'s Agriculture Roundtable, five Noble Foundation consultants examine why fertilizer costs have escalated and what management steps and alternatives are available to producers.

David Annis: The increase in fuel prices and the demand for corn-based ethanol are the driving forces behind the dramatic price jumps for fertilizer. Nitrogen fertilizer production uses natural gas so its price is directly linked to higher fuel costs.

Dan Childs: Corn production requires the largest amount of nitrogen, and acres and acres of cropland have been converted from other crops such as cotton and soybeans to corn production. The primary source of ethanol is corn, which is driving the demand for fertilizer.

James Locke: Another factor relates to the increased global demand for our soil fertility inputs. China, India and Brazil's use of fertilizers has greatly increased while the United States has reduced fertilizer production and must import more of its fertilizer inputs than ever before.

Childs: For example, domestic ammonia production has dropped about one-third since 2000 and has been replaced by imported ammonia. Further, 70 percent of dry urea is now imported. These fertility inputs are arriving at port locations and have to be transported to production areas, which, for the most part, are concentrated in the center of the country. Freight rates have doubled in the last two years, so that is an additional cost.

Locke: Couple that with the lower value of the American dollar, and these other countries can outbid us for these inputs.

Annis: Looking ahead, China lost three diammonium phosphate plants in last summer's earthquake, and that will be an additional price driver.

Eddie Funderburg: Producers are at a huge disadvantage as fertilizer companies are not even providing price quotes much past today's rate. The reality is unless you have a high quality niche market, you can't sell grass hay and make a profit.

Childs: The recent volatility in input prices, which include fertilizer, is also a huge concern for producers. The uncertainty in the financial markets is also affecting both agricultural input costs and commodity prices making the timing of purchasing inputs as well as selling commodities much more important. Prices for fertilizer have fluctuated as much as

$300 per ton in as little as a three-week time period.

Annis: If you are considering fertilizer application for any reason, you must soil-test. I can't stress soil testing enough. In fact, if you are not going to soil-test, then do not fertilize.

Funderburg: If you need to add potassium or phosphorus, then it is probably not financially feasible to recoup your investment, and it's marginal to recoup the nitrogen costs this year. Plus, if your potassium and phosphorus levels are low, then your nitrogen does not respond as efficiently either.

James Rogers: Cattle producers can decrease their fertilizer costs, but when you do that you have to increase the grazing acreage required per head. If you apply 100 pounds an acre, you can run about one to two cows per acre; with 50 pounds an acre it takes three to four acres per animal. With no fertilizer, that figure jumps to six to eight acres required per cow. Of course, these figures are based on a normal rainfall year and the assumption that the ground is pretty good.

Locke: Agreed. If you are not going to fertilize, then you must adjust your stocking rate or, at the very least, reduce your expectation regarding possible hay yield.

Childs: For every $50 per ton increase in the price of urea, beef producers will need calf prices to increase by $4 per hundredweight, while stocker cattle will need to see a $0.025 per pound value of gain increase to maintain affordability levels.

Funderburg: With numbers like these, we have to consider alternatives to fertilizer. Each has its own benefits and drawbacks. For some, adding clovers to their grasses may be an option, as this can increase the natural nitrogen levels. Clovers, like other legumes, alfalfa and soybean, can transform atmospheric nitrogen into usable nitrogen. But clovers also require higher phosphate levels than grasses. They are erratic seeders, so they need to be planted annually to ensure good stands. Further, we can't overlook that clovers are most effective in relatively high rainfall areas ....

Locke: Clovers will also challenge weed control efforts. Some chemicals that are effective in grasses can hurt clover production. Weed control, in general, is another important issue in today's economics, because sometimes you can get more bang for your buck with weed control than by applying fertilizer.

Rogers: In addition to using clovers and the challenges of weed control, producers are definitely going to need to evaluate their grazing methodology. Destocking is certainly a consideration, and rotational grazing can be an effective tool.

Locke: Grazing also helps recycle nitrogen back into pastures through the cattle's manure and urine.

Childs: Producers need to look at the efficiency of their herd. Open cows obviously are costly, but the cow that tends to be overlooked is the one that calves late – she could be the most expensive. Producers keep these in the herd, but they sell the open ones. The late calvers have calves that are 50 to 100 pounds lighter, yet the cow is eating the same amount of forage as those that calve on time. With cows consuming 25 to 30 pounds of forage a day, that can equal a significant amount of money. Hay production also appears to be a real area of concern. There are options in the short term. There was a lot of hay made in 2007 which can still be purchased probably at $50-60 per ton versus $100 per ton for hay produced this year with the increased fertilizer prices. Producers should have a forage test run on any hay they are considering buying to check the nutrient content. Long-term solutions are not as easy to come by.

