IOWA STATE UNIVERSITY
College of Agriculture and Life Sciences

STORIES

IN AGRICULTURE AND LIFE SCIENCES **VOL.10 NO.2 2016**

HIGH TECHNOLOGY

STORIES
IN AGRICULTURE AND LIFE SCIENCES

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IOWA STATE UNIVERSITY
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"I'LL BET YOU LEARN A LOT IN YOUR JOB!"

Professor Curt Youngs wrote this to me in an e-mail as we traded drafts of a story describing the impact of new ultrasound technology on his undergraduate teaching and research (see page 27).

He's right. I get to work with some of the brightest minds tackling major issues in our state, nation and world. And, I get to see some really cool stuff. Take this photo as proof, taken with the drone featured on the cover. Iowa State University photographer Christopher Gannon literally went to new heights to capture our cover photo. That's him on the top of the telehandler.

This issue is full of cool stuff—robots, sensors, drones, innovations, processes and programs at the cutting edge of agriculture technology. Most importantly, you'll meet the people that bring it to life, put it in the hands of our students and put it to work for farmers, agribusiness and industry.

Those people include Matt Darr (page 16) working to uncover new applications and impacts of precision agriculture; David Grewell, who puts industry experience to work creating a cutting-edge teaching program in manufacturing (page 10); and Rachel Lenz (page 7), who's creating a land management plan for the Des Moines International Airport as an undergraduate capstone project. The list goes on.

It's faculty, staff and students like these who helped the agricultural and biosystems engineering undergraduate program climb to the top in the nation. The program was recently ranked number one by U.S. News and World Report (learn more about the ranking on page 20).

You'll also find several young CALS grads launching their own high tech businesses thanks to a boost from the college's Agricultural Entrepreneurship Initiative (pages 28 and 36). And we honor the memory of young alum Ryan Hrubes, whose friends and family helped achieve a bucket-list goal by creating a memorial scholarship (page 38).

I hope you'll be inspired by these stories of collaboration, innovation and heart. I hope you learn a lot, too.

In closing, I invite you to mark your calendar for Jan. 21 and make plans to join us for a CALS pre-game party before the ISU Cyclone Women's Basketball team takes on Kansas State. We'll enjoy some food and fellowship in Scheman —families are welcome! Stay tuned to STORIES Online and watch your inbox for details on this event and other ways you can continue to connect, engage and share with CALS.

Kind regards,

Melea Reicks Licht

Iowa State University's Holiday Tree provides cheerful color to this view of Curtiss Hall on an early winter morning. Tree lighting on central campus was first celebrated in 1914.

Image by Barbara McBreen

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ON THE COVER

Ryan Bergman, left, program coordinator in agricultural and biosystems engineering, and associate professor Matt Darr study the use of unmanned aerial vehicles at Iowa State's BioCentury Research Farm located near Ames. Read more about this emerging technology on page 17. Image by Christopher Gannon.

Speaking with students in our award-winning Agricultural Entrepreneurship Initiative immediately brings to mind the powerful growth potential in their creativity.

Recently the American Farm Bureau Rural Entrepreneurship Challenge selected two businesses created by student innovators as semi-finalists for its 2017 competition. (Our students have won the national challenge two years in a row, in 2015 and 2016. Read more on page 28). Our two semi-finalists are Inland Sea, a business to produce and market salmon, and Performance Livestock Analytics, a data-driven, real-time farm management and analytics system for precision livestock operations.

Our faculty and staff are equally creative in their use of science and technology to develop potential applications. Each year they bring in tens of millions of dollars annually through grants and contracts from the public and private sectors. They are a key reason we are one of the top 10 universities in the world for agriculture.

When I think of the fascinating science occurring in the College of Agriculture and Life Sciences, I know we have tremendous capability to help grow the agricultural economy and assist rural communities.

One such example is Pat Schnable in agronomy. He is conducting time-lapse imaging of hundreds of different corn varieties every 15 minutes over their lifetime, allowing a better understanding of how plants respond to increased population density (read more on page 26). The research uses an automated imaging system with cameras controlled by microcomputers. The whole setup is powered by an array of solar panels manufactured by PowerFilm, an Iowa company.

I want to make you aware of just few other projects in addition to those featured in this issue.

Stephanie Hansen in animal science is finding that the addition of trace minerals, like zinc, to cattle diets may help to optimize growth responses and increase producers' return on investment when using growth-promoting technologies.

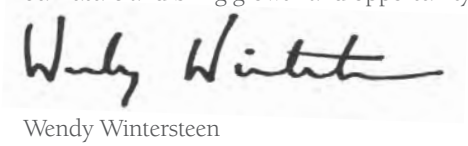
Joe Colletti, our senior associate dean, is leading efforts to build a Midwestern research community on Big Data, or digital agriculture. Iowa State is one of the regional leaders and recently hosted a meeting of more than 100 scientists from 11 states. Iowa State researchers are leading the way by partnering with producers, commodity groups, industry, government and foundations to advance data-driven discovery for agricultural innovation.

Gwyn Beatie in plant pathology and microbiology is studying how the microbiome, the invisible communities of microbes around plant roots, influences water use efficiency, an important advance for crop production.

Steve Whitham in plant pathology and microbiology has uncovered new evidence of how the soybean rust fungus switches off the soybean plant's immune system. It's a step toward finding a way to disrupt that interaction and help the plant defend itself.

Matt O'Neal and Matt Kaiser in entomology and USDA colleagues are studying the use of a stingless wasp to control soybean aphids in farmer fields.

It's innovative research like these projects and many others that will inform our future and bring growth and opportunity to Iowa and the world.



Wendy Wintersteen
Endowed Dean of Agriculture and Life Sciences

BY THE NUMBERS

TOP 10 WORLDWIDE

For the 4th straight year, Iowa State ranks in the top 10 universities worldwide for agricultural programs by the QS World University Rankings

#1 IN UNDERGRAD RETENTION

- CALS ranks #1 on Iowa State University campus for students retained within the college (87.7% of students stayed in majors in CALS)
- 90.4% stayed at Iowa State (second only to engineering's 90.7%)
- Since 2010, CALS 1 year retention rate has remained above 87.5% (national average is 79.2%)

RECORD ENROLLMENT FOR THE 5th STRAIGHT YEAR

- 5,395—total enrollment (undergrads & grads)
- 12th straight year of increases for undergrads
- +20 students from a year ago
- +73% compared to 10 years ago and +90% compared to 12 years ago
- CALS enrollment accounts for 15% of total Iowa State University enrollment
- Undergraduates =
  Women—50.7% (2,360)
  Men—49.3% (2,297)

$26 million

private fundraising support raised last year

CALS

4,000+

alumni, friends and supporters provided gifts

97% Placement rate

(within six months of graduation)

SCHOLARSHIPS EXCEED $3 MILLION

Scholarship funds awarded annually by CALS have topped $3 million—the college awarded 2,300 scholarships to students this academic year

EVELYN AND LEONARD DOLEZAL AUDITORIUM

- 30,000 students have passed through this auditorium in Curtiss Hall on their way to graduation since the dedication in 2013
- 3rd largest lecture hall on campus
- 5,500 square-feet, seats 393 people and is used for classes, club meetings and events

SUPPORT FOR NONPROFIT INTERNS

12—Number of students who received funding from CALS Career Services for nonprofit internships—total support reached $9,000 (41 recipients in past three years)

$56.5 MILLION

in sponsored funding brought in by CALS and Experiment Station faculty and staff in 2016

$400 MILLION

brought in over the last 8 years

***Thabisa Mazur** oversaw crops of organic vegetables from farm to table through her internship at the Horticulture Research Station. During the growing season, Mazur and a crew of students sold their crops to faculty, students and staff, including the chef at the Knoll—the residence of President Steven Leath.*

Story and image by Barb McBreen

WHEN VEGGIES INSPIRE

Onions tug at Thabisa Mazur's heart.

Onions are Mazur's favorite vegetable, but she also loves carrots, beets, brussels sprouts, squash, watermelons or anything she can grow. That's why an internship at the Iowa State University Horticulture Research Station is something Mazur is treasuring.

For the past year Mazur, a junior in horticulture from Ames, has plotted, planned and planted about an acre of organically grown vegetables.

She started mapping out her garden last winter after Nick Howell ('85 horticulture, '15 professional ag), Iowa State University Horticulture Research Station superintendent, asked if she would like to be the first to fill a one-year student internship at the research station. She accepted and started the year prepared with schedules and plant material ideas.

"What really is impressive is that her crop is organically grown," Howell says. "She's done incredibly well in keeping weeds, pests and disease under control. That's a difficult challenge."

On a foggy morning in mid-July Mazur walks through the garden and points out an empty row. "These rows were completely full of plants, but I had problems with cucumber beetles and then we had squash bugs. They killed the plants and I had to remove them. I definitely learned a lot about the challenges of growing crops organically," she says.

Mazur was inspired to learn more about growing food while working with her sister at a nonprofit farm in Cedar Rapids.

"They used land in a purposeful way and it was meaningful to me," Mazur says. "They built a garden in an urban neighborhood and I was captivated by their innovative use of space."

She came to Iowa State with the goal of learning to grow the best vegetables she could and says it's the best decision she's ever made. Mazur received the Edward R. Robinson Scholarship in Horticulture, Robert M. Clark Memorial Scholarship, the Wise Scholarship in Agriculture and grants.

Each Thursday morning during the growing season, Mazur and a crew of students harvested vegetables to be sold outside Curtiss Hall on Friday. When customers asked about the vegetables, Mazur shared recipes and details about each variety.

She also worked with several chefs on campus including Norma Whitt, Iowa State University Knoll chef. Whitt says it's important to Steven Leath, Iowa State president, and Janet Leath to buy local and support Iowa State students.

"They delivered some gorgeous beets, and the beet greens were some of the best I've tasted," Whitt says. "I just love Thabisa's enthusiasm and passion for what she is doing—it really shows through in the produce that she brings us weekly."

The experience has been humbling for Mazur. She's learned how to work with and lead a team and is thankful for the collaborative effort of her coworkers.

"I had such willing and enthusiastic coworkers to help with the bed preparation, transplanting, endless weeding and harvests. The success of the garden is owed significantly to the people I worked with," Mazur says.

The Horticulture Station has a supportive environment that Mazur says helped her incorporate her classroom knowledge. Howell helped her with marketing and Brandon Carpenter ('11 horticulture, MS '14), an ag specialist with the Horticulture Research Station, helped her with the details on planting and field work.

She says both Howell and Carpenter helped her learn to manage an organic garden. They also gave her the creative freedom to plant a wide range of organic and heirloom vegetables.

"Not a day goes by that I don't get dirt under my nails," Mazur says. "This is totally fulfilling and I can see myself doing this the rest of my life." S

TAKING DAIRY TO MARS AND BEYOND

Story by Barb McBreen
Image by Christopher Gannon

Supplying astronauts with enough food to make it to Mars and back to earth is a challenging task for NASA. It's 140 million miles away and will take at least one year to travel to and from Mars. That doesn't include an extended stay on the planet.

That's why Iowa State University food scientists have been testing the effects of radiation on milk products. Tad Beekman, an Iowa State junior in food science and human nutrition, has been helping Lester Wilson, a University Professor in food science and human nutrition, test the effects of solar radiation on food.

"Tad's working on the effects of radiation on rennet (an enzyme for curdling milk) because NASA would like astronauts to make cottage cheese from dried milk," Wilson says. "What we're trying to determine is what happens to the functionality of the enzyme and the dried milk when they are exposed to solar radiation."

For the past six years Wilson has been working on the study. Now Beekman, Wilson and Christine Eckert, a senior in food science, are analyzing the data to be published in the Journal of Food Science. Beekman, Eckert and Jessica Schaumburg, a senior in food science, presented the results in July at the Institute of Food Technologies convention in Chicago.

Beekman says it's been a learning experience that helped him understand what's involved in the scientific process.

"Here's the knowledge we have, here's the data we have and we had to figure out why it's happening as we write our final paper," Beekman says.

Beekman sees college as the first step in his career. He says everything in college is a learning experience that provides marketable skills for future employment.

"I'm a Student Union Board performing arts co-director and it's lots of fun, but I'm also learning marketing and management skills," Beekman says.

He began his college career in animal science, but switched because he wanted to explore the science of food. His internships have provided him experiences related to food science. Last summer he interned at Johnsonville in Sheboygan Falls, Wisconsin. The summer before he interned at Newly Weds Foods in Chicago.

"Newly Weds Foods produces spices, batters and breading," Beekman says. "I evaluated sodium reduction in their products. It's an innovative company that's looking for taste inspirations."

Beekman is a third generation Cyclone who grew up in Saline, Michigan.

He received a number of scholarships including the Award for Competitive Excellence and the College of Agriculture and Life Sciences Dean's Leadership Scholarship.

Beekman plans to intern at Johnsonville again this summer and to pursue his master's degree in food science after he graduates. He hopes to pursue a career in food sensory research and innovative product development.

***Tad Beekman**, junior in food science and human nutrition, is working with University Professor **Lester Wilson** to understand the effects of radiation on food transported to Mars.*

CONSERVATION RISING TO NEW HEIGHTS

Story by Dana Woolley
Image by Christopher Gannon

***Rachel Lenz** (left), senior in agricultural systems technology, touches base with her academic adviser **Jenny Macken** often throughout the year. Active in student clubs and a high academic achiever, Lenz is creating a land management plan for the Des Moines International Airport as her senior capstone project.*

Rachel Lenz found her senior capstone project in agricultural systems technology to be a perfect fit for her passion and skill set.

Lenz and her team are creating a land management plan for the Des Moines International Airport to identify which conservation practices are best suited to their 800 acres of land.

