

Legacy

Summer 2011

GROWTH POTENTIAL

Pecans have traditionally been thought of as a holiday treat, but agricultural producers are now looking at this nut as an investment in their futures.



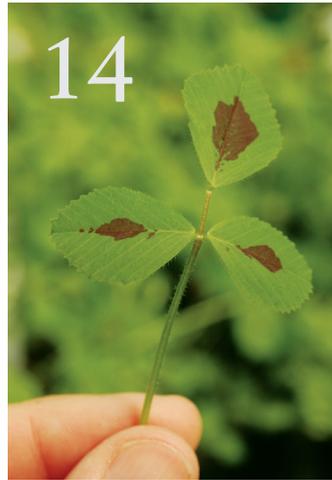


(on the cover) Pecans have been an agricultural enterprise in the Southern Great Plains for decades. With the explosion of international markets, however, more producers are planting improved and native varieties of pecans. The Noble Foundation's researchers and consultants are helping them optimize this opportunity.

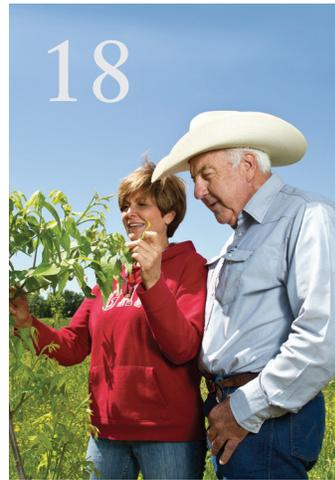
*(above) Yuanhong Han, research scientist, examines variations in seed morphology (size, shape and structure) in the model legume *Medicago truncatula*, commonly called barrel medic. Knowledge generated from the study of *Medicago* can be applied to agriculturally significant legumes like alfalfa.*



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What's for dinner?

The next time you sit down to a meal, try something. Before taking your first bite, attempt to name where each food item originated. Maybe the steak came from a stocker operation in Oklahoma, the ingredients for that salad from an emerald valley in California and the peaches for that pie from an orchard in Georgia. Like the majority of Americans, we rarely stop and consider the origins of our food. We simply ask: "What's for dinner?"

Our nation has moved so far from its agrarian roots that many – especially our youth – no longer understand how food is produced. They do not comprehend the decades of science and technology, the pure human grit and the countless daily miracles necessary to produce the bounty found in our supermarkets and – ultimately – on our plates. The ease with which we can obtain food – combined with a seemingly endless supply – has forged an almost reckless attitude toward the agriculture industry, devaluing the industry and those who provide the lifeblood of our world.

Agricultural producers are remarkable, juggling increased production demands, reduced resources and ever-changing environmental policy. They have performed these tasks so well that the industry has been virtually relegated to an afterthought. Functioning systems like agriculture are largely ignored by a world with more pressing problems, but a radical awakening stands at our doorstep.

During the next 40 years, global population will balloon from 6.8 billion to more than 9.3 billion. The world's farmers and ranchers must double the gross tonnage of food produced each year in only four decades. And they must do so with fewer resources and greater scrutiny.

Today, 1 billion people worldwide are considered malnourished. We read of food riots and upheaval based on food insecurity, which represent new stress fractures in the dam. Imagine the flood of fear when our basic needs can no longer be met. We cannot turn a blind eye to the challenges before us solely because we live in a land of plenty.

Technological advances are based on years of research and development, meaning that research and education become the linchpins of change.

For more than 65 years, the Noble Foundation has developed expertise to meet the challenges facing agriculture by addressing the entire spectrum of agriculture. Our work extends from the laboratory, where we conduct fundamental plant science and



advanced breeding, to the field, where we interact with farmers and ranchers to understand the challenges they face.

This researchers-to-ranchers approach must be applied on a global scale. Research institutions like the Noble Foundation and universities, private industry and agricultural producers will continue to work together, but we must be supported by an educated public and knowledgeable leaders.

Education has been a bedrock principle at the Noble Foundation, and now – more than ever – our society must be given factual, research-driven information on the importance of agriculture and the production processes required to generate food.

I have great faith that the world will succeed in meeting the challenges of the next generation, but as I look toward the future, I cannot help but remember words from the past. In the early 1940s, our founder Lloyd Noble said, "No civilization can survive the time when its agricultural economy is destroyed." He had survived the utter devastation of the Dust Bowl. The economy of the Southern Great Plains and its people were pushed to the brink until men like Noble stepped in and provided lasting solutions.

We must do the same. Otherwise, "What's for dinner?" will be an unanswerable question.

Sincerely,

Michael A. Cawley
President and Chief Executive Officer

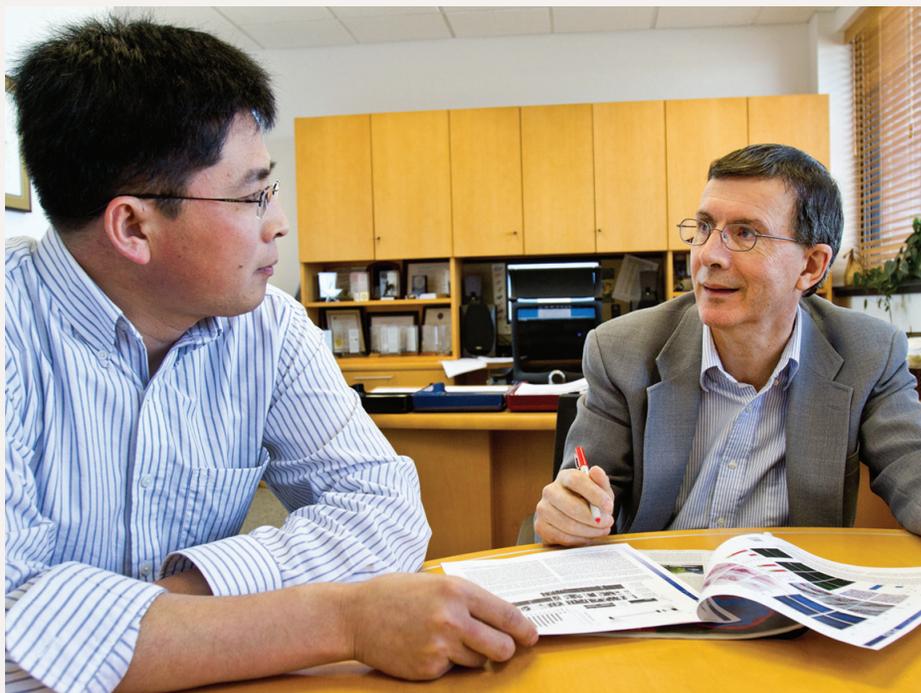
Notables

Inaugural Distinguished Professor selected

In spring 2011, the Noble Foundation Board of Trustees established the position of Distinguished Professor and Samuel Roberts Noble Research Chair, and appointed Richard Dixon, D. Phil., D.Sc., as the inaugural recipient.

Dixon serves as a senior vice president and director of the Plant Biology Division. His appointment was based on his outstanding record as a researcher and leader within the organization, as well as his reputation as one of the top plant scientists in the world.

Dixon came to the Noble Foundation in 1988 as the founding director of the Plant Biology Division. Under Dixon's leadership, the division has grown to more than 110 scientists and support staff, conducting fundamental, biochemical, and genomic plant research to benefit the health, value and productivity of forage legumes and bioenergy crops.



Senior Vice President Richard Dixon, D.Phil., D.Sc., (right) reviews a manuscript with postdoctoral fellow Huanzhong Wang, Ph.D.



Local students love Science in Ag Day

More than 200 seventh graders from Oklahoma's Dickson Public Schools attended the Noble Foundation's Science in Ag Day this May. The hands-on event emphasized the importance of proper management of agricultural resources like soil and livestock, and the impact of agriculture on the economy.



Want more information about Noble?

The Noble Foundation's social media outlets offer an in-depth look at the organization's people, programs and research, as well as real-time news about the day's agricultural issues. Follow us on Facebook (www.facebook.com/noblefoundation), Twitter (www.twitter.com/noblefoundation) and Flickr (www.flickr.com/noblefoundation).

Noble Foundation trains Texas National Guard unit

Noble Foundation agricultural consultants assisted the Texas ADT-5 (Agribusiness Development Team) this spring with fundamental training. The National Guard unit will be deployed this summer to Afghanistan on a tour to support the region’s farmers and ranchers.

By promoting agricultural education, the team hopes the Afghan people will have an economic foundation from which to rebuild stable lives. The Noble Foundation helped train members of the Oklahoma National Guard 2-45th ADT last year.



Horticultural Consultant Steve Upson discusses hoophouses with the Texas ADT.



Noble Foundation president sets retirement date

Michael A. Cawley, president and chief executive officer of the Noble Foundation, announced that he plans to retire on April 30, 2012, after more than 20 years of service to Oklahoma’s largest private foundation. Cawley is the longest tenured president in the Noble Foundation’s 65-year history. The Noble Foundation’s Board of Trustees has retained Spencer Stuart, a global executive search firm, to assist in identifying Cawley’s successor. Cawley will discuss his career in the fall issue of *Legacy*.



Help is just a phone call away at the Noble Ag Helpline

The Noble Foundation offers assistance to any agricultural producer in the United States or around the world through its Ag Helpline. For assistance, call 580.224.6500 8 a.m. to 5 p.m. CT, Monday-Friday.



