



# What we do & Why it matters

## Crop Sciences | [cropsciences.illinois.edu](https://cropsciences.illinois.edu)

The Department of Crop Sciences advances agriculture through local and international research to increase food security while protecting the environment. Our internationally recognized faculty lead cutting-edge research programs that educate the next generation of agricultural professionals.

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### ADAM DAVIS (department head)

Dr. Davis uses innovative modeling tools to identify and test new management strategies to make cropping systems more productive, profitable, and environmentally friendly. His research on integrated weed management provides farmers tools to reduce their reliance on herbicides. His group's data-mining and statistical analyses present new ways for farmers to improve yield resilience in a changing climate.

### LISA AINSWORTH (USDA-ARS)

Dr. Ainsworth applies physiological, biochemical, and genomic tools to understand the mechanisms of plant responses to global environmental changes, including rising atmospheric carbon dioxide concentration and increasing ozone pollution.

### JUAN DAVID ARBELAEZ-VELEZ (assistant professor)

Dr. Arbelaez-Velez focuses on the genetics and breeding of internationally important crops like rice and oats to diversify the regional agricultural system and to support agricultural productivity in developing nations.

### KACIE ATHEY (assistant professor)

Dr. Athey contributes to the understanding of non-chemical insect control within specialty crops systems. Her research combines field research with molecular gut content analysis to study practical insect control applications and arthropod food webs.

### MOHAMMAD BABADOOST (professor)

Dr. Babadoost develops solutions for vegetable and fruit crop diseases. He is internationally renowned for identifying effective disease management strategies for cucurbits, tomatoes, peppers, horseradish, basil, and apples. He also educates scientists in developing countries to improve production and quality of food crops.

### FRED BELOW (professor)

Dr. Below creates strategies to teach farmers and agricultural professionals the value of crop management decisions and develops systems to sustainably produce high-yielding corn and soybeans. He evaluates environmental, genetic, and management factors that impact the productivity of corn and soybeans.

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### **CARL BERNACCHI (USDA-ARS)**

Dr. Bernacchi conducts research on the impacts of atmospheric and climatic change on crop species in the Midwest. He develops strategies to increase food production, maximize sustainability, and minimize environmental impacts in light of these changes.

### **MARTIN BOHN (associate professor)**

Dr. Bohn breeds corn lines that contribute to economically efficient and sustainable, high-yielding production. He studies the genetic basis of biotic and abiotic stress responses, root development, and grain processing characteristics of corn using innovative, high-throughput phenotyping tools and genomic information.

### **GERMÁN BOLLERO (professor)**

Dr. Bollero utilizes advanced statistical methods to define, quantify, and find solutions to increase productivity and profitability of food systems while reducing undesirable impacts of agricultural practices on ecosystems. His accurate modeling and interpretation of cropping system productivity and environmental services drive future agricultural and environmental practices.

### **BRUCE BRANHAM (professor)**

Dr. Branham studies horticultural cropping and food systems. His research focuses on management and production issues in perennial crops ranging from turf grasses to small fruits.

### **GUSTAVO CAETANO-ANOLLÉS (professor)**

Dr. Caetano-Anollés explores molecular diversity and how molecular structure determines biological function in plants, animals, fungi, and microbes of significance to agriculture. He studies the origin, structure, and evolution of genomes, proteomes, RNomes, and functionomes for applications including bioengineering, biomedicine, and systems biology.

### **LAURA CHRISTIANSON (assistant professor)**

Dr. Christianson addresses important challenges in water quality by finding new techniques to grow crops in a way that preserves clean water, nutrient-rich soil, and healthy ecosystems. She is an international expert in woodchip bioreactors, helping growers reduce the amount of nitrogen in drainage water from agricultural fields.

### **REID CHRISTIANSON (research assistant professor)**

Dr. Christianson studies regional and national impacts of landscape decisions (agricultural and urban) on water quality. This work relies on collaborative partnerships and data-driven approaches to quantify benefits—water quality and other—provided by conservation practices. He also has expertise in water movement through the natural and man-made environment and stormwater management.

### **STEVE CLOUGH (USDA-ARS)**

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Dr. Clough is known internationally for his work on Arabidopsis transformation. His main research focus is on the use of genomics and molecular biology to explore plant-microbe and plant-pest interactions, mainly in soybean. His work improves our understanding of plant defense biology and identifies soybean genes affecting defense.

### **BRIAN DIERS** (professor)

Dr. Diers develops new soybean varieties and germplasm to help meet the growing global demand for protein and vegetable oil. He advances knowledge in soybean breeding and genetics by identifying genetic diversity using modern genetic tools with a goal of improving economically important traits in the crop.

### **HAMZE DOKOOHAKI** (assistant professor)

Dr. Dokoochaki synthesizes, analyzes, and creates new value from the rich data streams generated by all phases of agricultural production. He focuses on developing novel data-driven approaches at the interface of computer science, statistics, and crop science with the goal of improving and protecting our food production system.