Her team has designed a management plan to decrease erosion, reduce nutrient loss and control bird populations. The plan includes strip cropping the farmable acres by planting strips of row crops next to strips of the perennial alfalfa.

Lenz says strip cropping will help reduce erosion and nutrient loss in the soil. Her team also will initiate a required tillage practice for the strips planted in row crops. This tillage practice will bury the seed left on the soil after harvest and help diminish the bird populations feeding on the seed. She is working with Amy Kaleita, associate professor of agricultural and biosystems engineering, and draws on her academic expertise and first-hand knowledge of farm activities to make recommendations.

Lenz and her team will present the plan to airport officials in December and expect the plan to be implemented during the 2017 growing season.

Lenz keeps busy between classes working on her family farm in Vail, Iowa, participating in the Agricultural Systems Technology (AST) Club and Block and Bridle. She's managed to juggle all these activities and graduate in three and a half years. The senior in AST with a minor in agronomy is still exploring opportunities following graduation in December.

"I really enjoyed learning about the impact of runoff and erosion rates in my soil and water conservation classes," says Lenz. "People need to step up and make a difference in conserving soil and water. I hope I can make an impact."

Jenny Macken, an academic adviser in AST who advises Lenz, says Lenz stands out for her academic success and positive attitude.

"Rachel is extremely intelligent. She earned a spot on the dean's list for multiple semesters and received the Iowa State University Academic Recognition Award. She also finds time to remain very active on campus," says Macken. "Rachel is the only woman I've advised during her entire college experience. Most women transfer into our program, so I only get to work with them for a couple years. Whenever I see her, she is always smiling."

Lenz is the only woman in her AST graduating class and one of 11 in the AST major. Lenz says the experience has prepared her for entering the working world.

"I'm entering a field that employs mostly men, and I'm pretty used to that. It makes the idea of being the only woman less intimating and has prepared me for what I may encounter in my work place," says Lenz.

REVEILLE, RESEARCH AND RECRUITMENT

Story by Barbara McBreen
Images by Barbara McBreen, contributed

Thomas Wilgenbusch is an early riser.

Every morning before class he participates in an intense military fitness program focused on building cardiovascular endurance and muscle strength. It's part of his Reserve Officers' Training Corps (ROTC) program. Wilgenbusch spent one summer in Kosovo teaching English to security forces through ROTC.

On campus, Wilgenbusch, a junior in animal science, keeps a rigorous schedule full of classes, club meetings, studying and mentoring other students. Brad Skaar, an animal science professor and his adviser, coached Wilgenbusch in little league in his hometown of Story City, Iowa. Skaar says he's always been conscientious and organized.

"I don't know when he sleeps," Skaar says. "He has a lot of different things going on and he puts them in the right order."

Those organizational skills helped him attain a U.S. Department of Agriculture Wallace-Carver Fellowship at the USDA Agricultural Research Station Northwest Irrigation and Soils Research in Kimberly, Idaho, last summer.

"The fellowship gave me the opportunity to see multiple segments of the agriculture industry working together to maximize food production and efficiency," Wilgenbusch says.

The fellowship allows college students to collaborate with world-renowned scientists through paid internships. In the summer of 2016, 10 of the 37 students stationed at USDA research centers across the country were Iowa State students.

Along with his intense schedule, he finds time to mentor and talk to prospective students as a College of Agriculture and Life Sciences Ambassador. This year he served as chair of the committee that recruits, selects and trains new ambassadors.

"The student ambassadors go out to high schools, talk to 4-H and FFA students and lead campus tours," Wilgenbusch says. "Ambassadors practice a lot of skills like public speaking, organization and leadership, which we can use in our internships and future jobs."

Beth Foreman, student services program coordinator, leads the college's ambassador group. She says ambassadors enjoy sharing their experiences with prospective students.

"These students serve a critical role in recruiting new students. Ambassadors have a lot of credibility with prospective students because they are much closer to their age," Foreman says.

The Alpha Gamma Rho fraternity is another part of Wilgenbusch's life. He joined as a freshman and says it's been helpful to have upperclassmen as mentors who share their knowledge about classes and campus.

"We really try to work as mentors and help other students learn good study habits," he says.

Wilgenbusch has received a scholarship through the ROTC program and received the Fred Foreman Scholarship in Leadership and Participation.

He plans to pursue a career in animal science research and is currently working with Joshua Selsby, an associate professor of animal science, studying the muscular effects of heat stress in hogs.

CALLING FOR INCREASED FEDERAL INVESTMENT IN AG RESEARCH

Iowa State is one of 13 United States research institutions that joined the Supporters of Agricultural Research (SoAR) Foundation, calling for an increase in federal support of food and agricultural science. The coalition published a report, Retaking the Field, that highlights recent innovations and illustrates the need for improved U.S. agricultural research in the global industry. Visit www.stories.cals.iastate.edu for a link.

HEARTY HELLOS

CALS faculty and staff who have accepted new roles within the college include:

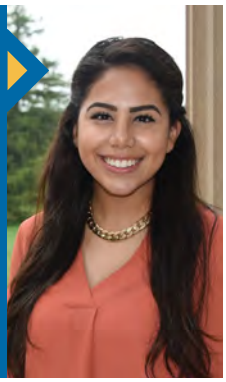
- **Mike Fiscus** ('93 ag studies), superintendent, Agricultural Engineering/Agronomy Research and Demonstration Farm
- **Mark Licht** ('00 agronomy, ag extension education, '03 MS soil science, '15 PhD crop production and physiology), assistant professor, agronomy
- **Mike Retallick** ('05 PhD ag and life sciences education), professor and chair, agricultural education and studies

DUPONT EXECUTIVE PRESENTS DEAL LECTURE

The executive vice president of DuPont, **Jim Collins**, presented the 2016 William K. Deal Endowed Leadership Lecture Oct. 5 at Iowa State. The lecture was established to help prepare future leaders and innovators. Collins' presentation, "Growth Comes When You Least Expect It," is available online at www.stories.cals.iastate.edu.

ARGUETA AWARDED
INAUGURAL GEORGE WASHINGTON CARVER AWARD

Estefany Argueta, senior in animal ecology and member of the Iowa State Army Reserve Officer Training Corps (ROTC), is one of five students in the U.S. to receive the inaugural George Washington Carver Spirit of Innovation and Service Award. The award is given to first-generation college students, with a high level of involvement in campus activities, pursuing a scientific degree. The award was sponsored by the George Washington Carver Birthplace Association.



AGRICULTURAL AND BIOSYSTEMS ENGINEERING RANKED TOP IN NATION

U.S. News and World Report named Iowa State's agricultural and biosystems engineering (ABE) undergraduate program number one among all national universities and first among public universities. ABE's graduate program is ranked second in the nation. The department is jointly administered by the College of Agriculture and Life Sciences and the College of Engineering. (Read more on page 20.)

SUCCESS FOR CALS STUDENT TEAMS

- The Dairy Science Club (above) placed first at the Intercollegiate Dairy Cattle Judging Contest and received third place in the scrapbook and yearbook competitions from the American Dairy Science Association Student Affiliate Division.
- The Weed Science Team received first place in the North Central Weed Science Society Collegiate Weed Science Contest.
- The ISU Graduate Meat Judging Team placed third at the Hormel National Barrow Show Intercollegiate Meat Judging Contest.
- The Soil Judging Team placed second in the American Society of Agronomy National Soil Judging Competition.
- The Agricultural Business Club and its members received high honors at the Agricultural and Applied Economics Association annual meeting:
  - The club received the Creative Club Award for its annual trivia night.
  - Three agricultural business seniors placed in the Earl O. Heady Decision Sciences Spreadsheet Competition: **Nate Christenson**, first place; **Geordan Hanson**, second place; **Trevin Kennedy**, third place.
  - **Nate Christenson** (senior), **Kyle Bates** (senior) and **Drew Mogler** ('16 ag business) placed third in the academic bowl competition.
- Iowa STAT-ers Club has been recognized as an official student chapter of the American Statistical Association.

WELDING INDUSTRY TECH TO STUDENT OPPORTUNITIES

Story by Dana Woolley
Image by Christopher Gannon

David Grewell has his thumb on the pulse of industry. He also has a unique approach to problem solving, which he uses in his research and encourages among his students.

A professor of agricultural and biosystems engineering, Grewell brings a wealth of real-world experience to the next generation of industry professionals. His goal is to see industry adopt cutting-edge manufacturing strategies by increasing their usage of sustainable materials and the creation of new materials.

As the director of a National Science Foundation center and his long-standing mentorship of undergraduate and graduate students, he has already made a significant impact in his field.

"I have two main research interests. I'd like to see industry-wide adoption of sustainable or renewable materials to augment petroleum-based chemicals and industrial use of ultrasonics to enhance biofuel production," says Grewell. "The benefits of high-powered ultrasonics can be used in a number of fields, especially in food processing."

Ultrasonics—the use of acoustic vibrations to improve materials and industrial processes—can be used in welding, sealing, emulsions and cutting.

For example, using ultrasonics to cut a candy bar leaves a smooth edge compared to a rounded edge, and there is no residue or food buildup. It can also speed up processes like sealing yogurt cups. While at Emerson Electric, Grewell worked on a system that was able to seal 120 cups of yogurt in one second.

Grewell's work in ultrasonics and interest in using alternative materials began when he was an undergraduate student at Ohio State University, majoring in welding engineering. He spent 15 years at Emerson Electric in roles from engineer to research project manager. He then became interested in the welding of plastics to metals. When he joined the Department of Agricultural and Biosystems Engineering, Grewell expanded his ultrasonics work into biofuels.

"With ultrasonics, the process to convert soybean oil into biodiesel can be reduced from 45 minutes to 15 seconds," he says.

Grewell's research portfolio includes biorenewable biodegradable polymers (binding agents), nano-composites (materials improved by adding microscopic particles), biorenewable fuel sources, high-power ultrasonics, ethanol and biodiesel production, micro-fabrications and polymer and metal welding.

Grewell's work also has applications in the automotive industry, which is something he teaches to students in his introductory manufacturing class.

> *"I want students to have an appreciation that other materials can be used."*

"I often include case studies based on my 15 years of industry experience challenging students to propose possible solutions to problems I faced," says Grewell. "I want students to have an appreciation that other materials can be used."

Grewell also teaches a class on bioplastics and biocomposites once a year, which builds upon the concept of using sustainable materials in manufacturing. He cites large companies such as Ford and Coca-Cola that are already using bio-based feedstocks in production materials. He challenges his students to think of ways they can reduce their environmental footprint by developing new plastics that behave exactly like other petroleum-based plastics.

Grewell employs several students in his research labs. Jake Behrens ('13 agricultural systems technology, MS '16 agricultural and biosystems engineering), a research

***Professor David Grewell** (right), and research associate **Jake Behrens**, discuss the uses for an injection molding machine in a classroom in Sukup Hall. Grewell directs the Center for Bioplastics and Biocomposites—a National Science Foundation Industry and University Cooperative Research Center.*

associate, has worked in Grewell's labs as an undergraduate and graduate student. Behrens credits his time in Grewell's lab with providing him career experience in leadership, research and networking.

"I have been assisting in Dr. Grewell's labs since fall '10 when I was hired as an undergrad research assistant. I typically helped with extrusion, injection molding, compression molding or mechanical testing," says Behrens.

After being accepted into the department's graduate program, Behrens took on additional responsibilities such as hiring undergrads, assisting with the manufacturing processes lab, going to trade shows to promote research and visiting industry partners.

"Throughout my time with Dr. Grewell I have had a lot of opportunities. Traveling with Dr. Grewell has been one of my favorite things about working with his research group. I got excited learning about the opportunities I might have doing this research, but when I started in 2010 I had no idea how much I would learn and grow," says Behrens.

When he's not teaching or in the lab, Grewell directs the Center for Bioplastics and Biocomposites (CB2), which was established in 2014. CB2 is a National Science Foundation Industry and University Cooperative Research Center that focuses on developing high-value biobased products from agricultural and forestry feedstocks.

"Industry really drives the focus of CB2," says Grewell. "We have 26 board members, each from a different industry partner, and we communicate once a month. Eventually, I hope CB2 can achieve critical mass and support itself without NSF after it makes it past phase II. I also hope that the discoveries we achieve with CB2 can be widely implemented."

Grewell's ability to form partnerships and his expertise have made him a leader in the industry. His honors span the gamut from research to student service to industry recognition. Grewell holds 15 patents; has been recognized by the College of Agriculture and Life Sciences with the Student Recruitment Award, International Award and Early Achievement in Research Award; is a fellow of the Society of Plastics Engineers; and is a U.S. Delegate of Commission 16 of the International Institute of Welding.