Agricultural education events offered year-round

Each year, thousands of farmers and ranchers from across the United States attend Noble Foundation educational events on topics ranging from crops, economics, horticulture, livestock, pasture, soil and wildlife management, such as the Feral Hog Workshop (pictured) in March. For a complete listing of upcoming agricultural events, visit www.noble.org/AgEvents.



New Opportunities

Advanced breeding methods and a novel endophyte combine to offer agricultural producers a new alternative for winter grazing

by Debra Levy Martinelli

Research at the Noble Foundation often capitalizes on technology and advanced breeding techniques to improve traditional agricultural practices. The results can provide lasting positive alternatives for agricultural producers.

For decades, farmers and ranchers in the Southern Great Plains have annually planted ryegrass as potential forage during fall through early spring. Perennial options have been unavailable because they can rarely survive the region's blazing summer heat. Certain varieties of tall fescue held the potential to last through the summer months and return each year, but they carried the potential for fescue toxicosis, an illness caused by a small fungus that forms a symbiotic relationship with the plant.

The Noble Foundation and a collaborator, AgResearch of New Zealand,

spent more than a decade developing a new variety of fescue that combines the advantages of a perennial – reduced time and expense of replanting annual crops – while removing the elements that cause toxicity.

Called Texoma MaxQ II™, the new tall fescue variety is the first commercial forage designed specifically as a cool-season perennial grass for the Southern Great Plains.

Licensed to Pennington Seed Co., Texoma MaxQ II will be commercially available this summer and will begin to reduce the need for costly hay.

“When Noble Foundation’s Forage Improvement Division began its breeding program for this perennial forage in the late 1990s, a cool-season tall fescue was already commercially available,” said Senior Professor Joe Bouton, Ph.D., founding director of the Forage

(above) Twain Butler, Ph.D., associate professor, reviews a test plot of the newly developed Texoma MaxQ II.

(photos: Broderick Stearns)

Improvement Division, who currently leads its commercialization efforts and oversees one of the organization’s forage breeding laboratories. “But it couldn’t withstand the sweltering summers of Oklahoma and Texas. The strategy behind Texoma MaxQ II was to find a better combination for this geographic region.”

Through a straightforward breeding process, Noble researchers developed a tall fescue variety containing a fungal endophyte which conveyed remarkable drought tolerance and persistence to its host plant through a symbiotic relationship. The initial endophyte, however, also caused fescue toxicosis, a condition

that impedes a cattle's desire to graze and results in production loss. Unfortunately, removing the fungus from the plant reduced its persistence and ability to withstand drought.

Meanwhile, on the other side of the globe, AgResearch discovered a naturally occurring endophyte that provides plants insect tolerance and is not toxic to consuming animals. AgResearch inoculated Noble Foundation's tall fescue with the new endophyte for further study at Noble's Ardmore, Okla., campus.

"Using this more appropriate endophyte, we were able to generate seed to begin testing the new variety," explained Carolyn Young, Ph.D., an assistant professor who leads one of Noble's mycology laboratories. "Luckily, we can tell the two endophytes apart quite easily, which allowed us to track the new cultivar via a quality assurance pipeline."

Initial trials of Texoma MaxQ II began in small, controlled plots before expanding to larger field trials established by local farmers and ranchers who have been interested in testing the new fescue.

As the plant continued to show tremendous promise, Twain Butler, Ph.D., agronomist and associate professor, stepped in.

Butler basically writes the "how-to" book on all new forage varieties, developing best management methods that address such factors as optimal planting dates, seeding rates, fertilizer requirements and how to best control weeds. Once a protocol for successful management has been developed, he and agricultural economists at the Noble Foundation compare the production and economics of the new system versus the old system – in this case, perennial fescue versus annual rye-ryegrass.

Butler's research compared the two systems over a six-year period, looking at such measurements as annual performance, grazing days and average daily

livestock gains, and the costs of production for each. Jon Biermacher, Ph.D., agricultural economist and associate professor, ran the economic analysis, which showed that the new variety out-performs the old annual system, but needed a rainy year to do so.

"We had a very hot, dry summer the year after establishment; it really set the tall fescue back, while the annuals did

"We're always looking to provide new tools for our ranchers and farmers."

Joe Bouton

very well," Butler said. "Throughout those six years, we separated the data by how much rainfall we received. We found a high correlation. In very wet years, the tall fescue performed as well as the annual system, but most of the years in the trial were extremely dry. During those years, the annual system out-performed the new perennial system. We concluded that in higher rainfall regions, fescue will be more economically competitive; in drier regions farther west, the annual system still is going to be more economical."

Noble Foundation researchers continue to evaluate the new fescue with different planting methods to further refine management strategies and better utilize its new traits.

Assistant Professor James Rogers, Ph.D., who specializes in pasture and range management, said the variety performs very well in regions where tall fescues grow. "There are 35 million acres of tall fescue nationwide. In several variety tests from here to the East Coast, Texoma MaxQ

II performed very well in those more adaptive regions," Rogers said. "We have found that it out-produces the standard fescue variety Kentucky 31 across a variety of nitrogen levels, even at the zero end level. It also has out-performed other varieties that we have tested."

The variety also matures earlier in the spring, which could provide grazing ahead of other perennial grasses, and then fades

back as warm-season grass varieties begin producing. "Texoma MaxQ II complements the region's use of warm-season forages," Bouton said. "This grass was designed to assist from fall through the spring period so it will not be productive in the summer months. Producers will continue to use traditional warm-season grasses during this time, but then can look forward to Texoma MaxQ II returning in the fall, helping to provide a year-round grazing option."

Bouton calls Texoma MaxQ II a significant accomplishment for the organization's breeding process and another advantage for producers. "We're always looking to provide new tools for our ranchers and farmers," he said. "We're supporting them so they can sustainably meet the growing demands on agricultural production and the expanded needs of consumers." ■

Cattle graze on Texoma MaxQ II in test plots on the Noble Foundation's campus in Ardmore, Okla.





Kent Moore stands on a small outcropping, overlooking part of his 2,000-acre ranch near Lindsay, Okla. Moore, 70, has worked with the Noble Foundation for 40 years and credits the organization with providing him the information and advice to be successful.

THE COWBOY WAY

Rancher forms lifelong relationship with Noble Foundation

by J. Adam Calaway

It only takes one glance to know that Kent Moore is a real cowboy.

A sweat-stained cowboy hat adorns his head, not for show, but for shade. Dusty jeans are tucked into working boots. No. 4 Blanchard spurs are clasped firmly in place; functional accessories for a 70-year-old who still rides horseback to check fields and move cattle.

Weathered hands offer a vise-grip handshake and a genteel greeting – “Glad to make your acquaintance” – echoes from an era when masculinity included politeness.

Everything about Moore reflects the lifestyle that defines him. Everything except his office. ▶





Kent and Duchess Moore pose on the front porch of their ranchhouse. The couple have spent the past 40 years working the ranch, sharing everything from chores to office space. Kent often uses Duchess's salon in nearby Lindsay, Okla., as a makeshift office for meetings.

Seeing Moore – the embodiment of the American cowboy – sitting in a room with crimson walls, plush furniture accented by leopard print pillows and frou-frou knickknacks elicits a visual paradox not easily reconciled.

To be fair, Moore's office is actually his wife's beauty salon, located in the heart of Lindsay, Okla. Duchess Moore has tamed both hair and prairie alongside her husband for 40 years, so his presence – which has quietly expanded to two desks and a card table, all piled with papers – in her space is both expected and welcome.

With the family homestead north of town and farms to the east and south, Duchess Moore Salon serves as the perfect intersection for Kent's daily travels. Mail, phone negotiations and the occasional meeting take place in the convenient, but unlikely, headquarters. Still, for the sake of visitors, Moore attempted further explanation for his salon squatting.

"In defense of my office," said Moore, continuing his explanation. "When we built our new house about 11 years ago, I was going to take two rooms that I had added onto our old mobile home and turn them into an office, but I ended up making those a bunkhouse for one of my hands so I have to office here."

Duchess cocked an eyebrow in disbelief. Moore smiled and moved to a new topic. Cowboys always know when they're outgunned.

A guardian of the land

Moore settled into his chair to discuss the subject that drew everyone to Duchess's salon in the first place: his 40-year relationship with the Noble Foundation.

Moore is one of more than 1,300 farmers, ranchers and land stewards who participate in the organization's no-cost consultation program.

The program stands at the heart of the Noble Foundation's mission to support agricultural producers in the Southern Great Plains in reaching their financial, quality-of-life and stewardship goals through the adoption of sustainable, research-proven practices.

"What's great about the Noble Foundation is they never tell you what to do," Moore said. "You set your goals, and they try everything



Noble Foundation Consultation Program Manager Hugh Aljoe (right) reviews Kent Moore's management plan during a recent farm visit. Moore has received advice and support through Noble's consultation program for 40 years.

to help you get there. They reinforce your ideas. They're a sounding board. They're that knowledgeable friend you turn to when you need help. I'd hate to think what I'd do if I didn't have them to call on."

Moore owns the Diamond K Cattle Company, a commercial stocker operation with more than 1,000 head of cattle on 2,000 acres of wheat, ryegrass and native pasture.

A portion of the land belonged to his grandfather and two great-uncles who settled in Lindsay around 1906, a year before statehood. The brothers planted broomcorn, a type of sorghum used to make brooms. Moore's father continued the family legacy, tilling the same fields and planting the same crops his entire life. When Moore came along in 1940, he joined the family's agricultural lineage

– with a twist.