Annis: Long-term options really fall into four categories: destocking, planting legumes to provide nitrogen (if the soil pH and phosphorus levels are acceptable), weed control and fertilization based on soil tests along with an extremely high level of management.

Rogers: Let's remember that the men and women in agriculture are resilient. When shifts occur, like we are experiencing with fertilizer costs, someone figures out how do something better and offsets the shifts. It has always happened, and the industry will once again find the balance to help stem the tide of increased costs.


Annis


Childs


Funderburg


Locke


Rogers

An evening to remember

J. Adam Calaway
Director of
Public Relations

It's funny where you find an answer to a question you weren't even asking. In my case, a reception offered a warm reminder about defining true success for an organization.

A few days before trick-or-treaters donned their costumes, the Noble Foundation Plant Biology Division celebrated its 20th anniversary with a symposium. Scientists from across the country and around the world returned to southern Oklahoma – the birthplace of many of their careers – for 48 hours of research presentations and fellowship.

On the first evening, they gathered in a warmly lit dining room at the Noble Foundation's Conference Center for a "welcome back" reception. Long-held friends reunited to swap stories about old times and catch up on new projects. They spoke about their growing families and reminisced about their own maturation as scientists. They teased each other about graying hair and infamous tennis rivalries, and laughed about the many late nights spent poring over data, attempting to get – almost willing – a project to succeed.

During the reception, past generations of scientists met today's Noble researchers and the groups became fast friends, all members of the same fraternity. Maria Harrison, Ph.D., now with the Boyce Thompson Institute in New York, recalled unpacking laboratory supplies as one of the first postdoctoral fellows (postdocs) to ever call the Noble Foundation home. On the opposite end of the career spectrum, Andry Andriankaja just entered the final few months of his postdoctoral fellowship at the Noble Foundation. On this night, he shared news of his future job in Europe with those who had not heard.

The many conversations continued into the night, each unique, but similar in tone, echoing the same appreciation for an organization that impacted their lives and propelled their careers.

In the middle of the activity stood Plant Biology Division Director and Senior Vice President Richard Dixon, D.Phil., who was responsible for shaping the future of countless postdocs. If the many researchers under his charge for the past 20 years helped build the Noble Foundation's international reputation for plant science research, he was definitely the architect. He took a bold step in 1988 and became the founding division director at an organization that had never undertaken fundamental plant science. But he moved from the United Kingdom to southern Oklahoma because he had a sense this new division could be something special. He was right.

Dixon was locked in conversation all night, but in a rare quiet reprieve, he stood alone looking over the room like a proud father.

"A lot of outstanding science came from the men and women in this room," he said. "I'm proud of what they accomplished here and what they have gone on to do. I'm fortunate to have been a part of what the Noble Foundation has accomplished, and I'm excited about what we're going to accomplish in the future."

But it was Mohammed Farag, Ph.D., who encapsulated the spirit of the evening by asking a simple, but defining, question. Farag recently completed his fellowship at the Noble Foundation and accepted a teaching position at the University of Cairo in his home country of Egypt.

He stood near the doorway of the crowded room almost all night, greeting each new conversation companion with the same bright smile and kind eyes. Standing almost a foot taller than everyone else, the slender Egyptian examined the faces around him and said, "The Noble Foundation is known for having great resources, but that's not what makes it so great. Do you know what does?"

There it was – the question I'd never asked so directly, but, after an evening with these scientists, I sensed his answer.

"It's not the resources, but the people, the spirit of this place," he said. "It is this."

