University of Wisconsin Department of Agronomy

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Taking the Genomic Revolution to the Corn Fields to Improve Crops

“Having the sequence of a genome is like having the blueprint of a house,” says Natalia de Leon, a professor of agronomy at the University of Wisconsin–Madison.

But, says de Leon, if you don’t know how those plans get turned into a house, they don’t do you much good.

That’s a problem that the initiative she helps run, Genomes2Fields, is trying to address. By bringing the genomic revolution into corn fields, Genomes2Fields aims to improve the nation’s corn crop by uncovering how genomes — the blueprints for plants — are turned into yield, stress resistance, and all manner of different traits. In a collaboration stretching across 20 states and into Canada, the project has tested hundreds of varieties of corn in more than 70 different environments since 2014 to tease out how genomes interact with environments to produce different traits in corn.

Natalia de Leon

The project recently received a $1.25 million grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture to support its expanding field trials. Roughly $438,000 of the grant is slated for UW–Madison, which is a central hub for experimental design, seed distribution, and machine vision analysis for the research. Initial and ongoing support for the project also comes from industry groups like the Wisconsin Corn Promotion Board. Other state corn growing associations are also supporting researchers from Genomes2Fields in their own states.

All of the data are made publicly available a year after it is collected, so any interested scientist could use this information to help advance knowledge and develop tools that will help produce improved varieties of corn.

Genomes2Fields put out its first multi-state trial in 2014. It grew out of conversations with corn grower associations and other stakeholders that approached scientists like de Leon, wanting to know how the expanding genomic information about corn could help them in their fields, and not just in a research lab.

"Once multiple corn genomes had been sequenced, it became desirable to see that information translated into products," says Shawn Kaeppler, the director of the Wisconsin Crop Innovation Center and another Genomes2Fields investigator and member of the initiative's executive committee.

The project decided to focus on how corn responds to different environments.

"We want to understand what is it that makes certain plants more adapted to stressful environments than other plants," says de Leon.

To do that, de Leon and 29 other researchers grow different lines of corn across the country, where they will be exposed to different stresses. By comparing the size of ears of corn grown in Texas heat against corn maturing during long, cooler Wisconsin summer days, for example, the researchers can uncover which genetic traits help corn varieties adapt to diverse environments. Each field is equipped with a weather station to ensure consistent climate data collection.

Shawn Kaeppler at the Walnut Street Greenhouse.

Scientists measure not only the size of ears and yield of corn, but also the plant height, the time it takes to flower, and a number of other relevant traits. Each location decides to make unique measurements as well. De Leon and Kaeppler are partnering with UW–Madison botanist Edgar Spalding to test high-throughput methods for measuring the plants. Spalding is flying drones over fields to measure plant size, and he has scanned corn cobs from last year's trials that are then measured by machine vision systems to quickly collect data.

The 2017 trials will, for the first time, collect soil and leaves from the majority of the test sites to analyze the microbiomes associated with the crops. As research continues to highlight the importance of microbial communities in human and animal health, plant researchers aim to uncover the role microbiomes play in crop growth as well.

Genomes2Fields is designed to combine the consistency across locations required to produce strong results with the flexibility needed for innovation in crop improvement research.

“The platform is out there for people to test and develop new technologies to try to make the process of improving plants, and translating all of this genomic information to the field, better,” says de Leon.

This article was originally published on the UW-Madison News website.
Source: https://ecals.cals.wisc.edu/2017/07/31/taking-the-genomic-revolution-to-corn-fields-to-improve-crops/?utm_source=ecals_email_newsletter&utm_medium=email&utm_campaign=ecals_email_newsletter

UW–Madison researchers explore the future of bioenergy crops in Wisconsin

By James Runde & Mark E. Griffin, Wisconsin Energy Institute
December 4, 2017

In Wisconsin, as in many other parts of the Midwest, we grow a lot of corn – four million acres of it, in fact. That’s four million acres of corn generating $2 billion in economic benefits to the state. Since roughly a quarter of those corn crops are currently used for ethanol production, some of that Wisconsin corn is also finding its way into our gas tanks.

“Corn has incredible benefits for biofuel production,” says Claudio Gratton, professor of entomology at the University of Wisconsin–Madison. “You get a ton of biomass very quickly, it has a market, and we know how to harvest it. But there are costs associated with it, too, environmental costs.”

Corn is an annual crop that requires a lot of fertilizer to thrive. Since corn doesn’t fix roots in the soil year round, corn crops also increase soil erosion and cause runoff pollution. In Wisconsin and elsewhere, when rainfall or snowmelt carry topsoil downstream, phosphorus and nitrogen-rich manure flows into our waterways, endangering water quality and sometimes leading to poisonous blooms of blue-green algae.