"My father and grandfather were farmers. They liked to plant and grow stuff," he said. "I like to grow cattle and horses, so to speak. I was going to be a cowboy. I knew it from the beginning. Of course, if you want to be a cowboy and run cattle in this country, you also have to be part farmer."

Moore would ranch, but not right away. He earned a bachelor's degree in animal husbandry from Oklahoma State University, where he was a member of the esteemed Livestock Judging Team, and also attended Texas Christian University's Ranch Management Program. He returned to Lindsay in 1960 and bought a small piece of land north of town. His parents loaned him equipment, and he returned the favor in labor. He raised alfalfa and

broomcorn. "I did the same thing that I did growing up," he said, "but now it was mine."

Moore soon began to fashion a plan to break into the cattle business. He met renowned cattleman Leonard Wyatt. "I became buddies with Leonard Wyatt, figuring I'd just do what he was doing," Moore said. "Turns out he was getting his information from the Noble Foundation, so I began to work with the Foundation."

Noble Foundation consultants initially helped Moore transition from broomcorn to rye and wheat for stocker cattle use. With that, his course was set.

Through four decades, Moore has leaned on the Noble Foundation's expertise to advise him on every aspect of his operation from seasonal pests and annual markets to soil testing and purchasing livestock ▶



At 70 years old, Kent Moore still checks fields and herds cattle on horseback. Part of his daily attire is a pair of No. 4 Blanchard spurs clasped to his boots.

“Working with the Noble Foundation has been good from the beginning. Every consultant I worked with through the years has helped make me successful,” he said. “Anytime I had a question or a plan that I thought was feasible, they’d give me their opinion. I didn’t take all their advice, but I probably should have.”

Through the years, Moore attended countless educational events, gleaned new methods to improve his operation and learning about the latest research. The respect he has for the Noble Foundation is reciprocated as Moore has been asked to be a guest speaker at a few Noble seminars.

“Mr. Moore is one of those producers who is completely focused on being a quality land manager,” said Hugh Aljoe, Noble Foundation agricultural

consultation program manager. “He pays attention to his land. He understands that you can’t take too much from the land, that you have to give back. He is a true guardian of the land.”

One dry year

Thirty minutes after finishing his interview, Moore found a more traditional setting – the horse stalls at the family ranch. Petting Diamond, a buckskin gelding, the cowboy expounded on the virtues of one-horsepower transportation versus all-terrain vehicles (ATV).

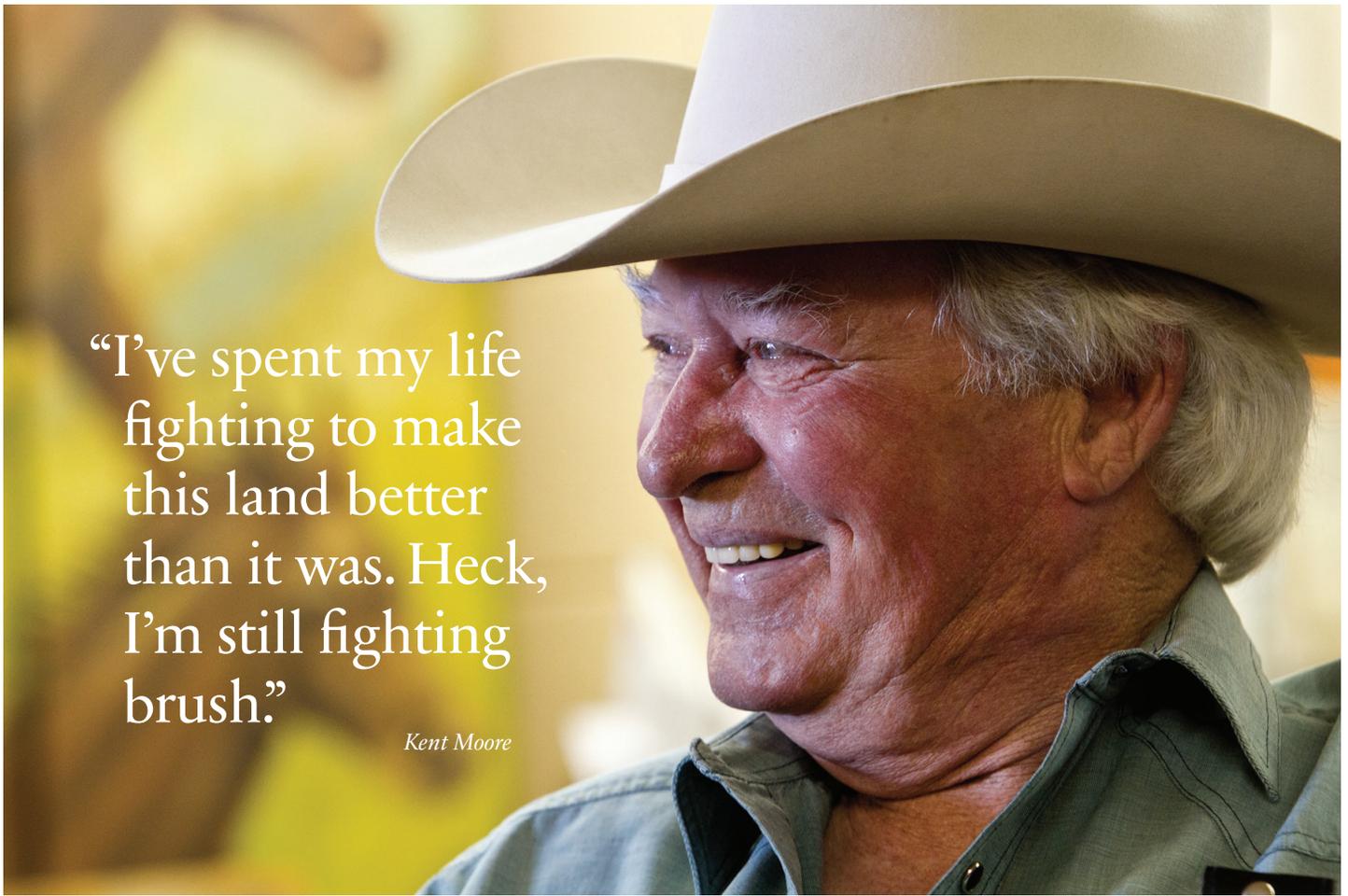
“You just go too fast on an ATV,” Moore said. “When you’re on horseback, you see more of your pasture. You’re able to see the weeds and fields better. You are able to spot

places that may wash out soon. You see your cattle better. Plus, it’s more pleasing.”

Riding through his fields this spring has been a much different experience than in years past. The Southern Great Plains has endured one of the worst droughts since the Dust Bowl years. By May, Moore’s fields are usually waving emerald seas filled with herds of plump cattle. On this day, undersized rows of rye reveal dry red dirt, and only a handful of stockers remain.

As the drought progressed through the spring, Moore’s experience told him it was time to reduce his herd, but he wanted a second opinion. His advisors at the Noble Foundation confirmed his instinct and helped formulate an effective destocking plan.

When asked to consider facing the



“I’ve spent my life fighting to make this land better than it was. Heck, I’m still fighting brush.”

Kent Moore

Kent Moore laughs about using his wife’s salon in Lindsay, Okla., as a makeshift office. With a homestead north of town and farms to the east and south, the salon sits in the perfect location to hold meetings and take phone calls.

annual trials of agriculture without the Noble Foundation, Moore chuckled and said: “I’d be so dumb. I would’ve done everything through trial and error. If I didn’t have them to guide me, I wouldn’t know what to do. When Lloyd Noble put the Foundation together, he couldn’t have had any idea of its impact on agriculture, on the producers.”

No sunsets here

At lunch, Moore chewed on chicken fried steak at a local greasy spoon. He teased the waitress, who called him by name and teased him right back. He waved to every person who entered, all strands of a tightly woven community he’s supported with his life and land. It was clear everyone knows Kent Moore, but that phenomenon is not

limited to Lindsay.

Moore’s passion for ranching propelled him to become an industry advocate and leader. He helped found the Working Ranch Cowboy Association. He has served in leadership positions for the Oklahoma Cattlemen’s Association, where he helped found the Range Round Up, a charity event supporting the Children’s Miracle Network, and the Oklahoma Quarter Horse Association. He has traveled across North America – from Texas to Canada – supporting an industry and a lifestyle he’s led so successfully.

Eventually, though, the conversation returned to Lindsay and a word cowboys never really consider – retirement.

“Some people encourage it, but I don’t know what I’d do if I retire,” Moore said. “I

probably need to form an exit plan. I have to decide what is the best way to taper off. I wouldn’t want to rent out my land. I’d want it taken care of to my satisfaction. I’ve spent my life trying to make this land better than it was. Heck, I’m still fighting brush.”

He takes another bite and then completely rejects the idea of riding off into the sunset. “Nah, I still look forward to getting the wheat in. I look forward to getting cattle. I look forward to selling them. It’s just what I do. It’s just who I am.”

It’s just the cowboy way. ■



Fantastic Forages

Mutant Medicago plants offer scientific community a chance to develop improved crops

by Laura Beil

In the 1960s comic book *Fantastic Four*, an astronaut team passes through a cloud of radiation. Once back on Earth, the space travelers realize they have become genetic mutants capable of superhuman powers: invisibility, profound strength and endurance, elasticity. One has even morphed into a human flamethrower. They then go about the business of saving the world.