MAKING DATA-DRIVEN DISCOVERIES POSSIBLE

Story by Lynn Laws
Image by Christopher Gannon

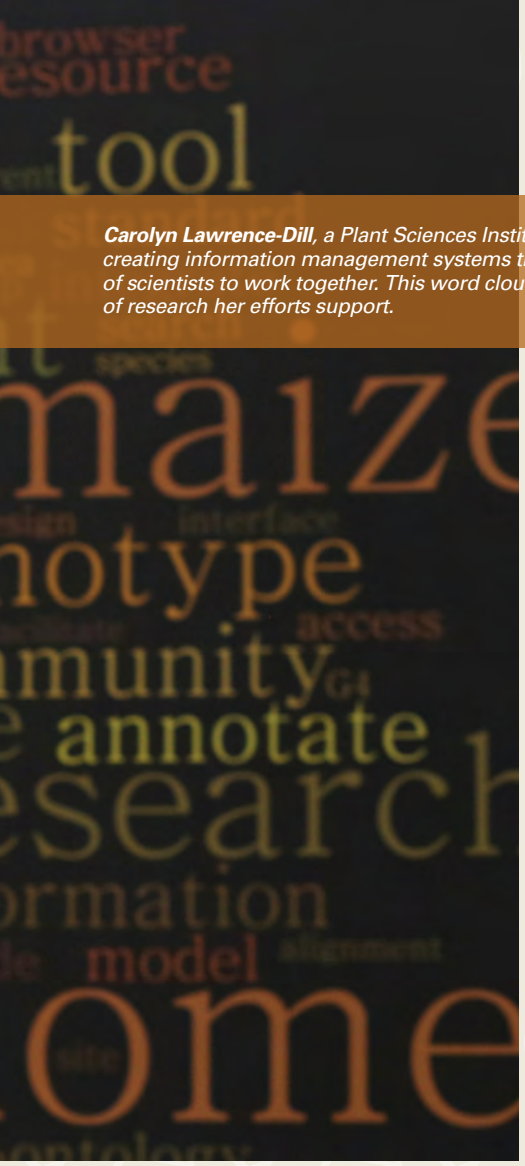
Carolyn Lawrence-Dill connects researchers and increases the shelf life of data. Her efforts make research information generated by scientists available to other scientists, increasing the impact of their work over time.

"My group's work supports scientists who are doing research in the field or lab. It's very rewarding—you can feel like you've saved hundreds of thousands of hours for people who are trying to solve a hard problem," says Lawrence-Dill. "But the aspect of my job I enjoy the most is creating information management systems that allow large groups of scientists to work together."

Lawrence-Dill is an associate professor in the Department of Genetics, Development and Cell Biology and in the Department of Agronomy. She's a Plant Sciences Institute Scholar, charged with advancing the field of predictive phenomics—an area of biology that measures physical and biochemical traits of plants as they change in response to genetic and environmental influences. Her work involves creating systems to manage complex datasets to support the development of better predictive models for plant breeding and genetics research.

After reading a recent journal article that began by describing people who make a living off the data that other people generate as "research parasites," she and her colleagues began jokingly calling each other "parasites." But, Lawrence-Dill and the article authors concede that, in truth, they have a symbiotic relationship.

"You can't imagine all of the possible research questions that could be answered with access to large scale datasets," says Lawrence-Dill.



***Carolyn Lawrence-Dill**, a Plant Sciences Institute Scholar, enjoys creating information management systems that allow large groups of scientists to work together. This word cloud illustrates the type of research her efforts support.*

Deemed a strategic priority by Iowa State University, Lawrence-Dill, Asheesh Singh, assistant professor of agronomy, and Baskar Ganapathysubramanian, associate professor of mechanical engineering, were awarded $750,000 as part of the university's Presidential Initiative for Interdisciplinary Research earlier this year. Their research proposal, "Data Driven Discoveries for Agricultural Innovation," led by Lawrence-Dill brings together more than 20 faculty members from across campus to make significant strides in the collection, management, interpretation and use of data related to agriculture.

Joe Colletti, senior associate dean and associate director of the experiment station in the College of Agriculture and Life Sciences, says Lawrence-Dill has expertise in computational biology and bioinformatics, is very collaborative and knows how to build productive teams.

"She is able to knit together the right people, at the right time, in the right way here at Iowa State, nationally and internationally," he says. "More importantly, she understands the connection between statistical methodologies and biological sciences—she can see the big picture. She really understands how to create tools for researchers and make data accessible through the right databases so that more value can be obtained from those data."

Lawrence-Dill and her team members have three active projects working with scientists in various disciplines across campus. She offers a quick summary in her own words:

Genomes to Fields (G2F)

"For one of the major G2F projects we have more than 20 locations—20 different universities and federal entities growing the same inbred and hybrid corn lines. If we can measure how the same plants grow in lots of different environments, and we get the genome sequences for those plants, we can start looking at how different components of the genome affect growth and development and other traits based on the environment. Once we get a dataset where we can see how those things relate, we hope to be able to predict how it's going to grow in current environments and future environments as the climate changes. My work for G2F is to put together an information management platform that enables collaborators on the project to access genetics, weather and phenotype data, which includes things like plant height, ear height and yield." (Read more about G2F on page 26.)

Enviratron

"The Enviratron involves eight different plant environments where a robot collects images and other data from plants. What I'm working on is to make sure the information collected is tagged with the right metadata (information that enables researchers to understand, discover and re-use the data). We are documenting, for other scientists, what the environments were and what the experimental design was, which includes things like how often you took measurements, what the temperature treatment was, the light treatment, and so on. What we're putting together is a system that will enable other scientists to find and use the data collected using the Enviratron system." (Read more about the Enviratron on page 25.)

Genome Editing Design Tool

"The tool we developed enables scientists to predict all the locations in a genome that can be edited. It is specific to the genome sequences recognized by the CRISPR-Cas9 system, which is the coolest thing going on in molecular biology right now. With our tool you could take any genome and identify the sites in a gene of interest that could be manipulated using CRISPR-Cas9. Then in the lab the CRISPR-Cas9 system can be used to change the DNA sequence identified (such changes could improve agronomic traits). Our design tool works on soybean, peanut, corn, rice—we can load it with any genome, but so far we've been specifically working with plants."

*Fueled by a grant from the National Science Foundation, **Kan Wang**, Global Professor in Biotechnology, and her colleagues are using genome-editing technology to improve crops.*

SWEET SUCCESS
FOR GLOBAL FOOD STAPLE

Story by Fred Love
Image by Ed Adcock

Iowa State University researchers are applying cutting-edge technology to unlock the potential of the yam, a crop that carries major significance across the globe.

Funded by a three-year, $830,000 grant from the National Science Foundation (NSF), Kan Wang, Global Professor in Biotechnology, and her colleagues are working to develop a suite of technological tools to allow scientists to develop yams with improved yields, nutritional value and better resistance to stresses. The grant is part of NSF's Basic Research to Enable Agricultural Development, or BREAD, program.

> ***"The yam is a tropical crop that's extremely important globally and very nutritious"***

Yams are a plant species cultivated throughout Africa, Asia, the Caribbean and Latin America for their starchy tubers. Yams are less common in the United States and often confused with sweet potatoes, a separate plant species.

"The yam is a tropical crop that's extremely important globally and very nutritious," Wang says. "It carries cultural importance throughout Africa. It has nutritional, cultural and even medicinal significance to populations across the globe."

The research team includes co-investigators Bing Yang, an associate professor of genetics, development and cell biology and Mark Westgate, a professor of agronomy. The team also includes an international co-investigator, Leena Tripathi, a scientist with the International Institute of Tropical Agriculture in Kenya.

The team, led by Wang, utilizes revolutionary genome-editing technology including the CRISPR/Cas9 system to forge a greater understanding of the plant's genome. They'll develop an array of tools to allow future researchers to use the technology to answer specific questions regarding yam gene function and disease resistance, among other uses, Wang says.

CRISPR/Cas9 is a genome-editing platform allowing scientists to delete, replace or insert genes for functional genomic study. Wang says the technology has been applied to other crops, such as rice and corn, but similar study of yams has lagged behind. Wang and her team will look at how the technology has been applied to other crops to see if those methods also work for yams or if they'll need to be adjusted.

Wang says the project fits with Iowa State's longtime connection to research and outreach in the realm of international agriculture and the recently-launched Presidential Initiative for Interdisciplinary Research.

"NSF always seeks for broader impact of all funded research programs. The strong reputation and long history of the college's international agriculture program, especially outreach and engagement for Africa improvement, greatly helped us land this grant," Wang says.

Project personnel conduct focused workshops and training for African scientists, and Iowa State undergraduate students will travel to Africa in connection with the research as a study abroad opportunity, Wang says.

"In three years, we hope we will have created a toolkit for scientists to increase the value of the yam as a crop," she says. "That means better yields, more resistance to stress and greater nutritional and medicinal value."

GLOSSARY

Advances in high technology in agriculture bring new terminology to describe innovations. Here's a quick reference guide to selected terms in this new vernacular.

Bioinformatics (computational biology) — using biological data to develop mathematical algorithms to study biological systems

Crop model — computerized tool using algorithms to predict crop performance based on agronomic and environmental data

Data analytics — examining data to draw conclusions

Digital agriculture — farming activities that depend on the collection, use and analysis of data (includes precision agriculture)

Genome — the full set of genetic instructions of an organism (coded in DNA)

Genome editing — a type of genetic engineering in which DNA is deleted, replaced or inserted, resulting in a genetically modified animal, plant or organism (GMO) with a desired trait such as drought resistance, improved nutritional value or faster rate of gain

Metadata — information that provides details about data (such as method and time of collection, and by whom)

Phenotype — physical characteristics of an organism resulting from its genes and environment

Predictive phenomics — measuring physical and biochemical traits of organisms as they change in response to genetic and environmental influences

Precision agriculture — hardware and software tools that give farmers better control to customize management of specific sites (auto-steer, yield monitors, variable rate machinery)

Remote sensing — the process of gathering data from a distance without making contact with the subject

Ultrasonics — the use of acoustic vibrations to improve materials and industrial processes

Unmanned Aerial Vehicles (UAVs) — lightweight quadcopters (informally known as drones) used for data collection, transmitting remote-sensing data, photos or videos that allow operators to study or make more precise management decisions on large swaths of land

VOICES: THE DIGITAL TRANSFORMATION OF AGRICULTURE

***Levi Powell** ('12 agricultural systems technology, MS '14 industrial and agricultural technology), program coordinator at Iowa State University's BioCentury Research Farm, checks auto-steer settings and fertilizer rate control on an in-cab monitor while **Ben Covington** ('12 agricultural systems technology, MS '13 industrial and agricultural technology), engineer designer, loads the machine with fertilizer. The Soil Warrior machine combines strip tillage and fertilizer application in one trip through the field.*

Story by Matt Darr
Image by Christopher Gannon

In 1959 the Iowa State College of Agriculture and Mechanic Arts was officially renamed the Iowa State University of Science and Technology. The focus on technology, both in name and in purpose, has empowered Iowa State University to be a leader in innovation resulting in a range of research patents and inventions from the first round baler to the first binary computer.

The Iowa State inventors of the first computer likely never imagined how their technology would empower today's digital transformation of agriculture. Today over 50 percent of Iowa row crops are planted using digital computers and global positioning systems (GPS) auto-steering systems. Over 40 percent use site-specific variable rate management of fertilizers. These precision agriculture tools have helped lower the cost of production, improve machinery efficiency and increase yields while also increasing the sustainability of agriculture.

The widespread growth of cloud computing and the availability of site-specific agricultural data has led to a transition from precision agriculture to digital agriculture. Digital agriculture has brought a new focus towards data analytics and modeling, which enhances our depth of knowledge in agricultural production. Unmanned aerial vehicles (UAVs) and high resolution aerial imagery are an example of an immediate impact. With today's UAV technology we can assess individual plant health during the growing season and quantify the impact of production practices and weather on plant-by-plant productivity. At a macro level this helps individual producers incorporate agronomic changes and site-specific management into their continuous improvement process. In the future this technology opens the door for plant-by-plant management and early detection of yield-limiting factors.

The growth of digital agriculture is also an opportunity for Iowa State to train the future generation of leaders in this field. Success in digital agriculture requires training in traditional agricultural fields blended with expertise in data science, machine learning and information technology. Iowa State is actively preparing our students to be successful in today's agriculture by infusing technology throughout our classrooms. We do this through a hands-on approach to education. Our students learn about the fundamental science behind new technology while also enhancing their confidence in using technology to solve real-world challenges. Additionally, departments across Iowa State have partnered together to ensure that our curriculum is adapting to the growing needs of data science in our graduates.

We also are delivering value back to the community through an integrated approach to research, extension and outreach in digital agriculture. Educational efforts include helping growers understand the use of crop modeling tools for yield forecasting, demonstration of UAV technologies for crop scouting and the use of data analytics to improve crop input selection. Most importantly, Iowa State is providing education on the need for data security and privacy standards to ensure producers protect current and future opportunities in the digital agriculture industry.

We look forward to future growth of digital technologies in agriculture and to demonstrating we are the Iowa State University of Science and Technology through our actions and incorporation of data analytics, UAV innovations and crop modeling into all aspects of our university mission.

Matt Darr is an associate professor of agricultural and biosystems engineering.

Unmanned aerial vehicles transmit videos or photos like this, allowing operators to review large swaths of land for variation among crops that would be more difficult to detect on foot or from the roadside.

BIRDS-EYE VIEW OF AGRICULTURE

Story by Fred Love
Images by Christopher Gannon, contributed

Farmers make their livelihoods in the soil, but sometimes it takes a birds-eye view to evaluate a field.

To that end, unmanned aerial vehicles (UAVs) are becoming an increasingly common sight hovering over Iowa's corn and soybean fields, offering producers a big-picture view of their crops.

Matt Darr, an associate professor of agricultural and biosystems engineering at Iowa State University, called UAVs a "bleeding-edge technology" with great potential in agriculture. And faculty and students at Iowa State are playing a multifaceted role in advancing this emerging technology, he says.

Iowa State engineers are developing software to make UAVs smarter and faster at processing data, and Iowa State faculty are helping students and producers acquaint themselves with what the technology can do in the here and now.

The technology has the potential to give farmers a whole new perspective on their operations—from above.

'A better report card'

If corn and soybean producers received grades like college students, their yields at the end of a growing season would amount to a final exam. Darr says UAVs offer farmers the opportunity to take the equivalent of midterm exams earlier in the growing season and make adjustments if necessary.

