Department of Agronomy and Plant Genetics

plant pages

SPRING 2023

CFANS
COLLEGE OF FOOD, AGRICULTURAL AND NATURAL RESOURCE SCIENCES

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Department Head, Agronomy and Plant Genetics

Welcome to the spring edition of Plant Pages, the Department of Agronomy and Plant Genetics newsletter. As we end the school year, we're celebrating the achievements of our students, faculty and staff. Throughout this newsletter, you'll see examples of how the department is working collaboratively to innovate, investigate, and educate. We begin the newsletter by recognizing a long list of award winners.

CELEBRATING DEPARTMENT AWARD WINNERS

Faculty Awards

Rex Bernardo - CFANS Distinguished Teaching Award: Graduate Faculty (2023)
Candice Hirsch - Presidential McKnight Professorship in Plant Genetics (2023)
Peter Morrell - CFANS Diversity and Inclusion Award (2022)
Jim Anderson (B.S. 1987) - Crop Science Society of America Crop Science Research Award (2022)
Jim Anderson (B.S. 1987) - National Association of Plant Breeders Public Sector Plant Breeding Impact Award (2022)

Staff Awards

Kristen Opitz - Borealis Award Exemplary Staff (2023)
Samatha Gunapati - Center for Precision Plant Genomics Travel Grant Award (2023)
David Nicolai (B.S. 1976) - North Central Weed Science Society Distinguished Achievement Award: Education (2022)

Graduate Student Awards

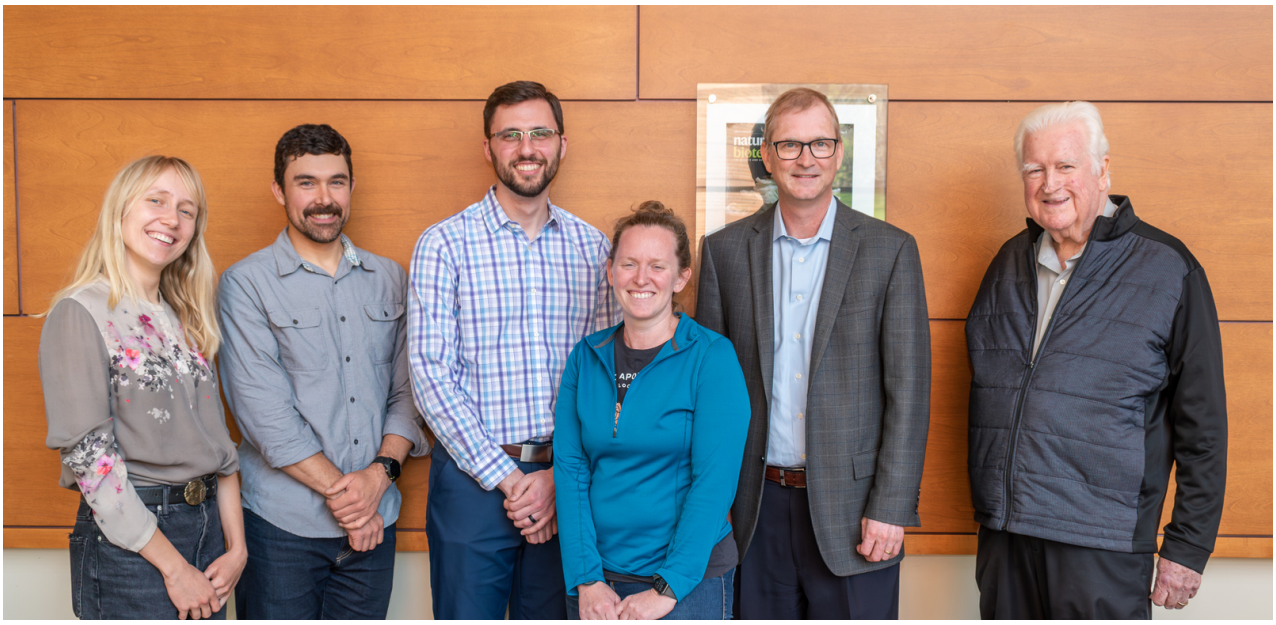
Applied Plant Science Graduate Program - Exemplary Graduate Student Organization (2023)
Michael Burns - Hayes/Phillips Outstanding Graduate Student Award/CSSA Gerald O. Mott Graduate Student Award (2023)
Michael Burns - Crop Society of America Gerald O. Mott Award (2023)
Hannah Stoll - President's Student Leadership and Service Award (2023)
Alex Griffin - Jerry Nelson International Travel Award (2022)
Lucas Roberts - Jerry Nelson International Travel Award (2022)
Lucas Roberts - National Association of Plant Breeders Borlaug Scholar (2023)
Joan Barreto Ortiz - Jerry Nelson International Travel Award (2022)
Carlos Sanchez - Jerry Nelson International Travel Award (2022)
Carlos Sanchez - CFANS Alumni Society Scholarship (2023)
Jake Kundert - Jerry Nelson International Travel Award (2023)
Venkatanaga Shiva Datta Kumar Sharma Chiruvelli - North Central Weed Science Society Travel Award (2022)
Venkatanaga Shiva Datta Kumar Sharma Chiruvelli - Weed Science Society of America Poster Presentation 1st Place (2023)
Navjot Singh - The Sugarbeet Research And Education Board of Minnesota And North Dakota Alan Dexter Sugarbeet Scholarship (2023)
Navjot Singh - Weed Science Society of America Poster Presentation 2nd Place (2023)