### **ANDREA FABER TAYLOR** (teaching assistant professor)

Dr. Faber Taylor examines the effects of green schoolyards and gardens on child development. She advances our understanding of the importance of greenspace in supporting health and well-being and future stewardship of the Earth. She teaches courses on this topic, sustainable horticulture, home gardening, and planting design to support pollinators.

### **AARON HAGER** (associate professor)

Dr. Hager contributes to increased crop production through development and implementation of integrated weed management programs. His research helps to identify and manage herbicide-resistance in the most aggressive agronomic weeds.

### **CHRIS HARBOURT** (adjunct research assistant professor)

Dr. Harbourt innovates at the nexus of data acquisition and processing in field crop production, developing 21st century data-driven solutions in decision agriculture for students, producers, and the ag tech industry.

### **GLEN HARTMAN** (USDA-ARS)

Dr. Hartman addresses significant challenges faced by soybean producers through his research on soybean diseases and pests. He differentiates pathogens and pests that attack soybeans and provides management strategies for these pests. His collaborative efforts with breeders, biochemists, and molecular biologists are instrumental in unraveling complex disease and pest conditions.

### **EMILY HEATON** (professor)

Dr. Heaton connects science with practice to incorporate perennial biomass crops into temperate cropping systems. She does this through the lens of regenerative agriculture, using combined field-modeling approaches to identify tactics that improve environmental and social outcomes in the US Midwest. An international expert, Heaton helps growers use the giant grass miscanthus for a range of bioproducts and ecosystem services.

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### **SARAH HIND** (assistant professor)

Dr. Hind examines how the plant immune system detects pathogenic bacteria that cause diseases on tomato and other vegetable crops. Her research contributes to the understanding of plant-microbe interactions and aids in the development of plants with enhanced resistance to infection.

### **MATTHEW HUDSON** (professor)

Dr. Hudson uses supercomputing and DNA sequencing to solve problems in plant, animal, and human genetics. His current research focuses on how crops are bred and on ways to treat and prevent plant, animal, and human diseases. He is particularly interested in the genetics of crop traits and the genetic and molecular interactions of soybeans with pathogens, pests, and other organisms.

### **TIFFANY JAMANN** (assistant professor)

Dr. Jamann decreases losses caused by corn diseases by studying plant host resistance. Her research provides the foundation for the deployment of host resistance as an effective disease management strategy that will provide long-term solutions to corn producers and industry.

### **JACK JUVIK** (professor)

Dr. Juvik enhances food nutritional quality while reducing the incidence of cancer, heart disease, macular degeneration, obesity, and other degenerative diseases in his plant breeding program, which focuses on the development of brassica vegetable germplasm (broccoli, cabbage, cauliflower, and kale) with improved flavor and health properties. He investigates the genetics controlling the biosynthesis of health-promoting phytochemicals in these vegetables.

### **KRIS LAMBERT** (associate professor)

Dr. Lambert develops sustainable strategies to manage plant nematodes. He studies the molecular and biochemical basis of plant-nematode interactions in order to determine how plant parasitic nematodes evade plant resistance mechanisms.

### **D.K. LEE** (professor)

Dr. Lee improves perennial grass production systems for sustainable biomass and bioenergy feedstocks. His research focuses on increasing genetic and abiotic stress tolerances of perennial grasses. He finds new ways to integrate perennial grasses into row cropping systems to improve sustainability, ecosystem services, and water quality.

### **ALEXANDER LIPKA** (associate professor)

Dr. Lipka accelerates the development of high-performing crops by identifying specific DNA regions associated with agronomically important traits. He uses statistical approaches for quantitative genetic analyses in crops.

### **STEPHEN LONG** (professor)

Dr. Long's research bioengineers the photosynthesis process in crops to achieve higher productivity, sustainability, and adaptation to climate change. He heads an international project to improve the crops that

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feed many of the poorest in the world, which has led to the discovery of a way to engineer photosynthesis resulting in a 20% increase in crop productivity.

### **ANDREW MARGENOT** (assistant professor)

Dr. Margenot addresses the literal foundation of all cropping systems: soils. He advances how we monitor and manage soils as natural capital. His research team evaluates how human activities can enhance or compromise soil services to human societies, with an emphasis on food security from urban and rural agroecosystems in the U.S. Midwest and East Africa.

### **NICOLAS MARTIN** (assistant professor)

Dr. Martin improves long-term profitability and stability of cropping systems by exploring applications of quantitative methods on big data. He leverages interdisciplinary efforts to expand the frontiers of agricultural research; investigates quantitative methods on processes at multiple spatial and temporal scales; and studies effective approaches to implement new insights and discoveries in agricultural decisions and operations.

### **SANTIAGO MIDEROS** (assistant professor)

Dr. Mideros studies fungal and oomycete plant pathogens. Based on genetic information from the host and the pathogen, he develops tools for precision management of diseases of field crops.

### **MARK MIKEL** (assistant professor)

Dr. Mikel studies genetic diversity in field and vegetable crops. He was instrumental in the release of the second corn annotated reference genome, which has become a valuable resource for agricultural research.

### **STEPHEN MOOSE** (professor)

Dr. Moose discovers genes that influence corn and related bioenergy grasses' response to nitrogen supply. He develops new approaches to increase crop yields with lower input costs and helps mitigate environmental issues associated with nitrogen fertilizer. His work reveals how genes cooperate to control plant traits important to both productivity and nutritional quality.