"Yield monitoring has been a good report card for 20 years, but you only get the data at the end of the season," he says. "UAVs allow you to quantitatively assess crops throughout the year. It's a better report card."

Mark Licht, an assistant professor of agronomy, says unmanned aerial vehicles can scout a field in a fraction of the time it would take to walk the same acres.

The UAVs, typically lightweight quad-copters capable of staying in the air for up to 30 minutes, transmit photos or videos that allow the operator to view large swaths of land. The top-down view makes it easier to spot variation among crops that might be harder to see on foot or from the road, Licht says.

*Agronomy graduate student **Rafael Martinez-Feria**, left, visits with farmer **Ivan Thomas** of Douds, Iowa, about unmanned aerial vehicles at the Iowa State University exhibit at the 2016 Farm Progress Show near Boone, Iowa.*

"I think the best use we have for UAVs right now is crop scouting," he says. "We can go out to areas of a field that are performing well and compare them with areas that are performing poorly, and you don't have to spend as much time in the field. From above, you can see patterns more easily."

Darr says using a UAV to conduct an early season crop assessment gives farmers another important data point to add to their yield monitoring.

"We want every seed to have an equal chance to mature, but it's really hard to assess whether that's happening without quality data," he says.

Flying into the future

While unmanned vehicles can already help with crop scouting, Darr says the future looks even brighter for the technology. Current models can gather images, but it still requires a human to sift through them and reach conclusions based on the images.

Darr says the next step in agricultural UAV development will feature smarter software and higher-resolution instruments that will give a more precise diagnosis of what's happening in a particular field. To illustrate his point, Darr predicted future UAVs will be able to identify sections of field with insufficient nitrogen or a range of other deficiencies.

"Today, they're a tool. The next step is to make UAVs a solution in their own right," he says.

Part of that process is taking place at Iowa State, where faculty are working across disciplines and with graduate students to design the sort of advanced software it'll take to power Darr's vision.

Progress is occurring in the classroom too, where Iowa State students are receiving instruction on the potential of UAVs and the importance of analyzing the images and data they may capture. Darr says students get excited to work with innovative technology like UAVs. He says Iowa State faculty are tapping into that excitement to demonstrate to students the importance of applying data analysis to real-world farm management practices.

A new perspective

Sean Blomgren, a seed salesman who lives near Ames, conducts UAV flights for clients to help them survey their fields. Blomgren says he knows of only a handful of producers who have purchased their own UAVs, but he says the technology has caught on with seed and equipment dealers, agronomists and other service-oriented sectors of the agricultural economy.

Blomgren says most farmers immediately recognize the value of scouting a field with a UAV once they see the top-down view the technology provides. It's a difficult perspective to get by any other means, he says.

"They love their farms," Blomgren says. "Their eyes light up when you show them a farm from an angle they've never seen before."

Darr says the outreach component of Iowa State's land-grant heritage means Iowa State University personnel are helping producers get the most out of the technology by showing them best practices and educating them on safety and what sort of options are available on the UAV market. Between developing the next iteration of UAV technology, teaching students how to use it and helping farmers get the most value from it, UAVs fit well with Iowa State's mission.

And Licht says he sees growth on the horizon both for how commonly UAVs are used and what functions they can perform.

"I think they're probably here to stay, but we're going to evolve in how we're using them," he says.

When it comes to the future of UAVs in agriculture, it's tempting to say the sky's the limit. S

STORIES EXTRA: www.stories.cals.iastate.edu

Visit STORIES website to check out drone video footage captured at Iowa State University's BioCentury Research Farm.

"Their eyes light up when you show them a farm from an angle they've never seen it before."

***Ryan Bergman** ('14 agricultural systems technology, '15 MS industrial and agricultural technology), left, program coordinator in agricultural and biosystems engineering, and associate professor **Matt Darr** research the use of unmanned aerial vehicles at Iowa State's BioCentury Research Farm located near Ames.*

BUILDING ON EXCELLENCE

Facilities, faculty and staff bring ABE to #1

By Dana Woolley
Images by Dan McClanahan, Christopher Gannon

The U.S. News and World Report named Iowa State's agricultural and biosystems undergraduate program number one among all national universities and first among public universities this September—a tie with Purdue University. Iowa State was ranked number two last year.

"The achievement of number one rankings was reached by dedication to the department's mission and vision," says department chair Steve Mickelson. "The department's faculty, staff, graduate students, undergraduate students and scholars are all engaged in and committed to teaching, research, extension and outreach."

The graduate program in agricultural and biosystems engineering (ABE) is ranked second in the nation. The Department of Agricultural and Biosystems Engineering is jointly administered by the College of Agriculture and Life Sciences and the College of Engineering.

"The department's original mission was to mechanize agriculture," says Mickelson. "That mission has evolved to encompass a global view of the entire food production system—the wise management of natural resources in the production, processing, storage, handling and use of food, fiber and other biological products."

In the summer of 2014, ABE moved into its new state-of-the-art teaching and research facilities in the Biorenewables Complex at Iowa State University—Elings Hall and Sukup Hall and Atrium.

Fluid Learning

Brian Steward, professor of agricultural and biosystems engineering, challenges his students to name a piece of agricultural machinery that functions without hydraulics.

Most students struggle to come up with an example, emphasizing the importance of the fluid power teaching laboratory in Elings Hall.

Each hydraulic trainer workstation consists of a work bench, computer, electronic sensors and controls with a variety of valves and actuators. Over time, the custom equipment provided by Danfoss has become more state-of-the-art, which Steward says makes this lab the only one of its kind.

"We've continued to improve and add trainers for students," says Steward. "While we were in Davidson Hall, we were limited by space and electrical capabilities. Our new building has helped us overcome those limitations. The lab is flexible, so we can arrange the trainers in a variety of ways depending on the class or research project. The added training units can accommodate more students in each lab section, thus increasing the quality and quantity of hands-on training in the lab."

Steward states the majority of research done in the fluid power lab is student driven, through honors projects and special topics projects. It also has been used for industry short courses. In these two-day workshops, Steward teaches practicing engineers and technologists how to build and troubleshoot hydraulic circuits.

The fluid power teaching laboratory in Elings Hall offers students the same state-of-the-art hydraulic technology used by industry.

"Industry uses the same components we use in this lab, so this is not simply academic. This prepares students for the kind of problem solving they'll experience in the real world," says Steward.

Bringing water quality research indoors

The basement of the biorenewables complex is home to cutting-edge equipment, including a brand new hydraulic flume in the Buss Hydrology Lab. Researchers can program flow at various rates to simulate anything from sheet flow on a parking lot to high flow conditions in a stream.

"The flume brings unique control to the study of water flow we are not able to achieve in the field," says associate professor Michelle Soupir.

The flume contains a sediment bed in which different soils or vegetation are placed to simulate stream bottom sediments, or flow through a buffer or wetland-type system. A sediment feeder is also part of the flume system allowing researchers to simulate water carrying a high load of suspended sediments. This makes the flume capable of meeting the varied research needs of environmental and engineering professionals.

"There are many ongoing discussions with faculty across campus about using the flume for research projects. We are also planning laboratory exercises for some of the upper level ABE environmental courses. I expect that we will also have graduate students work on the flume extensively for research projects," says Soupir.

The water source for the flume comes from the stormwater recovery system in the biorenewables complex, adding to the green features in the building. This gives researchers the option to use a natural water source instead of treated water and reduces impact on the environment.

"Dr. Manure" engages on social media

On campus and at extension field days he's known as "Dr. Daniel Andersen, assistant professor." He goes by a different name on social media—Dr. Manure (@Dr.Manure). Andersen uses his Twitter handle to engage with farmers, manure applicators and farm advisers to direct online traffic towards his blog, "The Manure Scoop." The playful titles provide accessibility so that Andersen can discuss what's really important, which is the science of manure.

"It's about starting the conversation. Often people look at manure and think it's a smelly waste product, but the truth is there are lots of options about how manure is handled and each of those decisions impact the value it has to our farming operation and its impact on the environment," says Andersen.

As "Dr. Manure" he hopes he can create a greater understanding of manure, so people start changing the way they make decisions about manure management.

***Michelle Soupir** says the new hydraulic flume in the Buss Hydrology Lab brings unique control to the study of water flow. The flume will be used by undergraduates, graduate students and researchers to create conditions not achievable in the field.*

SNAPSHOT:

Agricultural and Biosystems Engineering Department

Established in 1905

- **Four undergraduate degree programs:**
  - agricultural engineering
  - biological systems engineering
  - agricultural systems technology
  - industrial technology
- **Master's and doctorate degree programs:**
  - agricultural and biosystems engineering
  - industrial and agricultural technology
- **Current research and extension efforts:**
  - Land and water resources engineering
  - Biological and process engineering and technology
  - Animal production systems engineering
  - Advanced engineering and manufacturing systems
  - Occupational safety engineering
- **36 faculty, 99 graduate students, 813 undergrads**
- **Research expenditure reached over $10 million in 2015**
- **103 awarded proposals in 2015**
- **Faculty published 69 peer-reviewed papers in scientific journals in 2015**
- **15 faculty serve as professional society fellows**
- **73,576 agricultural and biosystems extension fact sheets downloaded in 2015**

***Amy Kaleita** keeps tabs on soil moisture using sensors close to or in the ground and **Brian Hornbuckle** is doing similar work from space using satellites like the model shown. Soil moisture data is used to inform agronomic decisions like planting depth and fertilizer use.*

SOIL TO SPACE

CAPTURING TOP QUALITY DATA

Story by Ed Adcock
Image by Christopher Gannon

Amy Kaleita, associate professor of agricultural and biosystems engineering, has many reasons for working with remote sensing.

"I got into sensors because I think they're cool and fun," she says, "but also as a graduate student I did enough field work by hand that I thought, we'd never be able to answer these big questions this way because it's so time consuming and so resource intensive to collect high quality data on the ground with traditional techniques."

A good deal of her research deals with keeping tabs on soil moisture using sensors close to or in the ground. Brian Hornbuckle, a research partner and an associate professor of agronomy, is doing similar work from space using satellites.

Getting better data on soil moisture would benefit producers in many ways, they say.

"If you understand soil moisture, you can integrate that information into decision-making tools and ecosystem and hydrology models to help understand the ripple effects of those properties," she says.

Getting a better handle on soil moisture also would give scientists a way to track water and what might be carried with it, such as plant nutrients. Hornbuckle says weather and crop forecasting could be improved with more accurate and timely moisture data.

"This is a big weakness in weather forecasting," he says. "We're hoping after we have good measurements of soil moisture we'll be able to model this effect better and have better forecasts, not just next week or next month but the next growing season."

Weather forecasters are interested in county-level data, but producers would like it closer to home. The advantage of satellites is the information is consistent and is collected every other day around the globe. A disadvantage is just one value represents the average conditions over a large area, sometimes as large as a typical Iowa county.

Hornbuckle's team is trying to increase the accuracy of the NASA and European Space Agency satellites, which are reading soil drier than what ground sensors are measuring.

After they correct the readings, they can deliver the data to Kaleita to "disaggregate" using her ground-based sensors that breaks down the data to a scale that is useful to producers.

She says farmers could take the soil moisture data and combine it with other information they are getting to track the behaviors of their fields. They might use it to adjust planting depth to put the seed where moisture and temperature are optimal. If there is an area of the field where water moves through quickly, they could adjust fertilizer to account for potential losses.

"We have the technology to vary the management across a field, but what is often lacking is the data that would support setting those rates at different levels in different locations in the field," Kaleita says. S

MODELING YIELD SUCCESS

Story by Grant Wall
Image by Christopher Gannon

Crop simulation models are computerized tools that integrate agronomic knowledge and can be used to answer questions farmers have about their field: How much water is in the ground? Does the field have enough nitrogen? What are yields going to look like? Crop modeling systems can help farmers predict those answers.

A new, web-based modeling tool developed by Iowa State University agronomists provides real-time information on weather, water, nitrogen, crops and staging. Sotirios Archontoulis, assistant professor, and Mark Licht, assistant professor and extension cropping systems agronomist, in collaboration with other faculty and staff, created the Forecast and Assessment of Cropping sysTemS (FACTS) web platform to assist growers with management decisions.

"The ability of the models to address practical problems is growing rapidly," says Archontoulis. "The next challenge to model application across different regions and cropping systems is to determine their prediction accuracy and improve the science behind the models."