Alumni Awards

Michael Graham (B.S. 1987) - University of Minnesota Outstanding Achievement Award (2022)
Geoff Graham (B.S. 1989, M.S. 1991) - University of Minnesota Outstanding Achievement Award (2022)
Geoff Graham (B.S. 1989, M.S. 1991) - APG Distinguished Alumni Award (2022)
Donn Cummings (Ph.D. 1977) - APG Distinguished Alumni Award (2023)

Stay connected with us!

CELEBRATING DEPARTMENT AWARD WINNERS



Left to right: Alexandra Griffin (Hayes/Phillips Outstanding Graduate Student award nominee), Jacob Jungers (Alexandra's advisor), Michael Burns (Hayes/Phillips winner), Candice Hirsch (Michael's advisor), Gary Muehlbauer, and Ron Phillips, who the award is partially named after

Donn Cummings (left) receives the 2023 Agronomy and Plant Genetics Distinguished Alumni Award from Department Head, Dr. Gary Muehlbauer

Left to right: Gary Muehlbauer, Brian Buhr (Dean, College of Food, Agriculture and Natural Resources), and Outstanding Achievement Award winners, Geoff Graham (Corteva Agriscience) and Mike Graham (Bayer Crop Science)

STUDENT SPOTLIGHT

Michael Burns is a Ph.D. candidate (Applied Plant Sciences) who uses machine learning and image analysis to predict end-product quality traits in food-grade maize. At the University of Minnesota, Michael has helped initiate a participatory vegetable breeding program and a graduate student-led program on teaching functional skills and sharing expertise. Michael plans to pursue a career that will allow him to bring new tools to plant breeding programs. He recently won the APG department's prestigious Hayes/Phillips Outstanding Graduate Student Award.

Michael Burns, Ph.D. candidate

MEET OUR NEWEST PROFESSORS

Congratulations to Aaron Lorenz, Seth Naeve and Candice Hirsch for their promotions to full professors.

Dr. Aaron Lorenz's (B.S. 2002) research focuses on optimizing and applying genomics and phenomics to an applied cultivar development program, mapping genes underlying complex traits relevant to soybean production, and developing soybean varieties adapted to new cropping systems. The University of Minnesota Soybean Breeding Program develops specialty, food-type, and general-use soybean varieties adapted to the Upper Midwest.

Dr. Seth Naeve's research program focuses on developing novel strategies for the efficient production of high-quality soybean. His research effort is split between analyzing environmental and cultural effects on soybean seed composition and researching management strategies to maximize production efficiencies while minimizing negative environmental impacts.