It's a problem without an easy solution. If farmers were simply to spread less fertilizer, they might see decreases in crop yield and profit. Introducing new or different crops is also not a simple fix, as many farmers rely on well-established corn and soybean markets with crop insurance for income.

Randy Jackson, a UW-Madison professor of agronomy who holds meetings with farmers and decision-makers as part of his research on sustainable agricultural systems, says current policies and prevailing market forces keep a tight hold on our current cropping landscape.

"To get started [in farming], you're going to need a loan, and the bank is not likely to give you a loan unless you have a business plan based on corn and soybeans," says Jackson. He also points out that some practices that exacerbate runoff pollution, such as planting row crops next to streams, are also the result of economic calculations. "It allows farmers to keep that land zoned agriculture, which means lower taxes."

But what's missing from our current approach to land management, Jackson argues, is a means of accounting for the social and environmental costs and benefits of various cropping systems. Jackson, Gratton, and other UW–Madison scientists are looking to measure those costs while exploring new and collaborative ways of making our cropping systems serve farmers as well as the people, plants, and animals that depend on healthy ecosystems.

To continue reading and explore the benefits of bioenergy crops, visit the Wisconsin Energy Institute website.

Source: https://ecals.cals.wisc.edu/2017/12/04/uw-madison-researchers-explore-the-future-of-bioenergy-crops-in-wisconsin/?utm_source=ecals_email_newsletter&utm_medium=email&utm_campaign=ecals_email_newsletter

"Our Wisconsin: The Climate Change Effect"

This documentary on climate change originally aired on WKOW September 14. In this installment of the award-winning documentary series, "Our Wisconsin," WKOW examines the environmental, social and political impacts of climate change on the state. Impacts on weather, water and wildlife have been, and continue to be, documented by scientists. Storms are hitting with more frequency and intensity, causing more damage, flooding and pollution run-off into our rivers, lakes and streams. **Dr. Chris Kucharik** and other CALS faculty, were interviewed for this piece. View the hour-long documentary online here: https://www.youtube.com/watch?v=e3NWbhYpQZU.

Source: https://ecals.cals.wisc.edu/2017/09/18/wkow-climate-change-documentary-featuring-cals-faculty-available-online/?utm_source=ecals_email_newsletter&utm_medium=email&utm_campaign=ecals_email_newsletter

Agriculture Can Indeed Fix Our Food System--
If We Reimagine It

By **Randy Jackson**, Michelle Miller, Pam Porter and Lindsey Day-Farnsworth
October 26, 2017

A recent article by Tamar Haspel argues that the local and organic food movement can't fix our food system. If this movement were solely focused on "buy fresh, buy local" at farmers markets and upscale restaurants, we would agree. However, bigger changes are underway for sustainable agriculture. Farmers and others in the sustainable food movement pursue a broader vision of change in agriculture.

Fresh market vegetable production in the United States takes up about 1.63 million acres of land. This pales in comparison to the 218 million acres dedicated to corn, soybeans and wheat. As Haspel points out, we need to think beyond locally grown produce to protect the environment and provide good jobs. Our vision for sustainable agriculture and the food system includes crops and livestock, as well as farmers, processors, distributors and markets, so more consumers can access sustainable food, year-round. What does this look like?

More grass-fed meat, milk and cheese: Grass-fed dairy and meat isn't just a hipster thing. Pasture-based livestock production is a key ingredient in a sustainable food system. Nearly half the corn we grow feeds livestock that could graze. Perennial pasture protects water by holding soil in place year-round, unlike corn and other annual crops. Grass-based farming is a great start-up strategy for farm businesses, because it requires lower investments in equipment and facilities.

More-diverse crop rotation: By feeding livestock more grass and less grain, farmers can diversify crop production to include pasture, small grains such as wheat and oats, and such cover crops as clover. Rotating many different crops in a field builds soil and naturally disrupts the pests and diseases that strike when a farmer grows only one or two crops.

More-diverse crop rotations and perennial crops reduce pollution from soil erosion and fertilizer runoff that mucks up lakes and rivers, and leads to "dead zones" in the Gulf of Mexico and elsewhere. Diverse crop rotations also help farmers cope with extreme weather and erratic markets. Thanks to new tools and technology, it's easier than ever to implement complex crop rotations on large farms.

Reclaimed forest and wild lands: U.S. farmers grow far more grain than we need. Landowners can convert some agricultural land to a more natural state without affecting our food supply. Forests, grasslands and wetlands can reduce runoff into lakes and streams, provide wildlife habitat and harbor biodiversity. That said, restoring wild lands must be done in a way that respects farmers and the public.