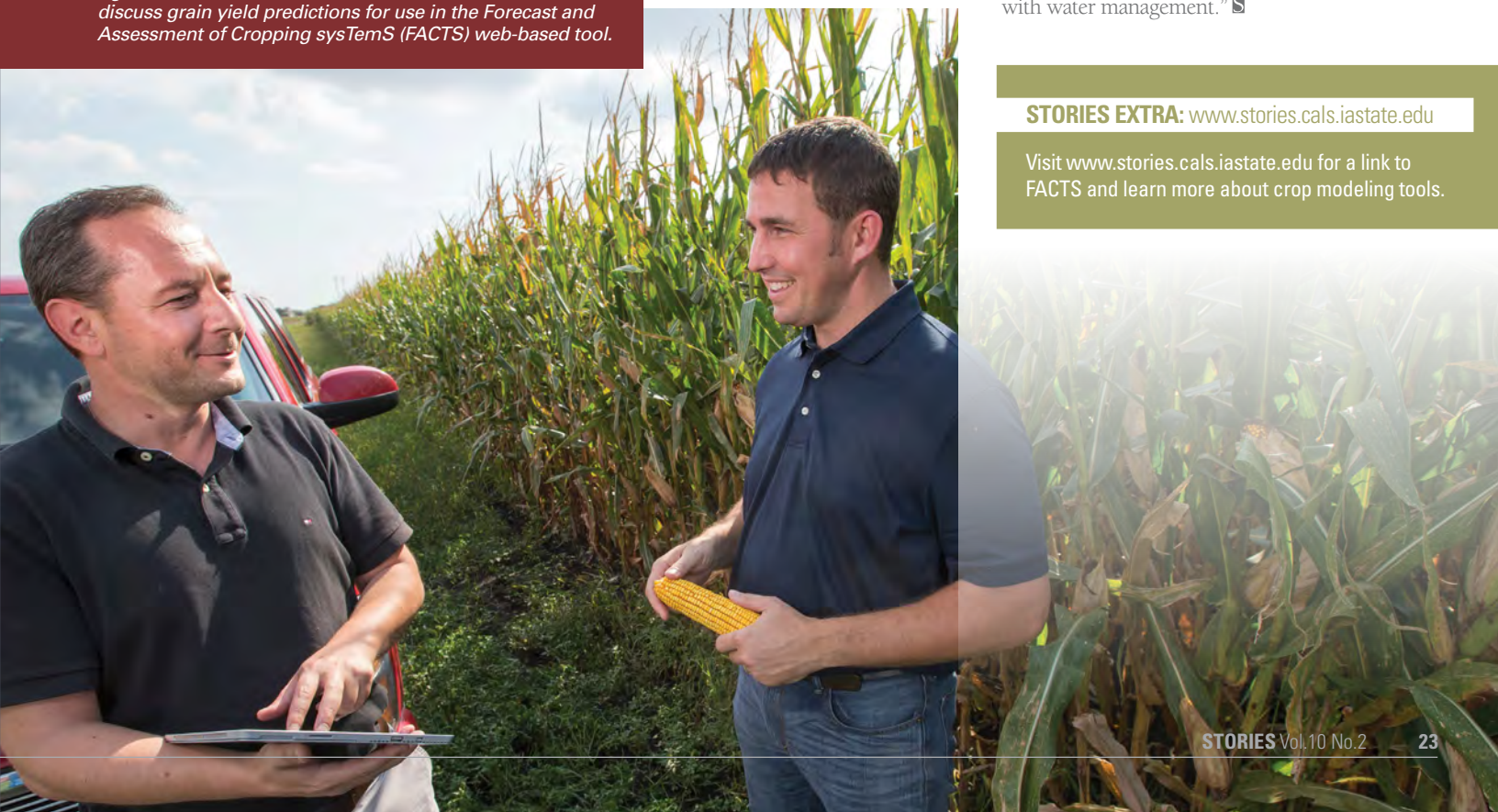
Licht says while modeling is widely available and has been reliably tested by both private companies and research institutions like Iowa State, the use of models is just now gaining traction among farmers, like Rod Pierce of Boone County.

"Crop modeling helps me monitor soil water availability and nitrates in the soil to determine the amount and depth of the nitrates. It also shows when the nitrogen is taken up and at what rate per day. This helps me plan my nitrogen applications as close to the plant needs as possible to limit losses," Pierce says. "The yield prediction model through FACTS is a big help in determining how many bushels I have to sell during the April through June time period. This strategy has allowed me to lock in some of the higher prices for the year. This amounts to hundreds of thousands of dollars in extra crop revenue."

Researchers are getting closer to being able to implement specific field management changes during the season thanks to information provided by crop models. Monitoring and controlling the application of nitrogen onto the field can help control the amount of nutrients lost from those fields.

"We have an idea of how much nitrogen a plant has taken up, how much the soil has mineralized and how much is still available," says Licht. "We can get out into the field with additional side dress applications if we think we are going to be short on nitrogen. We are on the cusp of getting to that point of in-season adaptive management. The same thing can also be done with water management."

*Agronomists **Sotirios Archontoulis** (left) and **Mark Licht** discuss grain yield predictions for use in the Forecast and Assessment of Cropping sysTemS (FACTS) web-based tool.*



STORIES EXTRA: www.stories.cals.iastate.edu

Visit www.stories.cals.iastate.edu for a link to FACTS and learn more about crop modeling tools.

Story by Ed Adcock
Image by Christopher Gannon

MONITORING ANIMAL HEALTH

Researchers are using remote sensing technologies to increase the health and efficiency of livestock production. One of the studies involved tracking chickens to get a sense of the basics for potential cage-free production.

***Hongwei Xin** (pictured), director of the Egg Industry Center and distinguished professor in agricultural and biosystems engineering, works with **Lie Tang**, an associate professor in agricultural and biosystems engineering, to use remote sensing to monitor the behavior of chickens.*

How many feeders to provide a cage-free flock is one of the many production questions that need answering, says Hongwei Xin, director of the Egg Industry Center and distinguished professor in agricultural and biosystems engineering. A remote sensing study sought to shed some light on the question by tagging the chickens and monitoring their actions.

"We wanted to understand the chicken's behavior. If given the choice in a given environment, what would the chicken do? And what would the chicken do if you had a different stocking density," he says.

He and Lie Tang, an associate professor in agricultural and biosystems engineering who specializes in agricultural automation and robotics, monitored the cage-free flock, measuring factors including feed efficiency, indoor environment, egg production and mortality.

A transponder on the chickens' legs was tracked using an antenna embedded in the floor. The system was combined with a 3D camera allowing them to see and record how the chickens moved. Tang says they found individual chickens in the cage-free setting exhibit dynamic movement and other behaviors.

"Bio-energetic information was assessed to provide the foundation for future design in cage-free, or as we call them alternative housing systems, because they are so new. We also wanted to see how much feeder space is adequate," Xin says.

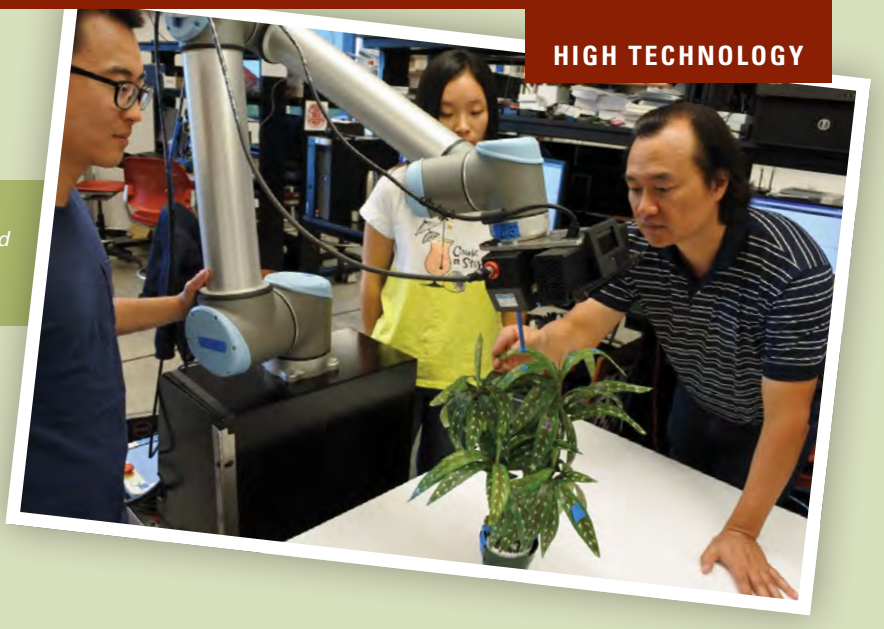
Feed efficiency suffered because the chickens were more active. The study found from 10 to 25 percent more feed is needed for the same production. They are using the same system to see if different lighting makes them less active.

Xin foresees a time when robots might act as an electronic stockman.

Robots could be sent into flocks of broiler chickens to get the birds up to exercise, look for health problems and remove carcasses.

Xin says a new study he is leading with Anna Johnson, associate professor of animal science, and Tami Brown-Brandl, an agricultural engineer with the USDA Meat Animal Research Center, will use remote sensing to determine if the size of swine farrowing crates needs to be changed for the health of the animals.

"We've been using 5 by 7-feet farrowing crates since the 1950s. The sows are getting bigger and the litters are getting bigger. The question is, what is the proper size to accommodate today's sow and litter," he says.



*This robot, created by **Lie Tang** (right) and his team, roves among growth chambers to collect data on plant characteristics in a controlled environment known as the Enviratron. Graduate students **Yin Bao** (left) and **Zhao Yang** assist Tang.*

Story and image by Ed Adcock

CREATING NEW WORLDS TO STUDY PLANT LIFE

The name could be from Star Trek.

"Step into the Enviratron," Mr. Spock might say, "and be transported to the environment of your choosing."

In a way, that's how it will work—for plants.

It's a concept that's never been done before. Scientists and technicians are still putting the pieces together for a series of plant growth chambers located in a building at Iowa State's Agricultural Engineering Agronomy Farm.

Steve Whitham, a professor of plant pathology and microbiology, is co-leading the project that will automate phenotyping. In this instance, phenotyping is measuring plant characteristics that might be of interest biologically or from a production standpoint—for example the shape of a plant, its response to temperature and other variables.

There are other automated phenotyping facilities around the world, but the plants are grown in one area, then moved to the instruments that take the measurements. That arrangement has a couple of disadvantages: the plants are likely grown under similar conditions, and the movement could be considered an experimental treatment.

"With the Enviratron, we have eight growth chambers, and you could set each one with a different set of environmental conditions—vary light, carbon dioxide, humidity, water or nutrients," he says. "So in one experiment I could have eight different environmental conditions running at once. The other aspect is we have the rover that moves between chambers instead of the plants coming to the instruments. Plants stay in the chamber eliminating the movement treatment and minimizing environmental fluctuations."

The design of the growth chambers is one of many challenges involved in the facility. Percival Scientific in Perry, Iowa, is developing the one-of-a-kind chambers.

The project is one of the multi-disciplinary efforts for which Iowa State is known. Each of the co-principle investigators serve unique roles: Steve Howell, distinguished professor in genetics, development and cell biology, is the project manager; Carolyn Lawrence-Dill, genetics, development and cell biology associate professor (see page 12), is in charge of data management; and Thomas Lubberstedt, agronomy professor, is on the management team.

One of the main challenges is the robotic rover, which is being designed by a team led by co-principle investigator Lie Tang, an associate professor of agricultural and biosystems engineering.

"You can observe and measure phenotype, but it has been mostly done manually," Tang says. "We see more and more automated applications to help scientists collect data. With the Enviratron we can probe the plant with very high precision using the robotic arm's advanced imaging and sensors."

Designing the one-of-a-kind robotic rover involves both hardware and software, requiring a team with backgrounds in computer, electrical and agricultural engineering, computer sciences and the plant sciences.

"Part of the challenge is that biological objects are so complex, they grow and develop so your robot needs to be able to adapt," he says.

The project is being funded by a three-year National Science Foundation grant.

Perhaps as early as next year, what sounds like science fiction could be providing breakthroughs for Iowa State University researchers. S

G2F

GENOMES TO FIELDS

Story by Ed Adcock
Images by Patrick S. Schnable

When Pat Schnable and his colleagues finished sequencing the corn genome in 2009 it turned out to be just the start for plant geneticists. Having the "blueprint" of the corn plant showed what genes are there, but scientists didn't always know what most genes did.

"It wasn't a sufficient end goal for what society or what the corn growers of Iowa and the world needed," he says. "They really want to understand how to convert that blueprint into actionable items for out in the field."

The Genomes to Fields Initiative co-led by Iowa State's Pat Schnable, studies the corn genotype and how it interacts with the environment. Researchers use computerized cameras to detect differences in plant characteristics.

That's the idea behind the Genomes to Fields (G2F) initiative he is co-leading with Natalia de Leon, an agronomist at the University of Wisconsin.

Schnable is a C.F. Curtiss Distinguished Professor, Iowa Corn Endowed Chair in Genetics and Baker Scholar of Agricultural Entrepreneurship at Iowa State.

Schnable also serves as director of the Plant Sciences Institute and the Center for Plant Genomics.

G2F seeks to understand the role of the corn genotype and how it interacts with the environment well enough so scientists can actually predict how the plants will grow and develop. The concept is called predictive phenomics.

It is data-driven research that collects a lot of information and looks for interesting patterns, he says, instead of testing a hypothesis.

The key is having hundreds of varieties of corn growing in dozens of environments and monitoring the plants' characteristics while they develop. Researchers are hoping to automate that process. Last year, they photographed hundreds of hybrids with computerized cameras every 10 minutes at 24 locations across the country. Schnable and his team hope to implement the technology in the G2F project in the future.

"This allows us to watch plants go through their development, and because each genotype is different we can look at the differences in the phenotypes, or their characteristics," he says.

Members of the Schnable Lab operate an unmanned aerial vehicle by remote control while collecting trait data.

Accurate models of phenotypes would improve the ability to select the best plants for plant breeding programs, Schnable says. If breeders can do a better job predicting, then they can focus on the best lines and don't have to field test these lines in so many environments—the expensive and time consuming part of plant breeding.

"That means you should do a better job of finding the winners," he says.

And farmers could benefit directly from the discoveries.

"If we understand this really well, we can give farmers evidence-based recommendations—which varieties to grow, in which fields and under what management conditions," Schnable says.

Another benefit of the project has been the collaboration of a creative mix of disciplines, from agronomy to engineering to statistics.

"Iowa State has always been at the forefront of these interdisciplinary, multi-disciplinary collaborations, but in the last few years the scale of that on campus has increased," he says. "The multi-state aspect of the Genomes to Fields Initiative brings a new dimension to this research."