Dr. Candice Hirsch's research involves integrating big data, including high-throughput genome and transcriptome sequencing, high-throughput phenotyping, and environmental measurements, with the end goal of improving corn as a crop plant. Within this broader goal, her team specifically focuses on 1) assessing variation in the corn pan-genome and the impacts on phenotypic variation and genomic prediction, 2) developing methods to assess transposable element variation and the impact on adaptation and stress response, 3) improving food-grade corn for masa-based products, and 4) high-throughput phenotyping to understand plant responsiveness to the environment.

WHAT'S NEW IN THE SUSTAINABLE CROPPING SYSTEMS LAB?

The Sustainable Cropping Systems (SCS) Lab is led by **Dr. Jake Jungers**, Assistant Professor in the Department of Agronomy and Plant Genetics. Jake and the team are working to make agriculture more sustainable by increasing the diversity and perenniality of cropping systems.

Their research aims to help the industry meet goals related to regenerative and climate-smart agriculture while advancing the understanding of the interactions between plants, soil, the atmosphere, and agricultural inputs. Specifically, the SCS lab conducts field experiments to develop best management practices to profitably farm new cropping systems in ways that limit the adverse effects of production on water, soil, and biodiversity.

Technicians **Katherine Bohn** and **Jesse Puka-Beals** manage field activities and lead a team of 4-6 undergraduate and MAST students each summer to support research being conducted by 5-7 graduate students. Here is an update on some of the exciting work happening in 2023.

Kernza® CAP

KernzaCAP is a $10 million USDA NIFA Coordinated Agricultural Project (CAP) led by Jake and co-project managers **Dr. Jessica Gutknecht** (UMN Dept. Soil, Water, and Climate), **Erin Meier and Aaron Reser** (Green Lands Blue Waters) to assist in the development and deployment of the world's first commercial-scale perennial grain crop, Kernza®. This large project includes ten co-PI institutions from across the U.S. and more than 50 collaborators from 30 organizations. The project aims to advance germplasm through breeding and genetics, optimize nutrient management, provide food science research to best incorporate Kernza® into food products, perform market research to understand consumer preferences and develop policy to support perennial crops. The project also supports student education and Extension programming to facilitate farmer learning and adoption. The team is about halfway through the project, and you'll find a link to their 2022 report on the next page.

Left to right: James Bowden, Jessica Gutknecht, Sienna Nesser, Alex Griffin, Jake Jungers, and Stella Woeltjen

WHAT'S NEW IN THE SUSTAINABLE CROPPING SYSTEMS LAB?

Water Quality

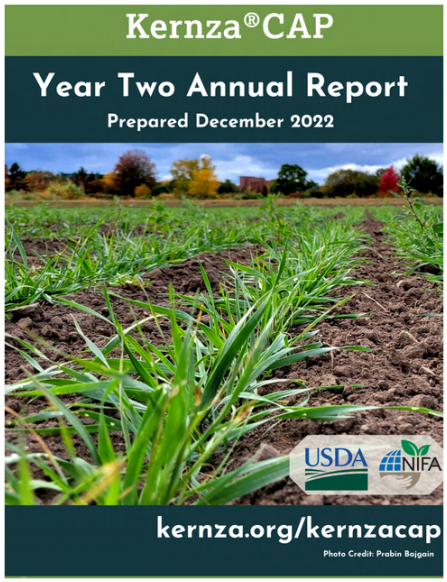
The SCS lab is working to quantify the water quality benefits of perennial and winter annual grain crops. Graduate student **Gurparteet Singh** uses data from the Kernza®CAP project to model nitrate leaching beneath Kernza® for regions across the Upper Midwest. In partnership with **Dr. Kevin Smith's** lab, graduate student **Jason Hickman** is also studying water quality beneath Kernza and winter barley. Jason's research addresses nitrate leaching, irrigation, and agronomic management questions.