Plant biologists at The Samuel Roberts Noble Foundation are using blasts of radiation (along with other techniques) to create real-life mutants of their own in the plant world. Though it's doubtful that any of these creations will ever acquire invisibility, these plants may still, in small ways, help to save the world. By studying what happens when a plant's genes become disabled and don't work, scientists can learn which genes are important for keeping plants alive and healthy – and which genes might be manipulated to make crop growth easier, sturdier and more productive.

“The main reason we need mutations is to identify gene function,” said Kiran Mysore, Ph.D., a scientist in Noble's Plant Biology Division. Plants contain from 30,000 to more than 100,000 genes, depending on the species. Each gene plays a role in allowing the plant to grow and maintain itself, yet researchers only know what a fraction of these genes do. Just as removing spark plugs shows they are necessary to start the car, knocking out genes provides clues to their importance.

So far, Noble scientists have produced more than 140,000 varieties of mutant seeds, each with different combinations of genetic flaws. At Noble, these mutants are created in two very different ways, each with its own advantages.

Mysore uses slices of genetic material called transposons.

Transposons are like genetic party crashers, uninvited segments of DNA that show up and elbow their way into the group. When transposons get incorporated into a plant's chromosomes, genes get disrupted and don't function. Mysore's work begins with normal seeds of the plant *Medicago truncatula*, a relative of alfalfa that is commonly used in plant research. (The plants are genetically similar enough that information gleaned can be applied to alfalfa.) In a painstaking process, Mysore's group triggers the transposons to jump throughout the plant's genome. The technique incorporates transposons into the plant's DNA in about 25 to 30 random places. The scientists don't control where the transposons go, so the insertions end up in unpredictable spots throughout the chromosome. When a transposon lands in the middle of a gene, it disrupts the function of that part of the genetic code.

Another Noble researcher, biochemist Rujin Chen, Ph.D., creates mutants with radiation. His laboratory irradiates the seeds in a way that produces about 10 mutations in each plant's DNA. These mutations typically remove pieces of DNA from the genome, thus interrupting gene functions. As with the transposons, the mutations occur in random locations throughout the plant's chromosomes. Only when the seeds are grown will the mutations reveal themselves.

About 80 percent of the time, according to Mysore, the mutant plant will appear to be completely normal once the seeds are grown – illustrating that some genes are more important than others for plant growth and development, while some genes are so important that plants may have backups for them. Other mutant plants will not sprout at all because the mutations are so catastrophic to seed growth.

Then there are the plants that are the most valuable: those that

Noble Foundation associate professors Rujin Chen and Kiran Mysore use mutant varieties of Medicago truncatula to discover genes impacting plant functions like forage quality, nitrogen fixation and plant architecture.



Samira Hassan, a doctoral student at the Australian National University, inspects roots of a mutant plant. Each year, scientists from around the world visit the Noble Foundation to screen mutants, looking for traits of interest to their own research projects.

grow with mutations in genes that offer clues to their genetic importance. The variations can be radically different. The plants grow with leaves that are too big or too small, or roots that are obviously not normal. Some mutations can't be seen because they control how the plant processes nutrients or resists disease, but reveal themselves with further tests. Scientists then take these plants and search for the disabled gene. "Identifying the causative mutation gives you a starting point to investigate how the underlying gene functions," Chen said.

The researchers hope they can eventually create mutations in the entire set of *Medicago*'s genetic programming. "In this way, we can figure out the function of a majority of regulatory genes," Chen said. The mutant plants have already led to important discoveries at Noble, such as the identification of genes that are important to leaf development – genes that might one day be enhanced or diminished to produce crops of greater yield. (Instead of having fat leaves, some mutant plants almost look more like grass.)

Chen's laboratory is also studying root growth and function, while Mysore's laboratory is using the mutations to study which genes help plants withstand the stress of disease or survive in poor growing conditions.

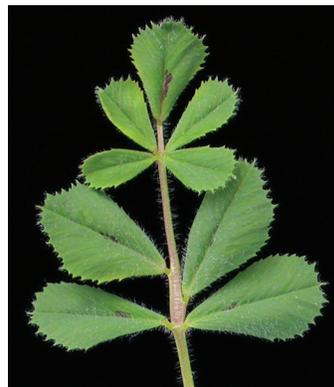
It is not just Noble scientists who benefit from the mutant seeds. Twice each year, scientists from around the world come to the Noble Foundation campus to screen plants – which involves

simply growing the seeds to look for traits of interest to their own research projects. Few, if any, research centers worldwide can offer so many types of mutant seeds to choose from. Each year, thousands of mutant lines are grown to see where their genetic flaws might lie. "Mutant screening on this scale is unique," says Samira Hassan, a doctoral student at the Australian National University in Canberra. She spent a week at Noble this spring, searching for plants that might have genetic mutations that control the way the roots grow and extract nutrients from their environment, along with other functions. Not only can she find an unparalleled selection, she said, but "the open and collaborative nature of the Foundation attracts us."

Hassan did not return to Australia empty handed. "We identified many plants that showed increased or decreased nitrogen fixation, root and shoot growth, flowering times and leaf patterns," Hassan said. "This could give us insight into plants' nutrient requirements, growth and tolerance to drought or salinity"

The goal at Noble is to eventually screen all of the mutant lines of seeds the scientists have created, a process that will take years. In the end, none of these mutants will ever stretch into other shapes or burst into flames. Nonetheless, they could one day help farmers and ranchers grow crops that are, in the real world, truly fantastic.





*The picture on the left shows a non-mutant of the model legume *Medicago truncatula*. The six photos to the right are mutants with radically different physical characteristics, including varying leaf sizes and shapes, and growth patterns. Some mutations are not visible because they control how the plant processes nutrients or resists disease. These mutations can only be revealed through genetic testing.*



Growth Potential

Pecan production offers new opportunities to agricultural producers

by J. Adam Calaway

If you tell Tim Montz that money doesn't grow on trees, he is likely to chuckle, then take you to his backyard.

Arranged in a militarily precise grid are 8,000 pecan trees, Montz's sole source of income, his literal forest of financial freedom. Based out of Charlie, Texas, in the Red River Valley, Montz is one of the United States' premier pecan growers with 25,000 trees on 1,100 acres that produce more than a million pounds annually. At an average of about \$2.20 a pound (and increasing), Montz knows what many others are just figuring out: pecans are more than just pie filling.

"There is a lot of money to be made in pecans," said the 57-year-old. "I was putting money into a retirement fund, but now this is my retirement. Of course, it's not as easy as planting a few trees."

Fully funding the golden years through pecans is not possible for most agricultural producers, but bolstering annual income – even for landowners with small acreages – is an increasingly attractive option.

"Farmers and ranchers are using pecans

as a way to diversify their operations," said Charles Rohla, Noble Foundation assistant professor and one of the nation's leading authorities on pecans. "The downside is the up-front investment and slow return; it may take a decade to see any profit. Of course, depending on management and marketing strategies, farmers and ranchers can earn from \$200 to \$3,500 an acre."

Potential profit and skyrocketing demand from markets with insatiable appetites have not gone unnoticed. More and more, farmers and ranchers are planting orchards, hoping to grow a brighter financial future. In support of the pecan growers, Rohla builds on more than 30 years of pecan research tradition at the Noble Foundation, studying ways to maximize the wonder nut's production and developing more effective management strategies.

"The biggest myth with pecans is that they are only a holiday treat. That's just not true," Rohla said. "Soon everybody will be thinking about pecans year-round, especially agricultural producers." ▶



Tim Montz (right) and son, Jake, survey their pecan orchard near Charlie, Texas. Montz has raised pecans for more than 30 years.

More for Montz

For Montz, the investment in pecans began with a cane pole. In 1978, Montz was a struggling cow-calf producer who harvested native pecan groves that grew on land he leased for cattle. He'd whack pecan tree limbs with a cane pole, harvest the pecans by hand and sell them for a little extra Christmas money. The profits led to further investment. In three years, Montz purchased a harvester, shaker and cleaner, and opened a small store in Byers, Texas.

In 1986, two events coincided to push Montz deeper into the pecan business. He inherited 35 acres of land, which was too small for wheat or cattle, and he met Hal Berdoll at a Texas Pecan Growers

Association meeting. Berdoll had moved beyond simply harvesting native trees and was planting his own orchard filled with "improved" varieties that produced more pounds per tree and more profits. "I thought if he could plant pecan trees, I can do it," Montz said.

Of course, there was one problem: Montz didn't know how to plant pecan trees.

A friend introduced him to the Noble Foundation, where consultants taught him the fundamentals. "I probably killed more trees than most people have planted, especially in the beginning," Montz said. "I was lost, and the Noble Foundation was there to provide answers."

Despite local naysayers, Montz planted 1,000 trees between 1986 and 1987, and continued purchasing land around his homestead just for pecans. "People thought I was crazy," he said. "They said I'd never make any money because they thought it took 100 years to get a full crop."

By 1994, Montz had 8,000 trees planted, but continued his cattle and wheat operation, spreading his resources and himself too thin. "One day a friend of mine said, 'You'd be a lot better off if you just concentrated on one thing,'" Montz explained. "I instantly knew he was right, so I turned the leases back and focused strictly on pecans."