Good jobs, from farm to table: Scaling up local food systems through regional processing, distribution and marketing can achieve economies of scale without sacrificing the environmental benefits of diverse farming systems. Regional food systems can provide consumers with organic and sustainable food year-round, and create jobs.

Farmer, farmworker and food worker livelihoods are part of our food system. Farmers receive, on average, 15.6 cents of the consumer food dollar. Small farms that sell directly to customers may earn more by eliminating distributors and marketers. However, larger farms may provide more stable employment, better working conditions and higher compensation for farmers and their employees. As Haspel observes, a healthy food system operates at a variety of scales.

Cities that encourage local and regional food processing and distribution may also create a food culture that supports locally owned groceries and restaurants, improving access to good food and good jobs.

More engagement with policy: Consumer buying power alone won't fix our food system. Public and private policies influence how our food is grown, processed, transported and sold. The Farm Bill sets the agenda for U.S. agriculture. But health care, labor, transportation, energy, immigration, banking and other policies influence farmers' decisions on what to plant, how to manage the farm, whom to hire and whether to take an off-farm job.

When we engage with food policy, whether by serving on the board of a local food co-op or contributing to the work of national policy organizations, we amplify the impact of conscientious food purchasing and pave the way for a better food system. Policies that support a diverse landscape and multiple scales of agriculture through more sustainable farming systems and land management, fair pricing and wages, and strategic economic development will ultimately improve the health and well-being of people, communities and the environment.

Let's make food policy work and put research into practice. The innovations necessary for a more sustainable food system exist. The challenge lies in scaling them up and expanding their reach.

Jackson is faculty associate at the University of Wisconsin-Madison Center for Integrated Agricultural Systems (CIAS). Miller is associate director, Porter is research program manager and Day-Farnsworth is a postdoctoral researcher at CIAS.

Source: https://www.washingtonpost.com/lifestyle/food/agriculture-can-indeed-fix-our-food-system--if-we-reimagine-it/2017/10/26/69d2dabe-b4fa-11e7-be94-fabb0f1e9ffb_story.html?utm_term=.d6daa1c65e35

"Lakes, Cheese, and You"

Visual essay helps consumers understand phosphorus pollution

November 13, 2017

The Water Sustainability and Climate (WSC) project, housed in CALS, recently produced a visual essay called Lakes, Cheese, and You, which was born of ideas generated by the WSC research team. The intent of the essay is to help consumers understand how they are connected to the predicament of phosphorus pollution in lakes, and how they can help solve it, through an important piece of the water-quality equation that is less often discussed: food choices. (Hint: Pizza is part of the story.)

The essay was put together using a platform called Story Maps, which was originally designed to tell stories with maps. It also works well for telling visual stories that incorporate compelling photos and videos.

WSC team members that contributed to the essay include Jenny Seifert, Eric Booth and Chris Kucharik.

View this essay here: https://arcg.is/1jm1XX.

Source: https://ecals.cals.wisc.edu/2017/11/13/lakes-cheese-and-you-visual-essay-connects-consumers-with-phosphorus-pollution/?utm_source=ecals_email_newsletter&utm_medium=email&utm_campaign=ecals_email_newsletter

Welcome!

Maxwel Coura Oliveira joined **Dr. Rodrigo Werle**'s program as a research associate in January. Maxwel was born in the state of Minas Gerais, Brazil. He earned his BS in Agronomy and MS in Weed Science from the Federal University of Jequitinhonha and Mucuri Valleys, Brazil. He received his PhD in Weed Science from the University of Nebraska-Lincoln in December of 2017. Maxwel is interested in investigating the distribution and management of herbicide-resistant weeds in Wisconsin, and evaluating weed management strategies in corn, soybeans, and small grains. He will train the Badgers Weeds Team, mentor graduate and undergraduate students in the Cropping Systems Weed Science program, and assist with the Wisconsin herbicide evaluation program.

Chris Bloomingdale has been hired as support staff with Mark Renz and Dave Stoltenberg.