Sustainable Alfalfa Production

Climate-smart agriculture is all the rage, and emerging carbon markets are raising questions and concerns for farmers and ag businesses. Alfalfa is a profitable perennial crop that can be grown for up to four years or more without tillage or replanting, which could have positive benefits for soil carbon. The SCS lab has partnered with USDA ARS Scientists **Dr. Josh Gamble** and **Dr. Jo Heuschele** to better understand alfalfa's role in mitigating greenhouse gas emissions. As part of a Forever Green Initiative project led by Dr. Gamble, SCS graduate student **Jake Kundert** is measuring the greenhouse gas footprint of an alfalfa/Kernza® cropping system. On a related note, Drs. Heuschele and Jungers will soon onboard a new postdoc who will study how alfalfa contributes to methane emissions from cattle.

KERNZA® CAP 2022 REPORT

Year 2 of the KernzaCAP project is in the books. Check out the annual report here.



Reimagining the Future of MN FSA

U of MN alum, Whitney Place has big goals for Minnesota ag.

Whitney Place's (B.S. 2010) degrees from the University of Minnesota in Applied Plant Sciences and Science, Technology, and Environmental Policy have served her well in her career. She was honored to join the Biden-Harris Administration as the Minnesota Farm Service Agency (FSA) State Executive Director. Prior to this appointment, Whitney served as Assistant Commissioner at the Minnesota Department of Agriculture, overseeing work on water quality, plant protection, and the state laboratory.

As FSA Executive Director, Whitney administers all FSA programs in the state and oversees the agency's day-to-day operations. FSA delivers farm programs and farm loans to aid agricultural producers in successfully producing food, fuel, and fiber. There are 402 full-time FSA employees in Minnesota serving farmers in 72 service centers across the state.

At Minnesota FSA, Whitney focuses on ensuring the vitality of Minnesota agriculture by effectively delivering programs and responding to any natural disasters impacting agriculture. The Conservation Reserve Program is part of the FSA portfolio, and she wants to continue Minnesota's efforts to protect the most vulnerable lands from erosion and enhance climate-smart agriculture in rural communities. Finally, Whitney wants to work toward a future where everyone is welcome to participate and has access to FSA loans and programs, including historically underserved groups like BIPOC and women farmers.

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Where Are They Now?

Department of Agronomy and Plant Genetics grad, Dr. Mikey Kantar, shares his journey from the University of Minnesota to the University of Hawaii.

Mikey Kantar grew up in Minneapolis, where he attended public schools and graduated from Minneapolis South High in 2002. As a high school intern, he worked at the University of Minnesota in **Dr. Ron Phillips**' lab, where he was exposed to plant genetics and breeding. He completed three degrees in the Department of Agronomy and Plant Genetics (BS Summa Cum Laude 2006, MS 2008, PhD 2013).

During his undergraduate studies, he worked with **Dr. Nevin Young** on the *Medicago truncatula* genome project. His MS work with **Dr. Paul Porter** was on breeding cover crops, and he also spent a semester working on the rice genome with **Dr. Hei Leung** at the International Rice Research Institute (IRRI). Kantar's Ph.D. work was on perennial grains with **Drs. Bob Stupar, Don Wyse, and Brent Hulke**. He completed a joint post-doc at the University of British Columbia and the University of Minnesota with **Drs. Loren Rieseberg and Bob Stupar**, where he continued to work on perennial grains, genetics of perennial habit, domestication and wild crop relatives. During this time, he also spent time at the International Center for Tropical Agriculture (CIAT), working with **Dr. Colin Khoury** on mapping crop wild relative distributions and the role of local adaption in these species. In his fifteen years at the University of Minnesota, Kantar worked with over 50 faculty in nine different departments across the university.

In 2016 Kantar joined the faculty of the University of Hawaii at Manoa in the Department of Tropical Plant and Soil Science. He is now a Tenured Associate Professor in that department. His lab has explored breeding for climate change using crop wild relatives, domestication of new crops, and agricultural state spaces. Since its establishment, Kantar's lab has worked on more than a dozen crop species (maize, common bean, sunflower, sweet potato, taro, pineapple, banana, chili, cannabis, barley, macadamia, soybean, yam, potato, sugarcane, rice, pumpkin, tomato, and various cover crops) publishing more than 85 papers. Over the last six years, he has had over 250 coauthors.