*Students in the Laboratory Methods in Animal Reproduction course get a detailed look at cattle reproductive physiology thanks to a new ultrasound machine operated by veterinarian **Jessie Juarez**. **Professor Curt Youngs** says the state-of-the-art unit will improve undergraduate instruction and research.*

ULTRASOUND UPGRADE BOOSTS STUDENT LEARNING

Story by Melea Reicks Licht
Image by Christopher Gannon

A recent upgrade to ultrasound technology used in animal science teaching at Iowa State University puts advanced imaging in the palm of students' hands.

"Upgrading to this new ultrasound device is like going from a flip phone to an iPhone," says Jessie Juarez ('10 animal science and dairy science, MS '12, DVM '14), a lecturer in animal science anatomy and physiology.

The ultrasound unit—an Ibex EVO—is a collaborative purchase involving colleagues from animal science with research, teaching and extension appointments.

Curt Youngs, professor of animal science, says the new unit will not only add value to animal reproductive physiology courses but also improve hands-on learning in beef science, dairy science and small ruminant courses.

"We've used ultrasound technology for decades for teaching. It uses sound waves, not harmful radiation, and is a safe and effective tool allowing students to see inside an animal's body without any kind of surgery," Youngs says.

Features of the new ultrasound machine make it easier to use and share images for teaching, according to Juarez and Youngs.

"The unit's battery pack makes the machine portable. It can capture thousands of images and video and transfer the images wirelessly to student devices. Students can view the images in real time on their personal tablets or smartphones," says Youngs.

Students can review archived images on Iowa State's online learning program. The ultrasound system also includes a voice tag feature allowing instructors to record a short voice message to playback when the image is viewed.

"By reviewing these images students are exposed to technology commonly used in industry," Juarez says. "They can learn the economic value of pregnancy testing and finding out if an animal needs to be rebred. They can focus on the health and wellbeing of pregnant animals."

Youngs says the technology will be especially useful for research underway at the Iowa State University dairy farm. The project compares different injection sites and evaluates the efficacy of two new reproductive hormones recently approved by the U.S. Food and Drug Administration for synchronization of ovulation.

"This research has been student-driven from day one. Shelby Patten ('16 dairy science) was the impetus for this project. She launched the research as a one-semester independent study research project, and it grew into a longer trial involving more undergraduate and graduate students," says Youngs.

Cassie Krebill, a junior in dairy science involved with the research, says the technology is enhancing her learning and problem-solving skills.

"The equipment allows me to compare images and make conclusions and observations ranging from cysts, twins and many other possibilities," Krebill says. "It's rewarding because I get to use results from the ultrasound monitor and apply classroom knowledge to reach the end goal of a healthy pregnancy."

INNOV

THEIR WAY TO THE TOP WITH TECH

Story by Lynn Laws
Images contributed

In 2015, the American Farm Bureau (AFB) held its first Rural Entrepreneurship Challenge—a shark-tank style, national competition where food and agriculture entrepreneurs pitch their ideas to a panel of experts for the chance to win up to $30,000. Iowa State alumni and former students of Iowa State's Agriculture Entrepreneurship Initiative (AgEI) took first place in 2015 and again in 2016. AgEI empowers students to start their own businesses through courses and entrepreneurial experiences.

Both AFB winners began developing their technology ideas during the Entrepreneurship in Agriculture class, and further developed the technologies with support from the AgEI program and other programs and expertise at Iowa State.

"The idea of measuring grain in real time first came to me when I was in high school and working the grain trucks on our family farm. I didn't have a lot of experience loading trucks and I was afraid I would overload it and we'd get a DOT (Department of Transportation) fine, or I'd underload it and feel like I didn't maximize the truck. I thought there should be a way to measure the grain coming out of the bin and into the truck versus needing a full truck scale, which our farm didn't have," says Ryan Augustine ('12 agricultural studies), founder of AccuGrain and the 2016 AFB challenge winner.

> ***"Entrepreneurs don't have to be the technology experts; they just have to be able to work effectively with a scientist to take new technology out into the world. "***

That idea came back to him in an AgEI class when asked to develop a business concept and business plan. A class assignment was to look at university technologies available for licensing. He found Iowa State physicist and adjunct associate professor Joseph Gray (retired) and a Ph.D. student, Feyzi Inanc, had patented position-sensitive x-ray technology. Augustine contacted Gray and a collaboration grew that still exists today. Between Augustine's business acumen and farming experience and Gray's technology, AccuGrain was launched. The technology uses a position-sensitive x-ray to measure flowing grain.

Kevin Kimle, AgEI director and Rastetter Endowed Chair in Agricultural Entrepreneurship, describes Augustine as "an exceptionally gifted entrepreneur with utter persistence and a hard worker."

"Entrepreneurs don't have to be the technology experts; they just have to be able to work effectively with a scientist to take new technology out into the world," says Kimle.

Gray agrees.

"In the technology transfer world, you have to have someone like Ryan who is going to take it out of the university or research environment and move it into a commercial environment," says Gray.

Michael Koenig ('12 agricultural education) and Stuart McCulloh ('13 agricultural education) won the 2015 AFB Challenge for their business, ScoutPro, which provides mobile apps to facilitate the process of crop scouting. Crop scouting involves walking fields to assess and record crop conditions such as insect infestations, weeds and disease.

During an AgEI class, Koenig and McCulloh, and a third partner, Holden Nyhus ('13 agricultural education), teamed-up to develop their business concepts. They had been crop-scouting interns and were required to carry a lot

VATING

*Agricultural education grads **Stuart McCulloh** (left), **Holden Nyhus** and **Michael Koenig** (right) developed ScoutPro, a mobile app for use in crop scouting, as part of their experience in the college's Agriculture Entrepreneurship Initiative. ScoutPro won the 2015 American Farm Bureau Rural Entrepreneurship Challenge.*

***Ryan Augustine**, an agricultural studies alum, worked with other Iowa Staters to use position-sensitive x-ray technology to measure flowing grain. The entrepreneurship class project went on to win the 2016 American Farm Bureau Rural Entrepreneurship Challenge.*

of resources into the field, including three Iowa State extension pocket guides to identify pests, weeds and diseases.

"We wanted to create something that allowed you to get through the field quickly and was less cumbersome," says Koenig.

They came up with the idea of an app for a mobile device that could use information from university extension crop guides for pest identification; use GPS on the device to draw maps and clearly identify the location of pests within a field; and link all of that information to build reports to assess the effectiveness of prevention and treatment measures.

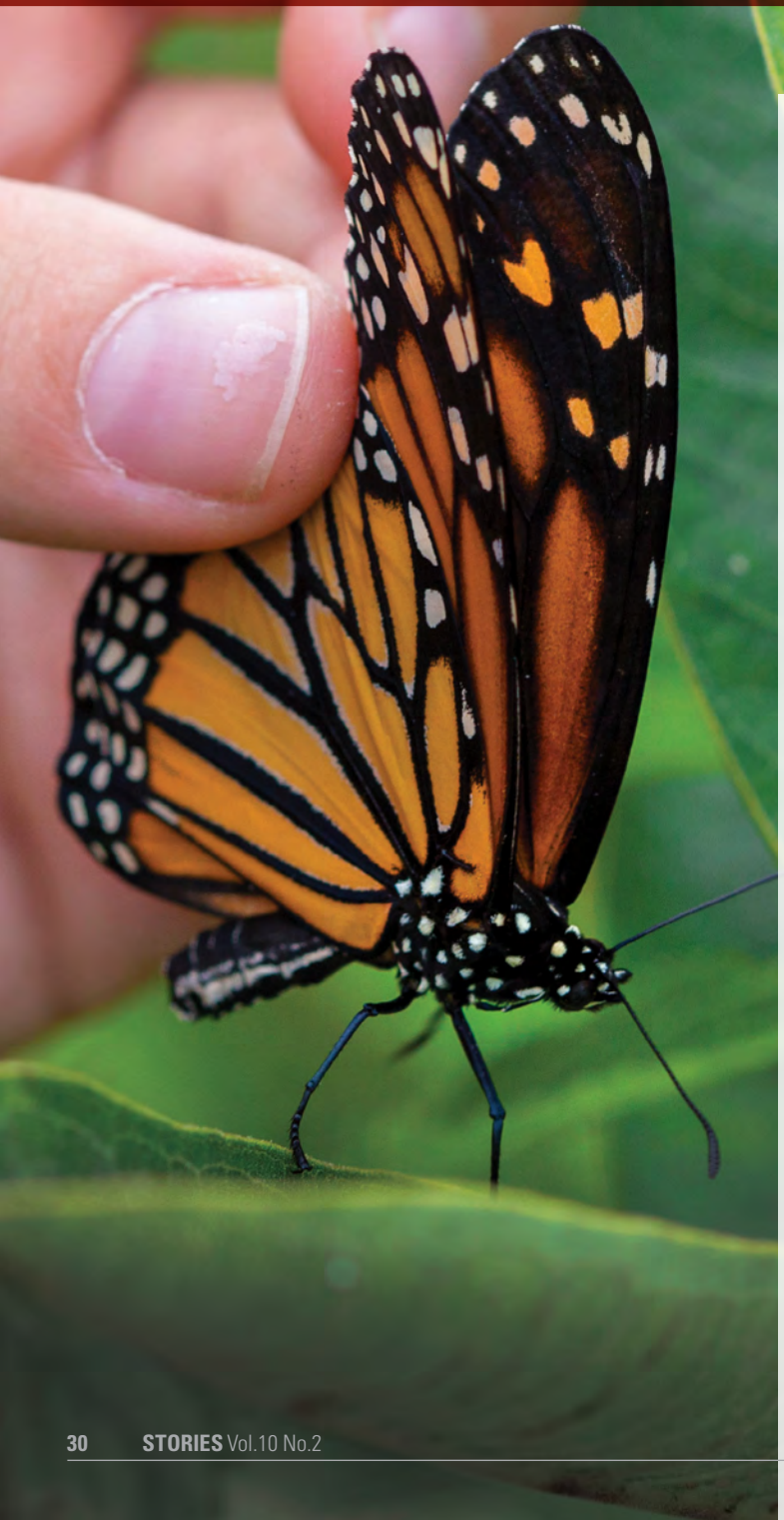
They formed a partnership with Iowa State Extension and Outreach working with Daren Mueller, assistant professor of plant pathology and microbiology and coauthor of Iowa State's corn and soybean scouting guides. The AgEI's Student Business Incubator program helped them develop business concepts and move towards launch. The program helped them meet and work with fellow Iowa Staters Sudheer Pamuru, an app developer, and Dan Noe, a graphic designer.

"Taking the AgEI class in our sophomore year allowed us to utilize the resources of the AgEI program, to develop the concept throughout our time at Iowa State," says McCulloh.

"The AgEI program and staff were key in driving us, especially early on," says Koenig. "We've gone from technically being interns for our own company to hiring interns out of the AgEI program to help grow our company through the skillsets they're learning."

MILKWEED, MONARCHS AND MODELS

Story by Lynn Laws
Images by Christopher Gannon



It is an epic journey. The monarch's annual migration over multiple generations spans from southern Canada to central Mexico. Monarch populations have been declining over the past two decades. Scientists attribute their decline to extreme climate fluctuations in North America, deforestation in Mexico and widespread loss of the milkweed plant.

Monarch butterflies only lay their eggs on the underside of milkweed leaves. When the hungry caterpillars emerge, they eat the leaves on which they were placed. While the caterpillars only eat milkweed, as butterflies they take their nourishment from the nectar of many flowers, in addition to milkweed.

Current research indicates that enhancing monarch habitat in rural landscapes in the upper Midwest could assist in stabilizing and enhancing monarch butterfly populations. But how many milkweed and nectar plants are needed? Where should they be placed on the rural landscape?

Iowa State researchers are using technology to understand how to help this iconic butterfly bounce back.

Epic flight, super computer

Tyler Grant, a postdoctoral researcher at Iowa State, is developing a unique and complex computer program to model monarch butterfly behavior in rural Iowa. Grant's model can simulate the movements of 100,000 individual butterflies at one time. It's derived from a smaller scale model created by a research team in Australia, Iowa geospatial information and the expertise of Iowa State University entomologists, ecologists and agronomists.

"Tyler's model will help us understand how different spatial arrangements of monarch habitat could influence the number of monarchs we can produce in Iowa," says Steven Bradbury, a professor in the Department of Natural Resource Ecology

***Kelsey Fisher**, a grad student in entomology, tracks the movements of monarch butterflies with radio signal receivers. The transmitters attached to the butterfly's thorax are the size of a sunflower seed, and including the three-inch antenna, weigh about half as much as the monarch.*

and Management. "To run the model we use high performance computing resources at Iowa State and a super computer at the U.S. Department of Interior."

"Using the model, we can simulate habitat changes in the landscape before we do it in the real world, to see what works to encourage an increase in monarch eggs laid in Iowa," says Grant. Preliminary results from the model suggest that 50 percent of eggs laid in Story County are laid in roadsides.

"What if we filled up all the roadsides with milkweed, or added milkweed in unused corners of fields? What if 50 percent of the gardens in Iowa had a little patch of milkweeds? We can determine what impact these changes would make," adds Grant.

Bradbury is excited about the multiple benefits he foresees. "The model could potentially be used as an online decision support tool for farmers or farm advisers. It could provide insights into which locations on his or her land would be the most beneficial for planting monarch habitat. This model could eventually be linked up with decision-support tools being developed for placement options of nutrient reduction technologies," he says.

Big movements, tiny transmitters

To enhance the model Grant is developing, Kelsey Fisher, a graduate research assistant in entomology working with Bradbury, began tracking the movements of real monarch butterflies this past July.