Montz added another 17,000 trees over the next decade and a half. He has endured pests, disease, deer, squirrels and even a tornado that blew away 500 trees. “I had to make this successful or I’d go broke. People who plant pecan orchards go broke all the time,” Montz said. “You have to look at pecans like a crop. You don’t just plant a tree and come back in 10 years. You help establish it. You provide it water and nutrients. You manage it for pests and disease. It’s hard work.”

During peak harvest, the operation can harvest up to 60,000 pounds of pecans a day, keeping Montz and the next generation very busy. Montz’s son, Jake, manages

the day-to-day operations and seven full-time employees. His daughter, Jill, operates a 10,000-square-foot retail shop in Wichita Falls that sells about 100,000 pounds of pecans each year.

Today, Montz’s operation is fully integrated from the orchard, to cleaning and shelling, to consumers worldwide. The bulk of Montz’s pecans are sold to wholesalers across the United States, Canada and Germany with enough orders to exhaust his supply each year.

Montz, who is president of the Texas Pecan Growers Association, has traveled around the world to cultivate exploding international markets like Shanghai, China, where the Texas group was overrun

with eager buyers.

Five years ago, China imported relatively few pecans, but a walnut shortage sent the country searching for a new nut. They found pecans with a preferable flavor and health benefits (see sidebar, page 24).

Today China gobbles up more than 25 percent of the total annual United States export, paying almost \$6 a pound according to *The Wall Street Journal*. “I see the pecan market only getting better and better,” said Montz, smiling. “We can’t grow them fast enough. That’s not a bad place to be.” ▶

Looking toward the future

On the Oklahoma side of the Red River,



Noble Foundation Horticultural Consultant Charles Rohla, Ph.D., (left) examines pecan trees with producer Jake Montz.

Meet Charles Rohla: Noble's pecan expert

Charles Rohla was born and raised in Chester, Okla.

Rohla received a bachelor's degree in animal science (1998), a master's degree in agricultural education (2002) and a doctoral degree in crop science (2006) from Oklahoma State University (OSU).

While working toward his doctorate, Rohla worked at OSU's Fruit and Nut Research Station at Perkins, Okla., as a research technician for five years focusing on peaches and pecans. He was drawn to the production and profit potential of pecans.

He studied under Mike Smith, Ph.D., during his doctoral program and time at the Fruit and Nut Research Station. Smith is considered one of the leading pecan experts in the United States.

Currently Rohla serves as president of Oklahoma Pecan Growers. He also sits on the Advisory Council for the National Pecan Growers Association and the Advisory Board for U.S. Pecans, a United States Department of Agriculture initiative to export pecans to expanding international markets, specifically China.

downstream a few hundred miles from Montz, is a pecan operation just putting down roots.

Chester Bench spent 30 years building his industrial crane business while dabbling in agriculture. When he sold out in 2000, Bench and his wife, Susan, bought a little slice of retirement heaven near Hugo, Okla. Except they didn't retire.

The Benches spent three years building fence, clearing brush and operating a small cattle business. Much like Montz 30 years before, Bench realized his land and the surrounding properties were filled with unmanaged, native pecan trees. He wanted more information, and a friend referred him to the Noble Foundation. Soon a caravan of agricultural consultants arrived to review his operation and, specifically,

examine the possibilities of pecans. “It was like the cavalry had arrived,” Bench said. “They jumped right out and got to work taking soil and leaf samples.”

The Noble Foundation consultants helped the Benches manage their 700 native trees and form a cooperative with the surrounding landowners to harvest another 1,500. The couple, who now employ four workers, manage seven native orchards while still running a 350-head cow-calf operation.

In 2006, Rohla joined the Noble Foundation and one of his first stops was the Benches’ operation. Together, they set goals to build upon the couple’s success with native trees and plant 7,000 improved pecan trees in five years.

Looking out from the Benches’ back porch into the lush green valley below, the young pecan trees – about 4,000 planted so far – look like matchsticks on the horizon.

The Benches are on the opposite end of the production spectrum from Montz with their first real crop of improved pecans still a few years away, but the goal is the same – benefit the next generation.

“We could be fishing in the middle of Toledo Bend, but we chose not to do that. We have three children and five grandchildren, and, hopefully, this will help them in the future,” Bench said. “We’re doing this for them.” Added Susan, who helped name their new business Legacy Pecan Company: “Ranchers try to leave a ranch to each child. We’re trying to leave a pecan orchard to each child.”

The math seems to justify the Benches’ confidence. “It takes two acres to run a calf that will make about \$800, while the same two acres could make up to \$4,000 in pecans,” Bench said. “We’ve ridden the stock market cycles up and down for decades, and the pecans are the better investment. If managed properly, they can be profitable for 75 years.”

While pecans, not industrial cranes, are now his business, Bench’s mind for marketing fueled a conversation about international consumers and new efforts to build a national coalition. The United States Department of Agriculture (USDA) recognizes the potential export market for

pecans and initiated “U.S. Pecans,” which is in its first year, to capitalize on the pecan boom. To be successful, the initiative will depend on the participation of producers who look at the broader potential of a joint effort – producers like Bench. “We must be unified to move this forward,” Bench said, leaning forward. “The U.S. produces 300 million pounds of pecans each year. That’s good, but there is huge room for growth.”

Rohla, who sits on the advisory board of U.S. Pecans and the National Pecan Growers Association, concurs: “Growing the industry is vital to its long-term success, but we have much work to be done in understanding the market and better utilizing the pecan itself.”

Using pecans better requires that we better understand them. Researchers are attempting to answer the more peculiar pecan problems, and Rohla knows cracking these issues will keep the pecan industry thriving.

Advancement through research

Research in pecans – industry-wide and at the Noble Foundation – is as diverse as the 1,000-plus varieties. “There are a lot of variables to pecan research and many questions that need to be answered,” Rohla explained. “If we can find the answer, we can increase production, improve land stewardship and provide a better product to the consumer.”

Studies focus on establishment, including proper weed and vegetation control, and jumpstarting production, specifically looking at different methods of irrigation.

Currently two universities and various irrigation companies offer conflicting recommendations. Rohla has undertaken a study to compare all options from subsurface drip to aboveground sprinklers, measuring the total growth and production of trees. “When producers get their first full crop depends on management, especially irrigation,” Rohla said. “Proper management and irrigation could cut that time down from 10 years to five years.”

Another major issue for increasing pecan production is reducing “alternate



Pecan Fast Facts

- The pecan tree is native to North America.
- George Washington and Thomas Jefferson both grew pecan trees.
- More than 1,000 unique varieties of pecans exist.
- The United States produced 302 million pounds of pecans in 2009, representing about 75 percent of the global market.
- China imported less than 1 percent of the U.S. pecan crop in 2005, but imported more than 25 percent in 2009.
- Georgia ranks first in pecan production with 80 million pounds, followed by Texas (70 million pounds), New Mexico (55 million pounds) and Oklahoma (20 million pounds).
- Oklahoma has 140,000 acres dedicated to pecans, making it the second largest in pecan acreage in the U.S.
- Oklahoma is the fastest growing state in new orchard establishment and has been for the last five years.
- Oklahoma only harvests one-third of its 140,000 acres of pecan trees, and the state’s producers only manage a quarter of what is harvested. If producers managed all the trees that were harvested, the state could increase production 400 percent, equaling 80 million pounds.
- “Improved” pecan varieties are those that have been bred specifically to enhance production.
- Pecan is an alternate bearing nut, which means it has a high production year followed by a low production year.



Working summers in Chester and Susan Bench's pecan orchard, student Kristin Harris places protective shielding around young pecan trees.

bearing.” Pecans naturally alternate between high and low production years. On high production years, the pecan quality is low and there is an abundance of nuts, deflating prices. On low production years, quality is better and the supply is limited, increasing prices.

Researchers, like Rohla, are trying to even out the high and low years, helping to stabilize the market. Mike Smith, Oklahoma State University horticulturist and Rohla’s mentor, developed a technique called “green thinning,” where producers thin the crop during high production years to remove potential growth and force the tree to reserve stock until the following year.

Rohla’s research on alternate bearing looks at managing nutrients to assist with the green thinning process. Limiting nutrients during high production years naturally reduces the amount of nuts available and saves the producer input costs. “It’s another step in addressing alternate bearing,” Rohla said. “But we still have so far to go to truly manage this phenomenon.”

Beyond investigating individual pecan problems, Rohla continues a 29-year-old Noble Foundation study, examining the marriage of pecans – specifically native production – and livestock, the region’s most prevalent agricultural enterprise.

Results have been consistently telling. Cattle grazing the pasture below the pecan trees decrease a producer’s input costs because they are not using fuel to mow under the trees. Additionally, cattle return about 85 percent of nutrients back to the trees.

“The two systems work well together,” Rohla said. “In every year we’ve studied, either the cattle will pay off or the pecans will pay off. And the years that they both pay off are particularly profitable.”

While most pecan researchers are strictly that – researchers – Rohla maintains his connection to the producers through the Noble Foundation’s consultation program. The growers often generate some of the best research projects. “They are out in the orchards every day, dealing with the real issues,” Rohla said. “We need to answer those questions that have the most impact.”

Bench has asked several of those questions. He once queried Rohla about planting methods, comparing bare root versus trees begun in containers (a process not often used in Oklahoma). Rohla established a study to determine the best method as part of a 100-tree research station on the Bench property.