Kantar's lab has also explored aspects of bibliometrics, trying to understand the role of gender dynamics in scientific publishing and the citation kinetics of types of research impacting scientific trajectories. His lab also focuses on understanding diversity and what universities can do to improve their institutional policies. The overall goal of his lab and work is to examine complex interactions so that everyone can work toward creating food systems that are more productive, healthy, and sustainable.

In addition to plant science work, he is interested in science communication. In 2018 he was an AAAS Leshner Leadership Institute Public Engagement Fellow, focusing on science-art partnerships. In 2019 he was a senior research fellow with BARD, spending time at the MIGAL Research Institute in Israel, focusing on crop wild relative collection and perennial grain domestication. In 2020 he was the chair of the Plant Breeding Coordinating Committee, which focuses on understanding the role of public plant breeding across the United States. Currently, he is in the Fulbright Specialist program focusing on international agriculture.

CATCHING UP WITH

The Maize Genetics and Genomics Research Group

Dr. Candice Hirsch leads the department's maize genetics and genomics research group. Research in the group involves integrating big data, including high-throughput genome and transcriptome sequencing, high-throughput phenotyping, and environmental measurements, to improve corn as a crop plant. Within this broader goal, over the last couple of years, the group has been focused on assessing variation in the corn pan-genome and the impacts on phenotypic variation and genomic prediction, developing methods to assess transposable element variation and the impact on adaptation and stress response, improving food-grade corn for masa-based products, improving grain durability, and using unmanned aerial vehicles (UAVs) for high-throughput phenotyping to understand plant responsiveness to the environment.

The Hirsch lab is a vibrant training environment for high school, undergraduate, graduate, and post-doc students. Last summer, the team was excited to host three interns through their long-running summer internship program with Macalester College, which provides research experiences to female-identifying undergraduate students. They also hosted two interns from the Minneapolis YWCA Girls Inc. Eureka! Program. Read on to learn more about our students' research.

CATCHING UP WITH

The Maize Genetics and Genomics Research Group

Rafael Della Coletta's work involved assessing the value of integrating different marker types (e.g., structural variants) into genomic prediction models and developing novel methods to study trait plasticity through what he has termed “marker effect networks”. He recently graduated and is working for Corteva Agriscience.

Dorothy Sweet (4th year Ph.D. student in the APS program) is using drones to study how plants grow and respond to the environment at high temporal resolution both in breeding trials and in production fields to facilitate the development of more climate-resilient corn varieties and improved management practices in the future.

Michael Burns (4th year Ph.D. student in the APS program) is leading food-grade corn research, including developing a high-throughput method to evaluate moisture uptake and pericarp retention during nixtamalization and assessing genetic and environmental factors that contribute to variation for these important quality metrics during cooking. These tools will facilitate breeding food grade corn varieties, better sourcing of raw material, and more efficient processing into final direct human consumption products.

Claire Menard (3rd year Ph.D. student in the PMB program) studies variability in transposable element content within maize, identifies genetic backgrounds and growth conditions that promote transposon activity, and links these jumping genes to natural phenotypic variation.

Amanda Gilbert (2nd year MS student in the APS program) is working to understand functional differences between core genes (those present in all individuals in the species) and dispensable genes (those present in only a subset of individuals in a species). This work follows up on the lab's recent characterization of the maize pan-genome using 26 de novo whole-genome assemblies.

The group also welcomed two first-year Ph.D. students this year, **Joan Barreto Ortiz** (PMB program), studying grain durability and **Rommel Garrido** (APS program), who will continue on the foundational pan-genomics work that the Hirsch lab has been working on for many years.

Finally, **Andy Read** (NSF PRFB Fellow) recently joined the group and is currently studying the relationships between dynamic DNA methylation, transposon regulation, and defense gene expression to understand the complex plant immune system.

Agronomy and Plant Genetics

Congrats, Grads!

The following M.S. and Ph.D. students have recently graduated. Congratulations to the 2022-2023 graduates!