Fisher and three undergraduate interns, armed with radio signal receivers, placed themselves around the perimeter of a prairie approximately half the size of a football field. Before releasing a monarch butterfly in the center of the prairie, Fisher attached a transmitter—a device that emits radio signals—to the butterfly's thorax with super glue. The transmitter is the size of a sunflower seed. Together with its three-inch antenna, it weighed about half as much as the monarch.

"We used four people, in case one person missed a reading, to ensure we would get at least three points we could use to triangulate the butterfly's location. Every 60 seconds we would take a compass bearing in the direction of the loudest beep from the receiver," says Fisher. "Using those three bearings we calculate an estimated location. For each butterfly we take bearings every 60 seconds for 45 minutes, so we have 45 estimated locations which can be connected to create a path."

When monarchs leave the prairie area, they are caught in a net. After 45 minutes of triangulating its location, they remove the $180 transmitter, to be used again. So far, Fisher's team has tracked ten different monarch butterflies.

"This past summer's research was to troubleshoot our methods and make sure monarchs with transmitters attached could fly like 'untagged' butterflies," says Fisher.

Next summer, Fisher's team will scale up the research to include more complicated and larger landscapes, such as prairie next to a roadside next to a corn field.

"A lot of the fall and winter is going to be seeing how we can analyze the data we collected with different software, digesting what we've learned and seeing how we can make the research better," says Fisher.

It's groundbreaking work according to Bradbury. "The model that Tyler is working on is unique. And nobody is doing what Kelsey is doing, either," he says.

Grant's and Fisher's research will help the Iowa Monarch Conservation Consortium and the Iowa Department of Natural Resources create science-based guidelines for establishing and maintaining monarch habitat in Iowa's rural landscapes in concert with agricultural production. Bradbury anticipates that increasing monarch butterfly habitat in rural Iowa will complement current state conservation programs and reap benefits for other pollinators and soil and water conservation.

Iowa State scientists created a computer model demonstrating how enhancing monarch habitat in rural landscapes in the upper Midwest could increase monarch butterfly populations.

CALS ALUMNI, FRIENDS HONORED BY COLLEGES, ALUMNI ASSOCIATION

CALS graduates were honored by Iowa State for service to the college and agricultural and life sciences industries during Homecoming events in October.

CALS Awards

Floyd Andre Award:
Cindie (DeCoster) Luhman, ('83 animal science, '90 PhD nutritional physiology), group vice president, research and development, feed and dairy foods, Land O' Lakes, Inc.

George Washington Carver Distinguished Service Award:
Walter Hill, vice provost, Land Grant Affairs; dean, College of Agriculture, Environmental and Nutrition Sciences, Tuskegee University

Henry A. Wallace Award:
Robert E. Walton, Sr. ('61 PhD animal science), retired CEO, American Breeder Service, Agracetus

Outstanding Young Professional Award:
Nancy Bohl Bormann ('04 environmental science, ag and life sciences education), environmental services manager, agronomist, Maschhoff Environmental, Inc.

Alumni Association Awards

Outstanding Young Alumni Award:
Rachel Allbaugh ('00 animal science, '04 DVM), assistant professor, Veterinary Clinical Sciences, Iowa State University College of Veterinary Medicine

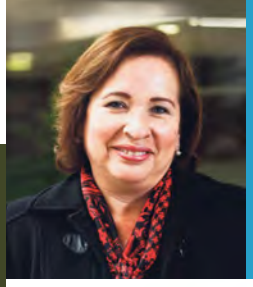
Alumni Medal:
Richard Degner ('72 ag and life sciences education, '77 MS), retired CEO, Iowa Pork Producers Association and **Nancy Degner** ('72 food science), retired executive director, Iowa Beef Industry Council

Impact Award:
CALS Jeff and Deb Hansen Agriculture Student Learning Center, **Marshall Ruble** ('78 animal science), manager

Veterinary Medicine Awards

Stange Award for Meritorious Service:
Vincent Meador ('77 bacteriology, '81 DVM, 86 MS veterinary pathology, '88 PhD), owner, Pacific Tox Path, LLC; affiliate professor, University of Washington

Stange Award for Meritorious Service:
Donald O'Connor ('69 bacteriology, '72 MS, '76 DVM), retired epidemiologist



GALARZA CONTRERAS
NAMED ENVIRONMENT MINISTER OF PERU

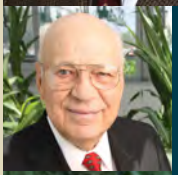
Elsa Galarza Contreras ('90 MS economics) has been appointed environment minister of Peru. She is the fourth minister of the sector and the first woman to be named to the position.

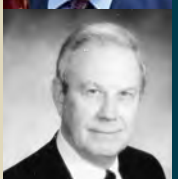
SWANSONS HONORED
AS CYCLONE FAMILY OF THE YEAR

The **Ronald** ('61 farm operation) and **Florine Swanson** ('64 home economics) family was selected as the 2015 Cyclone Family of the Year. The family includes CALS alumni: **Kendell Swanson** ('89 food technology, economics), **Stuart Swanson** ('90 ag business) and **Adelai Swanson** ('16 ag business).

HOGBERG HONORED FOR
PRESTIGIOUS SERVICE TO ANIMAL AG INDUSTRY

Maynard Hogberg ('66 ag and life sciences education, '72 MS animal science, '76 PhD), emeritus professor and former chair of the Department of Animal Science, was presented with the Saddle and Sirloin Club Portrait Award in November. The award is one of the American livestock industry's highest honors.





LIFETIME ACHIEVEMENT HONORS FOR NEWLIN, PERSINGER, SHOWERS

CALS alumni have been recognized with lifetime achievement honors from several national organizations:

Owen Newlin ('51 agronomy, '53 MS), received the American Seed Trade Association's inaugural Owen J. Newlin Lifetime Seed Industry Achievement Award.

Harlen Persinger ('67 dairy science, '72 ag journalism), received the Lifetime Achievement Award from the American Agricultural Educators Association.

William Showers ('70 PhD entomology), received the Entomological Society of America Plant-Insect Ecosystems Lifetime Achievement Award.

Q&A with Tuskegee Biotech Researcher Jacquelyn Jackson

Story by Brian Meyer
Image by Jim Heemstra

Jacquelyn Jackson (PhD '08 genetics) is a research assistant professor of molecular biology and genetics in the Department of Agricultural and Environmental Sciences at Tuskegee University.

Q: What do you hope to accomplish with your research on sweet potato?

A: Sweet potato is an important staple crop worldwide. If we can better understand how plants defend themselves against attack at the molecular level, we can possibly develop new plants with improved disease resistance and durability. Tuskegee has been creating transgenic sweet potatoes since the 1990s, so if we discover a gene that may be useful, we have the ability to transform the plant and potentially increase its disease resistance. Our group also has developed sweet potatoes with high protein content and others that express anti-cancer and anti-HIV peptides.

Q: What's the most satisfying aspect of your work?

A: One is interacting with and impacting our students. It's exciting to see several of our students heading off to graduate school, including enrolling at Iowa State. A second thing that's exciting is traveling internationally and getting to teach and train others in biotechnology. It was extremely rewarding to see how tissue culture techniques I use in the lab directly impact food security in a positive way. I've been to Bangladesh and Ghana to train students and lab workers in the research techniques they'll use to develop crops less burdened by diseases and that yield more.

Q: How did your experience at Iowa State influence your career?

A: I love Iowa State University and try to get to Iowa every chance I can; it's like a second home for me. I loved my adviser, Dr. Allen Miller (professor of plant pathology and microbiology) and my lab mates. The camaraderie, the atmosphere, the freedom to learn—you just felt stimulated to think. I appreciated the integrity, the standard and the quality he brought to our research. I know now it's more easily said than done, but I'll keep trying to follow his example. I feel that I spend most of my time teaching and training these days than doing research, but the influence of Iowa State's excellence is always there and on display.

Q: Who inspires you from the history of agriculture?

A: Of course I'm going to say George Washington Carver, but maybe not for the reasons many choose. I'm a religious person and I admire how Carver didn't let science squash his faith. It helps me understand that I can hold on to my faith and be successful in science as well. Carver also was so humble and dedicated in the work he did for his people. For him to leave Iowa State and the opportunities he had there, and instead come South when racial tensions and threats were part of everyday life—he let his service to the poor and the struggling farmers of Alabama drive him. He left a tremendous legacy.

UNIFYING THE VOICE OF AMERICA'S FARMERS

Story by Melea Reicks Licht
Images contributed

During his 30 years serving farmers in agricultural policy and economic and trade development, Chris Novak says he's seen a fundamental shift in how farmers perceive themselves.

"Today farmers produce food for consumers, not just commodities" Novak says. "Consumers have a stronger need and desire to know where and how their food was produced. The challenge is still fairly new for us. Farmers aren't the first to jump on Instagram to tell their stories to urban neighbors and friends."

Novak ('87 public service and administration in agriculture) is the chief executive officer at the National Corn Growers Association, a member of the U.S. Farmers and Ranchers Alliance (USFRA).

Randy Krotz, chief executive officer for USFRA, says there is no better advocate for agriculture than Novak.

"His commitment goes back to day one—he was one of the original thought leaders who created USFRA in 2010. He and four or five other commodity leaders decided it was time for the industry to come together and speak in one voice to consumers," Krotz says.

USFRA consists of about 100 farmer and rancher led organizations and agricultural partners working to engage in dialogue with consumers who have questions about how today's food is grown and raised. USFRA's mission declares its commitment to increasing confidence and trust in modern agriculture. Novak chairs the alliance's advisory council, which focuses on business development, fundraising and building alliance partnerships.

"My peers and I realized this wasn't a corn or soy issue. It wasn't a rice, cotton or pork issue. We were facing these issues

*As CEO of the National Corn Growers Association, a member of the U.S. Farmers and Ranchers Alliance, **Chris Novak** advocates for modern agriculture and the need for greater investment in agricultural research.*

> ***"From my grandfather's horses and wagons, to two-cylinder tractors, to today's auto-steered, GPS, computer-controlled tractors, the common denominator in technological advancement has been the research and analysis coming from land-grant universities like Iowa State University."***

alone, but we came to the realization that we would be stronger together. It's in all of our interests to work together to ensure we are talking to consumers in venues where they are looking and listening and in a language they can understand," Novak says.

It's a mission that's a calling of sorts for Novak. He first joined the agricultural policy and advocacy arena as an Iowa State student interning in Sen. Charles Grassley's office during his final semester of college in 1987.

"My PSA (public service and administration in agriculture) training was perfect for looking at the human side of the equation and understanding the politics and competing factors behind agriculture and environmental policy," he says.

From Capitol Hill, Novak's career moved to farm organizations and agribusinesses serving in the areas of farm policy, environmental services, trade, science communication and biotechnology. He joined the National Corn Growers in October 2014, after six years as CEO of the National Pork Board. Before his work with the Pork Board he served as executive director of the Indiana Soybean Alliance, the Indiana Corn Marketing Council and the Indiana Corn Growers Association. He also spent three years with Syngenta as manager of science communication. He completed his law degree at the University of Iowa and a master's in business administration from Purdue University.

Novak identifies two main priorities for commodity organizations.

"One, engage in international trade discussions at a federal level to ensure farmers' access to foreign markets. Two, tell agriculture's story. Companies are making decisions about how they market products to consumers, and these decisions impact how consumers feel crops and livestock on our farms should be produced. The challenge is to help these companies make informed decisions."

When Novak thinks of his family farm near Marion, Iowa, where he grew up and his father still lives, he marvels at the technological advancements those fields have seen.

"From my grandfather's horses and wagons, to two-cylinder tractors, to today's auto-steered, GPS, computer-controlled tractors, the common denominator in technological advancement has been the research and analysis coming from land-grant universities like Iowa State University," Novak says.

The industry needs sound science to meet agriculture's future challenges and to inform consumers and companies that market to consumers, says Novak.

"It is fundamental that we ensure infrastructure on campuses and research funding for the next generation of scientists," he says. "We need to look at ag research and how we can raise its prominence in the next Farm Bill."

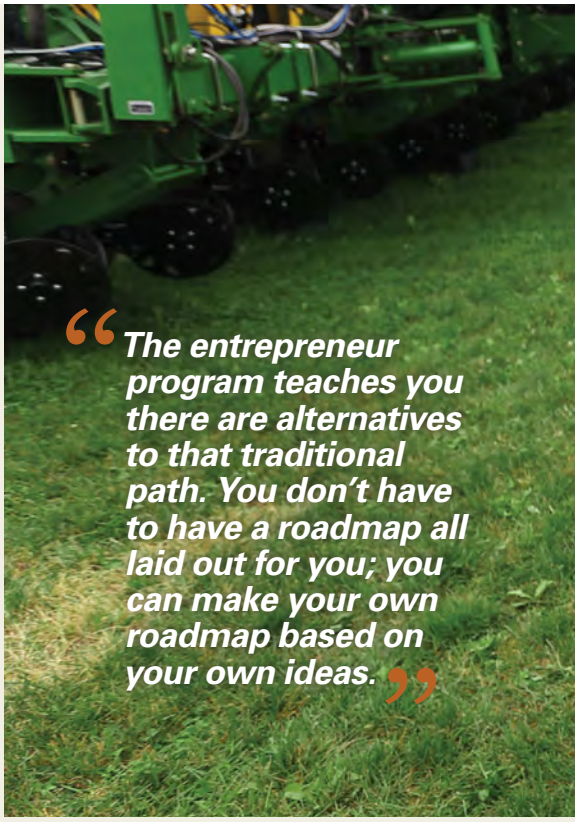
Novak is part of a national effort, led by Iowa State University's Wendy Wintersteen, endowed dean of the College of Agriculture and Life Sciences, to raise the profile of agricultural research funding.