Graduate student **Tomas Rush** (was listed in last issue, but we didn't have a bio for him), PhD Plant Pathology, Jean-Michel Ané. I was born and raised in Baton Rouge, Louisiana. I completed my undergraduate degree in Biological and Agricultural Engineering in 2008 and my master's degree in Plant Pathology in 2012 both at Louisiana State University. During my master's degree, I worked on validating the qPCR detection assay of the soybean pathogen, *Phakopsora pachyrhizi*, which is a devastating rust fungus found throughout the world. I was a Fulbright Research Scholar at Chulalongkorn University in Bangkok, Thailand from 2012-2013. While in Thailand, I worked on finding a biological control for the rice pathogen, *Burkholderia glumae.* In addition, I could find several new species of yeast from Thailand and Malaysia. I joined UW-Madison in 2014 as a PhD student. I have a major interested in plant pathology because I can have firsthand experience on helping the farmers and growers fight against agricultural problems. Plant pathology gives me the opportunities to live abroad and collaborate with several scientist and farmers around

the world. I am happy to be living in Wisconsin, because it is the only other state, beside Louisiana, I have ever lived in. My goal in life is to visit every country in the world.

In Memoriam

Dwayne A. Rohweder, a gregarious and esteemed agronomist sought for his expertise on forage and agronomic crops, died on Dec. 8, 2017. He was 91.

Rohweder was known for his effective communication style and the relationships he forged with those he met throughout his life.

Born on Aug. 12, 1926 in Marshalltown, Iowa, Rohweder grew up on a dairy farm outside Green Mountain, Iowa. He received three degrees from Iowa State University, a bachelor's in agronomy (1948), master's in Soil Fertility (1956), and PhD in Crop Production/Soil Management (1963). His first job was with the Iowa State University Cooperative Extension Service, where he spent time serving as the Area Extension Agronomist for southeast Iowa.

In 1963, Rohweder took a position with UW-Madison Department of Agronomy and University of Wisconsin—Extension as an agronomy specialist in forages. He held the same position until his retirement in 1988, with the exception two years when he served as Agronomist and Chief of Party for the UW – USAID University Development Contract Team at the Federal University of Rio Grande do Sul in Porto Alegre, Brazil. He obtained full professorship in 1970, trained many graduate students, was vice-chairman of the UW—Extension University Committee, and published over 134 articles in the forage sciences.

Rohweder was the recipient of many awards over the course of his career, including the Fellow Award for the American Society of Agronomy (ASA) in 1974; the Merit Award from the AFGC in 1975; Distinguished Service Award from UW—Extension in 1976; and the "Second Mile' award from the Wisconsin County Agricultural Agents Association in 1978. Over the years he continued to be professionally active, serving as editor for the UW-Madison Department of Agronomy's history book, titled "The First 100 Years."

Today, CALS students are eligible to receive the Dwayne Rohweder Forage Extension Fund Fellowship, named in his honor.

To learn more about Rohweder's life, read the full obituary on the Cress Funeral Home website.

Source:https://ecals.cals.wisc.edu/2017/12/12/dwayne-rohweder-professor-emeritus-of-agronomy-dies-at-91/?utm_source=ecals_email_newsletterutm_medium=email&utm_campaign=ecals_email_newsletter

Congratulations!

Agronomy Students Make the Dean's List

- Colin Bastle
- Cody Bol
- Shelby Brendler
- Yulin Du
- Jonah Van Der Weide
- Robert Weeden

Recent Graduates

- Nathan Drewitz, MS Agronomy
- Guillaume Ramstein, PhD PBPG
- Stacie Shuler, PhD PBPG

Niels Jorgensen Awarded First Place

At the recent Weed Science Society of America meeting in Arlington, VA, **Niels Jorgensen** earned a first place award in the PhD competition for his presentation *Using Historical Data of Miconia calvescens to Optimize Management and Containment Across the East Maui Watershed*. Niels is currently an

Dr. Natalia de Leon Awarded for Contribution

The annual Corn, Soybean and Sorghum Conference and Seed Expo is America's largest seed industry conference.

Held in early December at the Hyatt Regency Chicago hotel since 1977, the 2017 event was attended by more than 2,600 registered participants.

The National Council of Commercial Plant Breeders (NCCPB) Plant Breeding award was presented to Natalia de Leon, professor of plant breeding and quantitative genetics at the University of Wisconsin-Madison (UW). de Leon works in the UW corn silage and biofeedstock breeding program, the only silage breeding program in the U.S. public sector.

The NCCPB established an award to be presented to a person who has made outstanding basic contributions to the advancement of plant breeding and genetics in the public sector. It is presented annually at the ASTA-CSS conference.

Environment and Resources PhD student in the Nelson Institute working with **Mark Renz** in the Agronomy Department.