“While some researchers limit their work to high input, highly managed orchards, here at the Noble Foundation, we also study issues affecting lower managed orchards or dry land orchards,” Rohla said. “This work benefits many of the producers in our region and elsewhere. That’s the future. We’re not there yet, but we’re getting there.”

As for Montz’s future, well, that’s sitting in a building behind his office – a shiny new bass boat. “I’m still around to help make decisions, but I’m turning more over to Jake,” said Montz, patting his son on the back. “I love what we’ve grown here, and I love that it will help provide for my children.” ■

The health benefits of pecans

According to the National Pecan Shellers Association, pecans contain more than 19 vitamins and minerals, including vitamin A, vitamin E, folic acid, calcium, magnesium, phosphorus, potassium, several B vitamins and zinc.

Some sources have labeled pecans “unhealthy” due to their fat content; however, the majority of this fat is unsaturated, which may have a positive impact on health.

Researchers at Loma Linda University conducted a diet study that found consuming a diet enriched with pecans lowered both total cholesterol and LDL cholesterol levels. Studies have also shown that pecans can delay the decline in motor neuron function that often occurs during the aging process.

Chester and Susan Bench examine a 1-year-old pecan tree. Having retired from a career in business, Chester Bench is now planting 7,000 pecan trees in hopes of providing an economic boon for his children and grandchildren.



Rujin Chen, Ph.D.

by J. Adam Calaway

Rujin Chen's research is rooted in the experiences of his childhood homeland. Chen – the quiet middle son of engineers – grew up in the remote inner Mongolian city of Baotou. Surrounded by a desolate landscape, he gravitated toward biology; he appreciated better than most the struggles of living in a difficult environment. Today, the 47-year-old associate professor at the Noble Foundation seeks to unlock the inner workings of plants, hoping to develop stronger, healthier varieties that can flourish in arid regions around the world. Below, Chen discusses how a life begun in the desert blossomed into a career that is helping to reshape agriculture and how a shy bookworm discovered a passion for athletics.

How did growing up in Mongolia impact your life?

My parents were both engineers. They chose to move to Baotou and help build the city. We were an ordinary family and had to deal with not having enough food to eat because of disastrous food supplies. It was tough, but I still had a happy childhood. As for my career, Mongolia is mostly desert, and I guess that's why biology was so interesting to me. I wanted to understand how things survived in barren locations.

When did you first want to become a scientist?

In my early teenage years, I was very sick with a lung infection and spent several months at home. All I had to occupy my time was my science books. I enjoyed math and chemistry classes throughout school. My high school chemistry teacher played a major role in my life. I loved the way he taught. He was passionate, and he inspired me to go into science.

What brought you to the United States?

After I received my Bachelor of Science degree from Lanzhou University and my Master of Science from the Chinese Academy of Sciences, I came to Michigan State University to work on my doctoral degree (completed in 1996). It was quite a culture shock. The food took a while to get

used to. I had never seen people eat a raw salad. We always cooked our vegetables. However, I loved the environment. I loved the snow in Michigan. And the people were nice and accepting, and helped me make the transition.

What drew you to the Noble Foundation?

Coming to the Noble Foundation in 2002 was the fulfillment of a dream. I had been aware of the Noble Foundation as a center of excellence in plant research during my time as a graduate student at Michigan State University. I had worked on legumes in my previous research, and the Noble Foundation offered me the opportunity to lead an independent research program studying them.

How would you describe your work to a stranger on the street?

I am interested in understanding the growth of plants and how they interact with the environment. I anticipate that my research – along with that of others – will enable us to modify plants for better adaptation to local environments and increase production efficiencies.

What is your favorite part of your job?

My job gives me the opportunity to discover new things. I get to be a detective

of sorts, following up on clues and figuring out how things fit together. It is the most rewarding part of my job, but it is also the most difficult.

If you weren't a scientist, what would your profession be?

I think I would make an excellent rancher or I'd do something in finance. I think that both are high-risk professions and require extra patience and skill. I love the beauty of the land.

What is something people would be surprised to know about you?

I spend most of my time in front of a computer, so people may be surprised to know that I really enjoy sports. Space was limited in China, so I'd play badminton. Since coming to the United States, I've picked up soccer and volleyball. Now, in Ardmore, I play tennis every Sunday with some colleagues from work.

What is your favorite type of music?

I have too many to name. I love everything from traditional Chinese folk music to Beethoven to Willie Nelson. I love almost all music.

What is your favorite food?

I'll try anything. I especially enjoy ethnic food. Here in Oklahoma, I've really taken to fried catfish.



A Global Classroom

Noble scientist pens biofuels curriculum for educational websites

by Kim McConnell

Rao Uppalapati admits it was difficult to break down the scientific jargon of biofuels technology into easily understood chunks, but he said the outcome of sharing his research with students will far outweigh the weeks of effort.

Uppalapati, a research scientist at the Noble Foundation, has been crafting lesson plans for the K20 Center for Educational and Community Renewal, an interactive website hosted by the University of Oklahoma that allows teachers, scientists and others to collaborate on curriculum.

“It is difficult to break down some of the terminology,” he admitted. “However, we want to inspire kids to learn about emerging sciences, and this ‘Cellulose 101’ is specifically designed to be interactive and engaging for secondary level students.”

Jean Cate, Ph.D., K20 Center associate director, said the website hosts users from all 50 states and from 67 countries around the world, assuring that Uppalapati’s lesson plans will have a global audience when they are finished and posted sometime in June.

Uppalapati said his work to create a simple explanation of cellulosic biofuels technology is geared toward middle school and high school students, which means explaining his field of expertise simply enough to catch the attention of the students who might develop an interest in energy research.

Uppalapati said his work to create a K20 curriculum means explaining the fundamentals of plant functions, starting students with the basics of photosynthesis and leading them to an understanding of cellulosic biofuels production (the process of converting plant tissue from energy crops, such as switchgrass, into liquid biofuels). Cate said the lesson will encourage students to perform the experiments that will generate an understanding of how plants produce food and energy, ultimately leading them to cellulosic technology.

As part of the lesson, Uppalapati also explains the challenges of biofuels research, including problems posed by pathogens. “I want them to be aware that new, emerging fields require tremendous research in

countless areas,” he said. “I specifically show what I do as a plant pathologist and how it impacts the entire spectrum of biofuels production.”

Plant functional genomics and pathogens are Uppalapati’s areas of expertise, and he wants students to realize why it is important to study pathogens that threaten biofuel crops like switchgrass, a naturally occurring prairie grass that is prone to pathogens when grown on the large scale needed for biofuels production.

“Plants have an immune system, and pathogens learn to breach it,” he said, noting his lesson plans will allow teachers to explain how plants defend themselves and react to pathogens.

To help translate what happens with cellulosic biofuels technology in the lab for the teachers, Uppalapati worked with the experienced K20 staffers, including an OU biology major. “It’s quite a process, but a rewarding one for the researcher as well as the students and teachers,” Cate said, noting K20 made the deliberate choice of Uppalapati because of his collaboration with Noble Foundation Associate Professor Kiran Mysore, Ph.D., on research funded by EPSCoR (Experimental Program to Stimulate Competitive Research). “We enjoy working with Noble Foundation researchers. They are world renowned for their plant science, and we work well together since we both have international components.” There is also the link to EPSCoR, which has supported cellulosic bioenergy research in Oklahoma, and the scientists and engineers who are developing methods to convert plants like switchgrass (Uppalapati’s target species) to liquid fuel. EPSCoR helped fund the K20 lesson plans centered on Uppalapati’s work.

“I love that real-world research happening in the Noble Foundation’s laboratories today can be translated and taught to students around the world as we’re working on it,” Uppalapati said. “This is the future of research and education.” ■



Noble Foundation Research Scientist Rao Uppalapati, Ph.D., works in a field of switchgrass. Uppalapati has created a lesson plan for the University of Oklahoma's K20 Center for Educational and Community Renewal that will be available worldwide in June.



Launching a Career

Former postdoctoral fellow reflects on his years of research at the Noble Foundation

by Debra Levy Martinelli

When China native Chang-Jun Liu arrived at the Noble Foundation in 1999 for a four-year postdoctoral fellowship, he fully expected to broaden his research experience and abilities. He also surmised he would learn about life in America. It was his first experience outside his homeland. What he received was more than even he expected.

That cumulative experience of Liu's postdoctoral fellowship at the Noble Foundation is largely responsible for who and where he is today, said Liu during an interview more than a decade later. Liu is a biochemist at the U.S. Department of Energy's Brookhaven National Laboratory (BNL) in Upton, N. Y., and an adjunct professor of biochemistry and cell biology at nearby Stony Brook University.

His current research on biosynthesis of plant phenylpropanoids – organic compounds that serve as essential components of structural polymers, among other things – builds on his work under Rick Dixon, D.Phil., D.Sc., director of the Noble Foundation's Plant Biology Division, Distinguished Professor and Samuel Roberts Noble Research Chair, and senior vice president. At the Noble Foundation, Liu worked in the area of isoflavonoids, compounds that belong to a family of the plant phenylpropanoids that his BNL group currently studies.

To say that he merely conducted research, however, is a bit of an understatement. As part of a then ongoing collaboration between the Noble Foundation and the Salk Institute for Biological Studies in La Jolla, Calif., Liu characterized an enzyme critical

for synthesis of isoflavonoids in legume species.