### **DONALD ORT** (professor)

Dr. Ort redesigns photosynthesis for improved efficiency, identifies the molecular and biochemical basis of environmental interactions with crop plants, and investigates the interactive effects of CO<sub>2</sub>, temperature, and drought on plant, plant canopy, and plant ecosystem performance.

### **A. LANE RAYBURN** (professor)

Dr. Rayburn examines the role of chromosome changes in crop and native plants for the benefit of crop improvement. He also investigates how plants adapt to changing environmental conditions.

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### **DEAN RIECHERS** (professor)

Dr. Riechers investigates how plants respond and adapt to stress caused by herbicides. He explains herbicide-resistance mechanisms and describes herbicide safener mode of action by discovering new genes and proteins that rapidly detoxify herbicides. His work leads to an increased margin of selectivity between cereal crops and difficult-to-control weeds.

### **CHANCE RIGGINS** (research assistant professor)

Dr. Riggins conducts interdisciplinary research on wild, weedy, and cultivated plants to understand adaptive evolution in natural and agricultural environments. Exploring plant uses and novel applications of plant natural products is another theme of his work. As curator of the Crop Evolution Lab Herbarium, which documents agricultural biodiversity, crop-wild relative genetic diversity, and allied biocultural knowledge, Dr. Riggins also passionately advocates for raising awareness of where our botanical products come from and why it matters.

### **JESSICA RUTKOSKI** (assistant professor)

Dr. Rutkoski puts the principles and techniques of quantitative genetics and statistics to use in applied plant breeding to accelerate genetic progress in ways that benefit people and the environment. Her work is making winter wheat more profitable for farmers in the North Central Midwest to promote cropping system diversity and ultimately, environmental sustainability.

### **MARTIN SACHS** (USDA-ARS)

Dr. Sachs directs the Maize Genetics Cooperation Stock Center, a collection of maize mutants used in global research. He also analyzes flooding-related stress responses in maize. His research develops new strategies for improving crop tolerance to oxygen deprivation and ultimately increases crop productivity.

### **ERIK SACKS** (associate professor)

Dr. Sacks studies the genetics of rice, miscanthus, and sugarcane to facilitate the breeding of improved cultivars that address critical societal needs, such as the sustainable production of food, fiber, and energy. By identifying genes that confer tolerance to environmental stresses, such as cold, heat, or salt, and resistance to diseases and pests, he allows farmers to do more with less by reducing the risks and costs of production.

### **NATHAN SCHROEDER** (associate professor)

Dr. Schroeder makes new discoveries on the biology of nematodes, one of the world's most abundant group of animals. His work identifies how nematodes survive difficult environmental conditions, which helps control parasitic nematodes and reveals how higher animals like humans deal with stress.

### **NICHOLAS SEITER** (research assistant professor)

Dr. Seiter develops and evaluates management strategies for insect pests of field crops. His research includes developing economic decision-making tools, identifying natural enemies of insect pests, and assessing insect control methods for their effectiveness and fit within management systems. His overall goal is to provide



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management recommendations that improve the economic returns and environmental profile of insect management practices.

### **ANTHONY STUDER** (associate professor)

Dr. Studer improves the efficiency and productivity of cereal crops by optimizing photosynthesis and water use. His research helps develop crops that are resilient to climate change and meet the needs of growers at the regional, national, and international levels.

### **PATRICK TRANEL** (professor)

Dr. Tranel uses molecular and genomic approaches to investigate how weeds evolve in response to farmers' attempts to manage them. His work aids in the development of effective, sustainable weed management systems.

### **MARÍA VILLAMIL** (professor)

Dr. Villamil identifies management strategies to improve soil health and productivity in agroecosystems by addressing the societal challenge of sustainable food production. She focuses on how changes in soil health brought about by agronomic practices relate to carbon and nutrient cycling, crop production, and mitigation of greenhouse gas emissions.

### **DAVID WALKER** (USDA-ARS)

Dr. Walker breeds soybean lines with broad and durable resistance to economically important diseases to reduce dependence on pesticides. He also conducts research on the genetic control of soybean resistance to pathogens and on pathogenic diversity.

### **MARTY WILLIAMS** (USDA-ARS)

Dr. Williams helps growers sustainably produce affordable and nutritious vegetables for consumers. He is an international leader in framing high-caliber research, explaining critical problems in weed management and crop production, and delivering solutions to the vegetable seed and processing industries in the U.S. and beyond.

### **FRANK ZHAO** (professor)

Dr. Zhao's research advances the understanding of microorganism—host interactions to develop novel control strategies for bacterial and fungal diseases of field crops and fruits. He also studies antibiotic resistance in non-agricultural and non-clinical environments to benefit plant and human health.

### **JULIE ZILLES** (research assistant professor)

Dr. Zilles microbiological research investigates fundamental mechanisms influencing materials cycles in human managed and agricultural ecosystems, with impacts on water and air quality. She also studies best practices for enhancing the teaching of scientific writing throughout the curriculum.