NASA Internship

Recent agronomy undergraduate alumnus **Cadan Cummings** was accepted to participate in a 16-week NASA internship program at Johnson Space Center in Houston, Texas. Cadan graduated in December 2017 and was an undergraduate researcher in **Chris Kucharik**'s Agroecology Lab. The NASA internship program offers undergraduate students studying disciplines of science, engineering, and business the opportunity to work under the guidance of professional staff at one of their more than ten centers. He will be among 90 undergraduate and graduate students to gain research internships this spring with NASA's Johnson Space Center. Although a temporary member of the NASA community, Cadan looks forward to making a lasting difference to how Johnson Space Center works to attain a more sustainable campus. His spring drafting internship will specifically be combining GIS mapping with planning of native prairie landscapes.

Photo from http://www.kucharik-lab.com/people/cadan-cummings/

Also at the annual Corn, Soybean and Sorghum Conference, **Stacie Shuler** received the National Council of Commercial Plant Breeders' Graduate Student Award. Stacie earned her PhD in Plant Breeding Plant Genetics this spring and was a student of Bill Tracy's.


Stacie Shuler


Cadan Cummings

Q & A with the Department Staff

This issue features Shawn Conley.

This interview is taken from Shawn's interview with SeedWorld. This will become a regular feature.

Seed World: What's your favorite film?

Shawn Conley: My favorite movie is The Sound of Music. I fondly remember sitting on my grandma's lap when I was young, eating popcorn and watching this movie with her every year. As I got older this yearly tradition also got me out of milking cows so we could watch it together.

SW: Why did you choose to work specifically with soybeans?

SC: Soybean is an incredibly versatile and complicated crop. I always joke anyone can grow 300 bu corn that's easy! It takes a real scientist to consistently grow 100 bu beans! Furthermore my favorite saying and tagline is "Coolbeans" so it was kismet.

SW: What do you feel is your biggest accomplishment?

SC: My biggest academic accomplishment is writing the kids book Coolbean the Soybean. I wanted to develop a fun, yet educational, tool to help teach today's youth about where food comes from, career opportunities in agriculture, and explain why soybeans are so important, not only here in the U.S., but around the world. Hopefully this book can help inspire the next generation of agricultural scientists.

SW: What's your favorite hobby?

SC: I love duck hunting! Being out on the water with my family, friends and dog Sadie is what I look forward to every year!

SW: What's your latest research project?

SC: I am co-leading with Dr. Patricio Grassini a multi-state yield gap project funded by the NCSRP and WSMB. The project goal is to identify the key factors that preclude the State's Soybean Producers from obtaining yields that should be potentially possible on their respective individual farms.

SW: Who was your biggest mentor?

SC: Dr. Bill Wiebold at the University of Missouri has been great! I reach out to him when I need advice and he is always willing to share. The best advice he ever gave me was “Don’t read your press clippings”

SW: What research has you most excited right now?

SC: I am excited to see how RNAi and CRISPer technology influence soybean management.

Picture and text from http://seedworld.com/qa-shawn-conley-coolbeans-soybeans/

Field Day a Success

The 2017 Agronomy/Soils Field Day at Arlington ARS was a big success! About 135 lunches were sold, with about 165 in attendance to hear about and discuss research under the theme, ***Cultivating a Resilient Agriculture***. During the lunch-hour, an expert panel of farmers, agency personnel, and UW Extension presented their ideas about impediments and opportunities for working towards resilience in our agricultural system. This discussion complemented three field tours focusing on 1) Building soil health, 2) Managing risk in cropping systems, and 3) Perennial forages for diverse goals. A fourth "tour" included presentations and discussion focused on designing landscapes for ecosystem services. It was clear from these activities that there's lots of interest in working towards agricultural systems that produce food, feed, fiber, and fuel while improving water quality, stabilizing climate, and promoting human health.

Presentations were given by Agronomy faculty and staff including Randy Jackson (organizer), Gregg Sanford, Dan Undersander, Valentin Picasso, Joe Lauer, Shawn Conley, Nathan Drewitz, Dave Stoltenberg, Sam Marquardt, Mark Renz, and Chris Kucharik. Thank you to all in attendance, the speakers, and the organizing team.

Photo from: http://wisccorn.blogspot.com/2014/08/2014-agronomysoils-field-day-highlights.html

"Breaking the Bias Habit" Workshop

The Department of Agronomy and WISELI (Women in Science and Engineering Leadership Institute) hosted a workshop for faculty, staff, and grad students. The goal was to introduce attendees "to concepts of unconscious biases and assumptions about diverse groups of people by treating the applications of these biases as a 'bad habit.'" The workshop was Wednesday, February 21 and was attended by multiple departments. The three speakers were effective in their presentations and provided ample time for questions and useful small group discussions. Workshop organizer Natalia de Leon says, "[it] was overall a wonderful learning opportunity and provide[d] a lot for people to think about and consider, personally and in terms of our surroundings."