That breakthrough led to a subsequent postdoctoral position at the Salk Institute, supported in part by a \$50,000 postdoctoral excellence award from the Noble Foundation to help fund continued study of that enzyme.

"Chang-Jun was a remarkable young researcher during his time at the Noble Foundation and later at the Salk Institute. He was dedicated, insightful and focused," Dixon said. "His diligence has resulted in excellent research and a remarkable career. I'm proud that he is a member of the Noble Foundation's research alumni."

Today, Liu's phenylpropanoids biosynthesis research includes the characterization and regulation of biosynthetic pathways, the structure-function relationship of the involved key enzymes and the structural modification of cell wall biomass.

"We study lignocellulosic biomass, an abundant and environmentally friendly, renewable energy source derived mostly from plant cell walls," explained Liu, who earned his doctorate in plant biochemistry and molecular biology at the Shanghai Institute of Plant Physiology, Chinese Academy of Sciences. "Plant cell walls provide unlimited quantities of renewable biomass, but the intertwined lignin and cellulose that comprise the cell wall resist decomposition, which makes obtaining energy from the biomass difficult."

By investigating the biosynthesis and molecular regulation of plant cell walls, Liu and his colleagues hope to develop novel strategies to tailor the cell wall composition and structure for biofuel and biomaterial production. "If we can manage

the biosynthesis," he said, "we believe we can make a cell wall suitable for efficient, sustainable biofuel production."

Looking back, Liu attributes much of his success to his experience at the Noble Foundation.

"The Noble Foundation is a state-of-the-art facility with a highly effective management system. The valuable mentorship and support I received from Rick and other scientists in his group strongly influenced my future research," Liu said. "They taught me how to run a successful research group and develop enthusiasm. I frequently draw on that knowledge when I'm faced with a new scientific challenge or am mentoring a new student."

Beyond the research, Liu credited many Noble Foundation employees with integrating him into American life and culture. "Asia and the United States have completely different social and educational systems," Liu said. "So many colleagues at the Noble Foundation provided me with guidance and friendship so that I could adapt to life in the United States."

There were many "firsts" for Liu during his time at the Noble Foundation. Peers helped teach him how to drive and then he purchased his very first car. When Liu and his wife, Yang Chen, welcomed their first son, Allen Liu, into the world, the Human Resources Department provided assistance with hospital arrangements and insurance. His colleagues offered their spare time to help refine his English.

"These experiences may seem trivial to some, but they had a profound influence on my career and life development," Liu said. "Of the many lessons I learned, Rick's may have been most important. He led



me into my research field and taught me to interact with colleagues and be a professional scientist. I owe him a great debt of gratitude.”

Liu stays in touch with Dixon, seeking his guidance on a variety of issues, and continues to get other help from the Noble Foundation in the form of research materials and collaboration with Dixon and Fang Chen, Ph.D., a research scientist in Dixon’s laboratory.

“In my opinion, the Noble Foundation is one of the best institutes in the nation for plant study, particularly in molecular

genetics and biology,” Liu said. “I so appreciate my four years there and the collaborations I’ve enjoyed with the organization since my fellowship.

“The experience was important for both my character and professional development. Without it, I don’t think I would have had the opportunity to be where I am today.” ■

Former Noble Foundation postdoctoral fellow Chang-Jun Lie now researches cell wall biomass at Brookhaven National Laboratory.

(photo: Courtesy of Brookhaven National Laboratory)

If you could know the answer to one question, what would you ask?

Discovery often begins with simple curiosity. A researcher asks a single question, thus initiating the lengthy process of exploration. This quest for knowledge drives Noble Foundation scientists and agricultural researchers to delve into the genetic fabric of forage grasses and legumes, as well as seek out novel solutions for production practices. Still, unearthing answers

is a trying practice that may take years or a career. Below, four Noble researchers imagine being able to have the answer to any one question – some focus on their research, others wax more philosophical, but one aspect of human nature remains constant – everyone is curious.



Luis L. Escamilla-Treviño, Ph.D.
Postdoctoral Fellow

What is the best way to make biofuels economically competitive without affecting the environment or food supply? Right now, research efforts are diverse. We traditionally use starchy grains like corn for ethanol, but we're now researching cellulosic biofuels from plants like switchgrass, poplar and sorghum. Researchers are also looking at oily seed and algae as potential biofuel sources. If we could answer this one question, we could focus resources, saving time and money to acquire energy independence.



Russell Stevens
Wildlife & Range Consultant and Regional Manager

I want to know who or what is holding the “smoking gun” responsible for the decline of the bobwhite quail throughout much of its range in North America. Understanding the reasons for the decline of bobwhite quail might provide us insight into our nation's prairies and other habitats occupied or formerly occupied by this species. The causes could be random, singular events occurring over time or the canary in the coal mine warning us of other unseen issues.



Michael Udvardi, Ph.D.
Professor

How can we get grasses, including cereals like rice, wheat and corn, to fix nitrogen? Agriculture uses 100 million tons of nitrogen fertilizer to grow plants and feed the world. This involves large economic (about \$100 billion) and environmental costs. Legumes, such as alfalfa and soybean, are among the few plants that don't require nitrogen fertilizer because they can convert (fix) atmospheric nitrogen into ammonia, a natural fertilizer, via symbiosis with bacteria. If we could get grasses to fix atmospheric nitrogen, we could transform agriculture and feed the world more sustainably.



Sindy Interrante, Ph.D.
Postdoctoral Fellow

Is there a system and management strategy to maintaining sustainable, long-term grass-legume mixtures under grazing? Developing and maintaining grass-legume grazing systems that are sustainable as well as economical seem to be elusive. The development of a year-round grass-legume grazing system without commercial nitrogen fertilizer inputs is a major goal in forage agronomy. The answer to this question would provide an economical, environmentally friendly and sustainable system that would greatly improve our ability to feed the world in the future.

The Seeds of Success

Sam Noble Scholarships change lives of area students and the future of agriculture

by Natalie Lovenburg

A few years ago, Josh Brecheen was walking the campus of Oklahoma State University, studying agricultural communications and animal science. Today, he's serving as an Oklahoma State Senator for District 9.

Brecheen's journey from Stillwater to the state capitol is one he says he could not have made without receiving a Sam Noble Scholarship. "The Noble scholarship was so generous," he said. "It freed me up to focus on education and internships that further exposed me to the pathway of public service."

As a state senator, Brecheen serves as an advocate for agricultural interests as well as educational improvement. He has presented these messages to more than 600,000 people at more than 600 schools, universities and conferences in numerous states, discussing the issues that face farmers and ranchers in Oklahoma and the United States.

Brecheen is one of 148 students who have received the Sam Noble Scholarships since their inception in 1999. Every year, the Noble Foundation awards up to 12 southern Oklahoma students the opportunity to further their education no matter their stage of college (from incoming freshmen to those seeking graduate degrees) or advanced technical training.

The scholarship program was named in honor of the late Sam Noble, the son of Lloyd Noble, who established the Noble Foundation. Sam Noble created the program through a gift to the Noble Foundation in 1992 to specifically support educational endeavors in agriculture and technology.

"Mr. Noble's thoughtfulness has helped many receive one of the most important tools for life – an education," Mary



State Senator Josh Brecheen was one of 148 students who have received financial support for their college education from the Sam Noble Scholarship program. As senator, Brecheen has spoken to more than 600,000 people, advocating agriculture.



A recent recipient of the Sam Noble Scholarship, Sara-Jane Smallwood has worked on projects in the United States House of Representatives and Department of Justice. She is currently pursuing her master's degree at Indiana University.

▶ Kate Wilson, director of granting for the Noble Foundation, said, “It is remarkable how one man’s generosity has forever changed so many lives.”

To date, the Noble Foundation has awarded more than \$1,967,000 to southern Oklahoma students. While the majority of the recipients study agriculture, 24 technology scholarships have been awarded to encourage and enable outstanding students to become highly proficient in a trade or vocation by pursuing an associate’s degree or other certificate at Oklahoma State University Institute of Technology in Okmulgee or Oklahoma City. Technology awardees can major in everything from diesel technology and engineering instrumentation to computer science and high voltage electricity repair,

among many others.

Recipients of the Sam Noble Scholarship can be found throughout the United States pursuing an array of careers in agriculture and technology.

“I look back at the scholarships I received six years ago and see the domino effect they had helping me obtain an education at Oklahoma State University,” said Sara-Jane Smallwood. Smallwood explained that her education led to internships, work as a paralegal in Washington, D.C., and graduate studies at Indiana University. Now Smallwood serves as a teaching assistant at Indiana, while working toward her master of public affairs degree.

“I can’t help but think how truly blessed I am to have been supported by the Noble

Foundation,” she said. Much like Brecheen, Smallwood shares the desire to give back.

When she left her hometown of Clayton, Okla., to attend OSU, she knew she’d return one day to her family and friends, and to the small town she’s deeply rooted in. “It’s been my goal all along to acquire the skills and valuable knowledge through education and professional experiences in order to move back home and give back in a positive way,” Smallwood said.

Before taking on graduate work in public affairs, Smallwood had the opportunity to work on projects in the United States House of Representatives and Department of Justice that directly affected Oklahoma. “Having grown up in a small town in southeastern Oklahoma, it means more to me than anything that



Aaron Elam pursued both a bachelor and master's degree from OSU with the support of the Sam Noble Scholarship program. Today, Elam is the Feed Program Administrator for the Oklahoma Department of Agriculture, Food and Forestry.

the Noble Foundation and various smaller organizations in the region truly invested in me," Smallwood said. "I'm going to return that investment within my state."