Primary Name	Degree	Advisor	Co-Advisor	Thesis Title
Adeyemo, Emmanuel Damilola	PhD	Bernardo, Rex	Anderson, James	Combating Fusarium Head Blight Resistance in Wheat with Genomic Selection and Computer Vision Technology
Barreto Ortiz, Joan Manuel	MS	Watkins, Eric	Ehlke, Nancy Jo	Uncovering Hidden Phenotypes to Accelerate Domestication in Perennial Ryegrass for Seed Production
Black, Katie	MS	Wells, Samantha	Johnson, Gregg	Strategies For Increasing Continuous Living Cover Adoption In Minnesota's Corn-Soybean Systems
Chen, Yuqi	MS	Smith, Kevin	Cohen, Jerry	Shortening Silphium integrifolium Juvenility and Establishing a Sterilization Protocol for Micropropagation
Cubins, Julija Alda	PhD	Wells, Samantha	Gesch, Russell	Research from Pod to Pod: Harvest Time Optimization of Shatter-Resistant Pennycress, Camelina Integration into the Corn-Soybean Rotation, and Communicating Science via Podcast.
Da Silva, Maykon Junior	MS	Naeve, Seth		Managing Soybean Iron Deficiency Chlorosis with Agronomics, Economics, and Remote Sensing
Della Coletta, Rafael	PhD	Hirsch, Candice		Developing Genomic Tools to Breed for Climate-Adapted Plant Varieties
Havill, Joshua	PhD	Muehlbauer, Gary		Phenotypic and Genotypic Characterization of Hop (Humulus lupulus L.) Germplasm Resources for Powdery Mildew Resistance
Hawkins, John Charles	MS	Smith, Kevin		Exploring Variation for Fusarium Head Blight Resistance and Deoxynivalenol Distribution in the Naked Barley Diversity Panel
Hoerning, Cody Alan	PhD	Wyse, Donald	Gesch, Russell	Evaluation of Soybean Cyst Nematode Development on the Winter Oilseeds Pennycress and Camelina
Larsen, Leta Judith	MS	Samac, Deborah	Sheaffer, Craig	Improving Alfalfa Seedling Establishment: Understanding and Managing the Components of Wet Soil Syndrome
Ley, Ethan	MS	Johnson, Gregg	Wells, Samantha	Evaluating Weed Management Decisions That Influence Cover Crop Adoption in the Upper Midwest
Link, Emma	MS	Jungers, Jacob	Gutknecht, Jessica	Soil Physical, Chemical, and Microbial Community Responses Following Two Years of Perennial and Annual Grain Management
Mayta, Juan Carlos	PhD	Lorenz, Aaron		Identification of Quantitative Trait Loci for Resistance to White Mold in Soybeans via Genome-Wide Association and Linkage Mapping
Meyer, Nathan	PhD	Jordan, Nicholas		Making Space for Evaluation to Strengthen Conservation Innovation
Ott, Matthew Ames	PhD	Forcella, Frank	Wyse, Donald	Improvement of Oilseed Cover Crops Camelina (Camelina sativa L. Crantz) and Pennycress (Thlaspi arvense L.) Genetics and Associated Agronomics for the Upper Midwestern Landscape
Sweet, Patrick	PhD	Bernardo, Rex		A Novel Mating Design to Optimize Genomic Selection Efficiency for Commercial Corn Breeding
Tandukar, Zenith	PhD	Anderson, James		Understanding the Genetic Architecture of Secondary Domestication Traits in Field Pennycress (Thlaspi arvense L.)
Wartha, Cleiton Antonio	PhD	Lorenz, Aaron		Advancing the Implementation of Genomics-Assisted Breeding in a Public Soybean Breeding Program
Woeltjen, Stella	PhD	Jungers, Jacob	Gutknecht, Jessica	Evaluating Crop Physiological and Stand Age-Related Controls Over Soil Carbon and Nitrogen Dynamics in Perennial and Annual Grains

Interested in supporting current students as a mentor or volunteering in other ways? Visit cfans.umn.edu/alumni for more information.

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