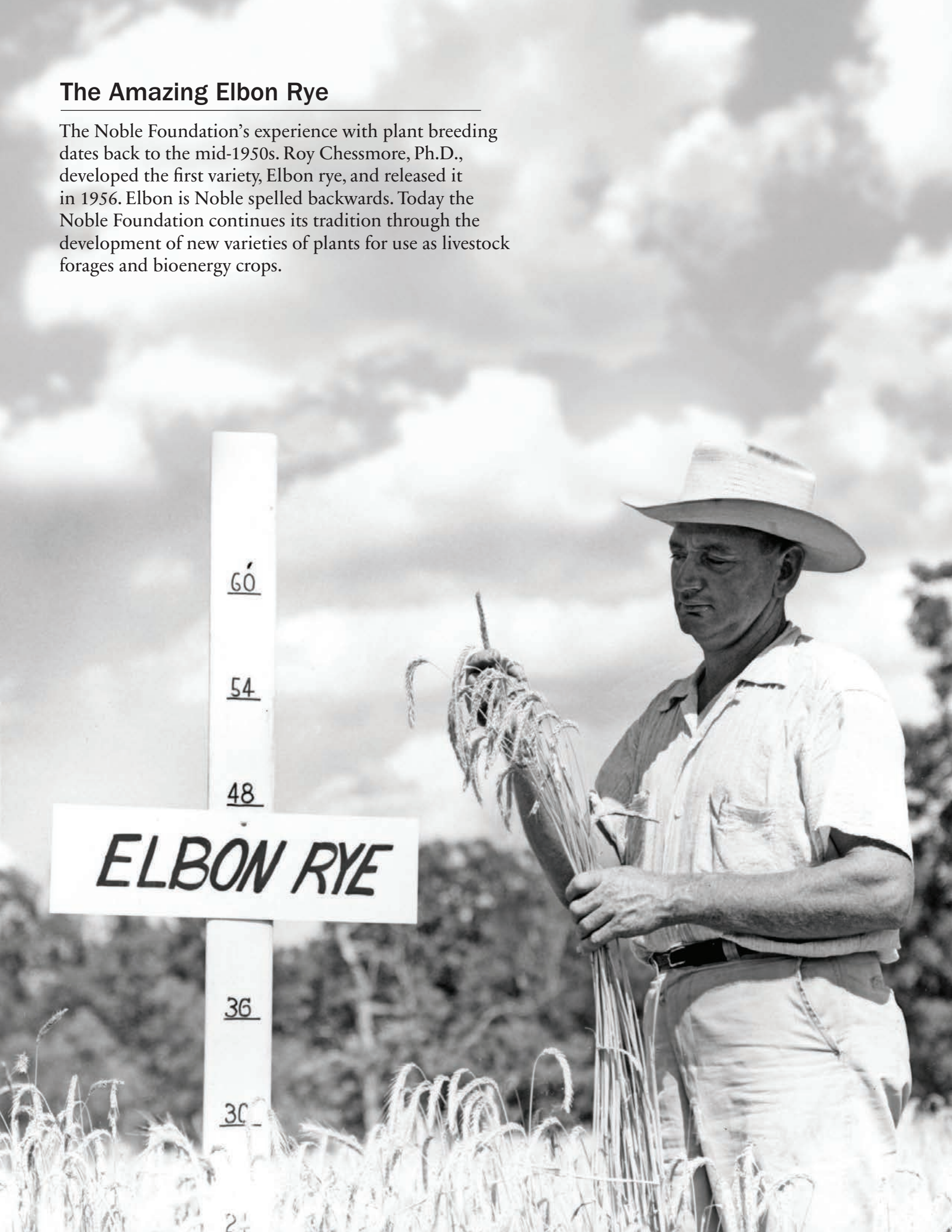
And, with those words, we both knew he was right.

"The Noble Foundation is known for having great resources, but that's not what makes it so great. Do you know what does?"

Mohammed Farag, Ph.D., former Noble Foundation postdoc

The Amazing Elbon Rye

The Noble Foundation's experience with plant breeding dates back to the mid-1950s. Roy Chessmore, Ph.D., developed the first variety, Elbon rye, and released it in 1956. Elbon is Noble spelled backwards. Today the Noble Foundation continues its tradition through the development of new varieties of plants for use as livestock forages and bioenergy crops.



Parting Shot

Discovering Your Future

One summer is all the time it takes to discover a passion, explore the unseen worlds of plant science and set a course that can change your life.

The Noble Foundation Summer Research Scholar Program offers the opportunity to conduct plant science in a real-world laboratory setting with some of the profession's greatest minds, performing cutting-edge research that holds the potential to impact global agriculture, influence animal and human health, and create alternative energy sources.

The Summer Research Scholar Program is more than just an internship; it's a chance to discover your future.

For additional information or an application, visit www.noble.org/SummerScholar/programDescription.html. Applications for summer 2009 must be submitted by Jan. 15, 2009.

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