Much like Smallwood, Aaron Elam's passion for agriculture has come full circle.

Growing up in Pauls Valley, Okla., Elam was interested in all things agricultural. He was heavily involved in Future Farmers of America. His interest in the industry continued to grow and eventually led him to OSU where he worked on both bachelor's and master's degrees. Elam graduated with no student loan debt, thanks to the Sam Noble Scholarship. After graduation, Elam became the Feed Program Administrator for the Oklahoma Department of

Agriculture, Food and Forestry. "I wouldn't be where I am today without the Noble Foundation and the Sam Noble Scholarship," Elam said. "I'm grateful to have had the opportunity to choose a career I can be excited about and invest myself in."

As Feed Program Administrator, Elam regulates animal food distributed throughout Oklahoma. The Consumer Protection Services Division in which he works oversees commercial and livestock feed and pet food. Beyond his day job, Elam owns a small cow-calf operation in Blanchard, Okla. "I genuinely enjoy my job and being involved in a regulatory position that helps consumers," he said, "but I think it's important to remain directly involved in agriculture as well. I am able to do both because of the education I received as a result of the

scholarship."

In the end, Elam reflected on the grander issues facing agriculture and the need for programs like the Sam Noble Scholarship. "I don't think most people realize how agriculture impacts the world around us," he said. "Agriculture is a vital industry, not just for Oklahoma, but the entire world. It touches everything we do, and without a thriving agricultural industry, the world wouldn't be able to operate the way it does. By investing in agriculture, we invest in a successful future." ■

Not just another fish story

by J. Adam Calaway

On a perfectly average Thursday a few weeks back, I bolted out of my building's back doors to take the 312 steps from my office to the cafeteria. Running through my mental to-do list, I launched into the springtime sunlight – a 30-something professional with grilled pork chops on his mind. A few paces later, I was 7 again.

Every spring, there's a day when the ever-present Oklahoma gust slows to a cool breeze, the sun with its warm solace breaks my lockstep, and I bask in a memory so deep it's encoded into my emotional DNA.

No matter where I am, I'm drawn back to the muddy banks of a small cove beside a set of railroad tracks, where I fished for crappie with the greatest man I know – my dad.

Nearly every spring Saturday of my preteen years, my father would rouse me out of bed at an inhumane hour so we could slip away to a secret fishing hole that only a few thousand people knew about.

We were methodical in the ritual: load tackle into my dad's dirt-brown 1987 Ford Ranger, grab a candy bar and Coke breakfast, stop at the hole-in-the-wall bait shop for a baker's dozen of minnows or a white Styrofoam cup of night crawlers, and slather enough sun block on my ginger face to ward off my mother's scorn.

By sunup, our lines would be wet, and all the worries of my little world would melt away to the rhythm of a red-and-white bobber rolling gently on the lake ripples. We'd pass the day easily, soaking up sunshine and talking about whatever random subject tumbled out of my kid brain.

Those days stand as the high watermark of many great childhood memories. I'll remember them as the adventures that defined my youth – everybody needs a great "fish" story – but more for the lessons that defined me.

In the right hands, my father's hands, fishing became a metaphor for life. He taught me that going after crappie or success requires patience and persistence; that focusing on "the one that got away" often ruins the next opportunity; and that lasting



relationships are built one day, one fishing trip, at a time.

At the end of each outing – whether we caught our limit or we were skunked – my father would look at me and say the same thing: "It doesn't matter, I had fun because I got to be with you."

All the time, energy and resources he expended on those fishing trips mattered little to him. He was investing in my life with no expectation of return. He was forging a relationship, not for his benefit, but for mine. And – through his example – he was teaching me one of life's great tenets – lasting joy stems from serving and supporting others.

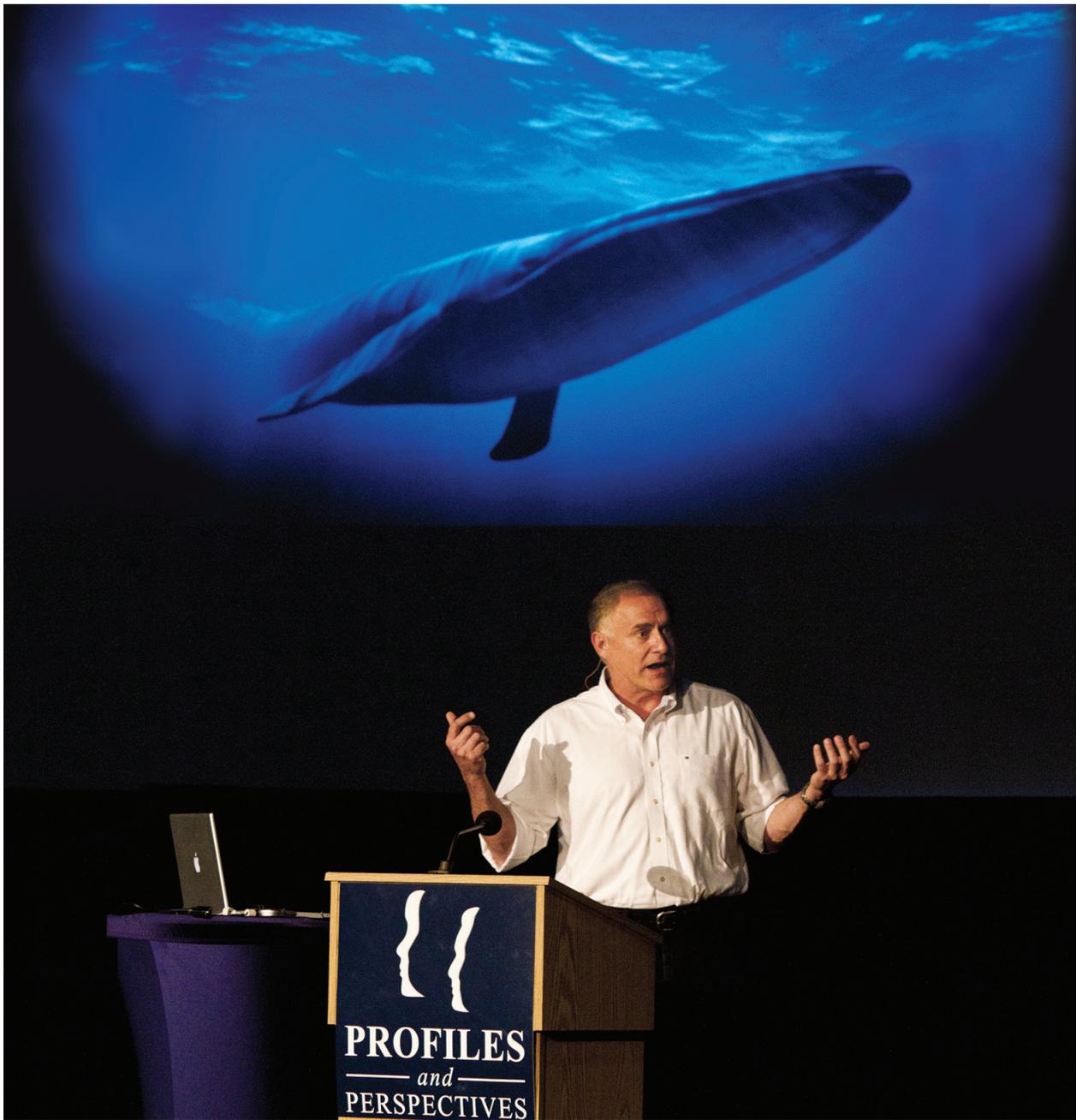
My father's selflessness shaped much of who I am. Now, I see how an organization – endowed with a similar ethos – can change the world.

In 1945, Lloyd Noble established the Noble Foundation with a singular mission "benefit mankind." Noble dreamed of finding lasting solutions to the woes that plagued agriculture in the early 20th century to secure the land for future generations. He knew success could only be achieved by investing in the individual lives of farmers and ranchers.

Through more than six decades, Noble Foundation agricultural consultants have built generational relationships with the stewards of our land: serving, supporting, educating and counseling them so that they can achieve their individual goals.

Today, this organization advances Noble's vision through these direct interactions, as well as plant science and agricultural research. The impact of our work is sweeping, but the outcome is ultimately personal. Whether we discover a novel cellular mechanism, breed an improved forage variety or develop a new production method, our actions advance the agricultural producer on the ground.

These men and women are the lifeblood of society, and we are wholly dedicated to their cause. We invest our collective energies. We offer our expertise and talents. And we seek to serve them the right way, like a father – like my father. ■



The 2010-2011 Profiles and Perspectives season concluded with Greg Marshall, a biologist and filmmaker, who developed the Crittercam. Crittercam is a small, lightweight camera that is attached to various animals, thus providing breathtaking glimpses of the world from their view for National Geographic.

The 2010-2011 Profiles and Perspectives season also included Noble Foundation scientist Alison Blancaflor; Egyptologist Kara Cooney, Ph.D., and popular gardening expert and radio host Neil Sperry. For more information on Profiles and Perspectives, visit www.noble.org/profiles.



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(below) Noble Foundation Greenhouse Manager David McSweeney leads a tour of high school students through the organization's 50,000-square-foot greenhouse facility. The Noble Foundation greenhouse is one of the largest research greenhouses in North America.