Together they co-chaired a roundtable meeting of leaders of national agricultural commodity organizations in November in Washington D.C. The meeting is one of a series of national discussions on the topic of exploring a unifying message to make federal investment in food, agriculture and natural resources research a higher priority.

Since 2011, USFRA has been working to build trust in American agriculture by understanding the perceptions of consumers and influencers about how food is grown and raised. Each year, with checkoff support from various commodities, they have conducted in-depth research to achieve this goal.

TACKLING PRODUCTION PROBLEMS WITH TECHNOLOGY

Story by Lynn Laws
Images by Christopher Gannon



Colin Hurd noticed a problem. It was June of 2010 and he was working for Summit Farms in Alden, Iowa, as an intern following his freshman year at Iowa State.

“I was running a sprayer. I noticed the corn was yellower and shorter where the planter tires had been during planting,” says Hurd.

Soil compaction, which can be caused by large row planters, reduces air, nutrients and water to plant roots, restricting root development and ultimately yield.

Hurd (’13 agricultural studies) thought of those yellow leaves again that fall while participating in the Entrepreneurship in Agriculture course at Iowa State University. Students in the course were asked to develop an original business concept that solved a problem. Hurd’s idea was to attach a tillage implement behind planter tires that would break up soil compaction as they moved through fields.

“I thought if I could get a ballpark figure of how much yield is lost because of the planter weight, then I should be able to put together a spreadsheet and make a compelling business pitch,” says Hurd.

His in-class pitch presented to a panel of experts won him one of three scholarships to be used to further develop business concepts.

Over a period of two years, Hurd experimented with old tillage parts; worked with an engineer, Kyle Meyer (’05 agricultural studies), to create a design; established the corporation Agricultural Concepts; pursued marketing and distribution strategies; and had the final design tested through Iowa State University Extension and Outreach.

The research showed Hurd’s invention, TrackTill, increased yield in the center rows by eight bushels.

“That was a very important number,” says Hurd. “It meant the average farmer could look at TrackTill as an investment in yield and expect a payback within two years. That’s pretty significant.”

TrackTill was released in January 2014. By the spring of 2015, 60 people across the country, from Delaware to Kansas, were using TrackTill. Yetter Co. was interested in licensing it and had a national sales and distribution network. Hurd was certain they could get it to market a lot faster and could likely lower the price.

“The ultimate goal I always had for TrackTill was to make it acceptable and valuable to as many farms as possible and licensing it to Yetter was the best option for doing that,” says Hurd. He licensed it to Yetter Co. that spring.

By November 2015, Hurd had established his second business, called Smart Ag.

While working with TrackTill customers, he noticed how confined they were to short windows of time to plant and to harvest, and how difficult it is to find farm laborers during those windows.

“It was a real eye-opener for me,” says Hurd. “It led me to the conclusion that automation is the logical next step for farmers to improve their efficiency.”

This fall, Smart Ag began in-field tests on new hardware and software that will allow a combine operator to have full control of an unmanned grain cart. The operator will be able to move the grain cart adjacent to the combine for loading, then to an unloading area and, later, a staging area.

“It can work on any brand of equipment or combination of brands. It’s a very simple plug and play style system that no one

***Colin Hurd** has a knack for creating businesses to address crop production problems using technology. His first, TrackTill—an implement that attaches behind planter tires to break up soil compaction—started as a class project in the college's Agricultural Entrepreneurship Initiative.*

has developed or been able to bring to market," says Hurd. "We are focused first on providing a simple, reliable system that will work well in a variety of situations. Then working with our first customers to add more features to optimize their grain cart's performance based on a variety of variables and goals such as compaction control, multi-combine operations and preferred unloading and loading patterns in each field."

The system's online software will allow farmers to load in their field boundaries, navigate around unharvested crops or inner boundaries automatically, show a real-time map of the field on any internet connected device and receive notifications of obstacles or errors remotely. It will also have real-time obstacle avoidance built in.

Hurd says his Iowa State courses widened his perspective on agriculture and allowed him to find out what he enjoyed doing.

"I was really drawn to the business side of agriculture. And then the ag entrepreneur program broadened my perspective of what it means to work in business," says Hurd. "People sometimes think that going into business means you're going to go get a job with a major corporation and work your way up the ladder. But the entrepreneur program teaches you there are alternatives to that traditional path. You don't have to have a roadmap all laid out for you; you can make your own roadmap based on your own ideas."

Kevin Kimle is the director of the Agricultural Entrepreneurship Initiative and teaches the Entrepreneurship in Agriculture course. "Colin is fantastically creative and able to look at the future of agriculture and come up with very practical, but cutting edge innovations. He's definitely a guy to keep an eye on," says Kimle.

Hurd says he'll continue to grow his business in Ames, Iowa. "At Smart Ag we're always looking at ways we can use technology to solve problems on the farm."

REACHING FOR THE SKY

HRUBES' SPIRIT OF SERVICE, LEADERSHIP REMEMBERED

Story by Melea Reicks Licht
Images by Barbara McBreen, Melea Reicks Licht, Amy Brandau, contributed

*Agricultural business alum **Ryan Hrubes** was known for his spirit of service and leadership. His wife Emily says he demonstrated this "through his love to many, how he advocated for agriculture, his engagement in the community and his commitment to being a lifelong learner."*

Ryan Hrubes ('10 agricultural business) met his wife Emily Chappie at a National Agri-Marketing Association (NAMA) meeting while they were both undergraduates—he at Iowa State University, she at The Ohio State University.

They would cross paths three more times in three different states neither of them lived in.

"It was a God thing," says Emily.

In time, their friendship led to a marriage proposal.

Ryan was a sales representative for Dow AgroSciences. Emily worked for Union Pacific Railroad as a business manager. As newlyweds, the two were active in their church and community at Calvary Omaha Church in Omaha. Ryan was treasurer for Young Professionals in Agriculture, Nebraska and Southeast Iowa Chapter. They both were active in Agriculture Future of America (AFA), a nationally recognized leadership and career development organization they participated in as college students.

On August 20, 2015, Ryan, Emily and their friends and mentors Rev. Ty Schenzel and his wife Terri were involved in an automobile accident.

Emily was the only survivor.

"Ryan was a man of character, service and passion. He loved the Lord greatly and because of his faith he believed in our individual responsibility not to be served, but to serve. Ryan demonstrated this through his love to many, how he advocated for agriculture, his engagement in the community and his commitment to being a lifelong learner," says Emily.

Investing in people

In November 2015, Emily, Ryan's sister Andrea and his brother Nathan announced plans to remember Ryan to 1,000 guests at the AFA Leader in Agriculture Award Dinner. The Ryan Hrubes Memorial Scholarship for Leadership in Agriculture at Iowa State would provide academic support and financial support for a student to attend AFA. Also, AFA would create a lifelong learner scholarship in Ryan's name

A buckeye tree donated in Hrubes' memory by The Ohio State University College of Food, Agricultural, and Environmental Sciences was planted near Curtiss Hall. **Mike Gaul** (left), director of career services, met Ryan's brothers **Brandon** (second from left) and **Nathan** (right) and scholarship recipient **Joni Erwin** to watch the planting.

Joni Erwin (center), a senior in agricultural business, poses with the Hrubes family at the Agricultural Business Club Banquet after receiving the Ryan Hrubes memorial scholarship. From left: **Nathan Hrubes**, **Dennis Hrubes**, **Emily Hrubes**, **Erwin**, **Barbara Hrubes**, **Brandon Hrubes** ('05 agricultural business and economics) and **Kelsey Smith**.

to be awarded to students based on service and dedication to self-improvement.

Emily told the AFA participants: "Serve your neighbor. Stand up for what you believe in. Never stop learning."

They gave her a standing ovation.

Mike Gaul ('86 MS horticulture), director of Career Services in the College of Agriculture and Life Sciences, administers Ryan's memorial scholarship, which includes a cash stipend and sponsorship to AFA.

"Ryan's life balance of family, faith, community, friends and work was to be envied and only adds to his legacy as a quality individual," Gaul says.

Throughout his four years at Iowa State Ryan worked for Gaul in the college's career services office. He was a member of the Agricultural Business Club, NAMA, VEISHEA and AFA. He completed six internships, including an internship in Brazil. He also studied abroad in Australia, Germany and Malaysia.

The first recipient of Hrubes scholarship, Joni Erwin, exemplifies many of the same attributes Ryan possessed.

Erwin is a senior in agricultural business from Crawfordsville, Iowa. Erwin is president of the Agricultural Business Club, a College of Agriculture and Life Sciences student ambassador and a member of NAMA, the Agricultural Marketing and Management Organization, Alpha Zeta and Cardinal Key. She's participated in three study abroad programs and completed internships in crop scouting, marketing and sales. Erwin is a recipient of the Fred Foreman Scholarship for Growth in Leadership Participation and is in the fourth track of AFA's leadership development program.

"My leadership skills have benefitted greatly from these positions. I've learned so much about leading an organization, collaborating with other student leaders and serving as a mentor to my peers. I strive to get others involved and encourage them to develop as leaders and professionals," Erwin says. "It is such an honor to receive this scholarship in memory of Ryan."

"It's a privilege to support future leaders like Joni. I know Ryan would be proud of this," Emily says. "One of the reasons it was so important was that Ryan and I had creating scholarships at Ohio State and Iowa State on our bucket list."

Iowa State grown Buckeye

Emily and Ryan's story also touched colleagues at Emily's alma mater.

Jill Arnett, program manager of The Ohio State University College of Food, Agricultural and Environmental Sciences Office of Prospective Student Services, says the college's ambassador team wanted to support Emily and "pay it forward" in offering a living memorial for Ryan—a tree planting at Iowa State.

"By planting a buckeye tree we hope it provides a positive impact for all who see it, even if they don't know why it is planted. Emily focused on impacting as many people as possible at Ohio State. We hope this tree continues to grow and mature throughout the seasons while extending strong roots as both Emily and Ryan portrayed," Arnett says. "We hope his loved ones know by planting this tree we celebrate his life."

The buckeye was grafted from a parent tree on the Iowa State campus. Planted in October, between Ross and Curtiss Halls, the tree grounds Ryan's memory to Iowa State for generations.

An excerpt from the tree's memorial reads:

"Ryan served both The Ohio State University and Iowa State University during his time as a student through Agriculture Future of America by providing mentorship, leadership workshops and inspiration to land-grant students involved in the organization. Ryan's wife, Emily (Chappie) Hrubes, is an alumnae of The Ohio State University and consummate leader who continues to inspire and lead the future of agriculture in many ways… This tree is a memorial gift between two colleges of agriculture in recognition and thanks for the impact our students make on each other. May this tree be a reminder to all that this life is about serving others." S

STORIES EXTRA: www.stories.cals.iastate.edu

Find links online to donate to the Ryan Hrubes Memorial Scholarship for Leadership in Agriculture and learn more about Agriculture Future of America.

__Walter Hill__ (left) was honored by CALS with the George Washington Carver Distinguished Service Award. He and CALS dean Wendy Wintersteen recently presented Carver Spirit of Innovation and Service Awards. __Estefany Argueta__ (center), a senior in animal ecology at Iowa State, was one of five undergraduate students to receive the award.

BUILDING ON CARVER'S CONNECTION

Story by Brian Meyer
Image contributed

Four words are inscribed on Walter Hill's wedding ring: love, family, work, struggle.

"Those words are still what gets me up in the morning," he says. "That, and a gratitude and thankfulness to the Creator."

For three decades, Hill has brought love, family, work, struggle and gratitude to bear in his service to Tuskegee University as dean of the College of Agriculture, Environment and Nutrition Sciences, director of the George Washington Carver Agricultural Experiment Station and director of the 1890 Research and Extension Programs.

Ties between Tuskegee and Iowa State's College of Agriculture and Life Sciences go back many years. Undergirding the partnership is the common link of George Washington Carver, Iowa State's first African American student and faculty member, who went on to serve the people of Alabama for 47 years as a Tuskegee faculty scientist, educator and innovator.

Past ties included faculty exchanges and Tuskegee students spending summers in Ames conducting research as part of the college's Carver internship program. "Iowa State was reaching out constantly, just a welcoming opportunity for growth on the part of our students and faculty," Hill says.

In the past few years, the two universities have pledged to strengthen and broaden cooperative research, education and extension collaborations. Scientists are working together on creating new foods from purple hull peas, a Southern crop. Others are exploring Big Data applications for agriculture.

> ***"You actually manifest the words 'mutually beneficial.' When you do that, trust builds. That's where I believe we are with Iowa State."***

Also, Tuskegee and Iowa State are joining forces with Simpson College and other schools on activities to inspire young people as part of the Carver Birthplace Association in Missouri. "When I told Dean Wendy Wintersteen about the opportunity, she was like, 'Let's roll!' Now that's what you want in a partner," Hill says. Together they established the Carver Spirit of Innovation and Service Award, presented to worthy undergraduates on both campuses.

The Tuskegee-Iowa State relationship has many elements essential for a solid partnership, Hill says—shared work and responsibility, shared leadership and shared credit. "You actually manifest the words 'mutually beneficial.' When you do that, trust builds. That's where I believe we are with Iowa State."

This fall, the College of Agriculture and Life Sciences honored Hill with the George Washington Carver Distinguished Service Award. When he accepted he likely drew on his mother's advice.

"I'd always felt uncomfortable when people were giving me praise or honors. I asked her what I should say. She told me to just say 'Praise the Lord.' That's my natural instinct now. Everyone's got to find a way to speak to humility as you grow and achieve, and not become self-absorbed. When I see Carver's face, I feel that. His humbleness was part of what made him great." S

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