DONALD DANFORTH PLANT SCIENCE CENTER

Principal Investigators at a Glance

Our principal investigators are leading cutting-edge research in plant biology and genetics to create solutions for food security and environmental challenges. Fueled by a passion for changing the world through plant science, their labs make critical discoveries and develop new technologies that propel the plant science community forward.

Full biographies can be found on our Principal Investigators Page

DONALD DANFORTH
PLANT SCIENCE CENTER

Members

Doug Allen, PhD, *USDA Research Scientist: Member*

Doug's research is dedicated to understanding the metabolic networks of crops to enhance biomass composition. These investigations give mechanistic insight into plant metabolism, important for designing crops to meet future nutritional and chemical feedstock needs. He is part of the Subterranean Influences on Carbon and Nitrogen Center (SINC).

Areas of research: central carbon metabolism, metabolic flux analysis, photosynthesis, carbon partitioning, lipid and protein biosynthesis and turnover

Rebecca Bart, PhD, *Member, Interim Vice President of Research*

The Bart Lab studies the interactions between plants, microbes and the environment and translates newly gained knowledge into sustainable crop improvement strategies. She is currently exploring host-microbe interactions in important crops including cassava, sorghum, maize, tomato and cotton. Becky is part of the Subterranean Influences on Carbon and Nitrogen Center (SINC).).

Areas of research: crop improvement, disease triangle, plant-microbe interactions, plant pathology

Ivan Baxter, PhD, *Member*

Ivan's research focuses on understanding how plants adapt to their environment, specializing in using the elemental profiling and other high-throughput techniques as a window into this complex process. Ivan is also part of the Subterranean Influences on Carbon and Nitrogen Center (SINC) and New Roots for Restoration Biology Integration Institute.

Areas of research: elemental accumulation, bioinformatics, quantitative genetics, high-throughput phenotyping, metabolomics & ionomics

Armando Bravo, PhD, *Assistant Member*

Armando's research investigates the mechanisms that control mutually beneficial interactions between plants and 'arbuscular mycorrhizal fungi' (AMF) that can be used to increase plant nutrition sustainability.

Areas of research: arbuscular mycorrhizal symbiosis, plant evolution, nutrient uptake

Tessa Burch-Smith, PhD, *Associate Member*

Tessa's research seeks to understand how plant cells communicate with each other through intercellular connections called plasmodesmata (PD) by using molecular biology in combination with advanced imaging to investigate the cell biology of PD. Tessa's lab also studies PD and their interactions with plant viruses.

Areas of research: plant cell biology, intercellular communication, retrograde signaling

James Carrington, PhD, *President and Chief Executive Officer*

Jim's research focuses on RNA-mediated regulation and silencing of genomes, genes and viruses. His lab focuses on the biogenesis, functions, and evolution of small RNA-directed silencing pathways in multicellular eukaryotes. Jim is a member of the National Academy of Sciences recognized for his work on gene silencing, small RNA, and virus-host interactions.

Areas of research: RNA silencing, virus-host interactions, epigenetics

Kevin Cox, PhD, *Assistant Member; Assistant Professor of Biology, Washington University in St. Louis*

Kevin's lab is dedicated to studying spatial biology, or the spatial organization of molecules in plants. Using spatial biology techniques, Kevin's team aims to understand aspects of plant-microbe interactions and duckweed biology.

Areas of research: plant-microbe interactions, imaging, spatial & single-cell genomics, duckweed biology

Andrea Eveland, PhD, *Associate Member*

Andrea's lab is exploring the developmental mechanisms that control plant architecture traits, and how the underlying regulatory networks interface with environmental challenges. A primary focus is inflorescence architecture, which is a key determinant of yield impacting seed number and harvesting ability in cereals. She works closely with the Taylor Geospatial Institute and is part of the AIFARMS AI Institute leadership team.

Areas of research: developmental genetics, genomics and data science, crop improvement, systems biology, abiotic stress interactions

Malia Gehan, PhD, *Associate Member*

Malia's lab has biological interest in resilience and natural variation in response to abiotic stresses (high and low temperature). Her group develops methods to estimate and assess stress non-destructively through imaging (hyperspectral, thermal, RGB, fluorescent). Her group co-develops a software project called PlantCV (https://plantcv.org) with Noah Fahlgren's team. In 2021, she received an early career award from the North American Plant Phenotyping Network. She is a Taylor Geospatial Institute Fellow and part of the New Roots for Restoration Project.

Areas of research: environmental stress, temperature stress, phenomics, imaging

Elizabeth Kellogg, PhD, *Member and Robert E. King Distinguished Investigator*

Toby studies genomes, growth and development of sorghum, maize, and their wild relatives, using biodiversity research to make ecosystems and agriculture more sustainable. The Kellogg lab's work identifies deep similarities among plants as apparently disparate as rice, wheat, maize, and the other cereals. She is a member of the National Academy of Sciences.

Areas of research: comparative genomics, systematics, developmental genetics

Allison Miller, PhD, *Member; Professor of Biology, Saint Louis University*

Allison's research focuses on perennial plant biology, diversity and evolution, with an emerging focus on understanding patterns and evolution of trait co-variation within and among organ systems and life stages. Allison serves on the research council for the Taylor Geospatial Institute and leads the New Roots for Restoration Biology Integration Institute.

Areas of research: functional trait diversity and evolution, root-shoot interaction, G x E interaction, agro-ecosystem sustainability

Dmitri Nusinow, PhD, *Member*

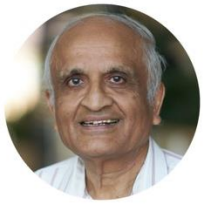
Meter's lab focuses on finding new genes that have the potential to increase productivity in response to daily and seasonal changes in light and temperature and to uncover the molecular connections between signaling networks, the circadian oscillator, and specific outputs. He is also interested in cover crops.

Areas of research: circadian rhythms, photoperiodism, temperature perception, optogenetics, synthetic biology

Sona Pandey, PhD, *Member*

Sona's group focuses on how plants impact and respond to their surroundings using examples from species ranging from mosses and model plants such as Arabidopsis to crops such as soybean and sorghum. At the mechanistic level, the group studies a class of conserved signaling proteins, the heterotrimeric G-proteins (G-proteins) which control developmental and signaling pathways regulating stress responses and yield in plants.

Areas of research: biotic and abiotic stress signaling mechanisms, plant biochemistry, evolution, development, genomics/proteomics, climate change response



Dilip Shah, PhD, *Associate Research Member*

Dilip's research investigates modes of action of antifungal plant defensins and defensin-like peptides to enable development of fungal disease resistant crops for yield protection. Critical discoveries from his group include the finding that plants produce a large number of small cysteine-rich antifungal peptides known as defensins and defensin-like peptides. Dilip is the co-founder of Peptyde Bio, a startup that was acquired by Invaio Sciences in 2023.

Areas of research: antimicrobial peptides, biotic interactions, crop protection

Nadia Shakoor, PhD, *Assistant Member*

Nadia's research combines high-quality genomic data with the analysis of greenhouse and field-based high-throughput phenotyping data to resolve the complexities of adaptive traits in crops such as sorghum. She is also the founder of Agrela, which aims to improve data collection across multiple industries with the launch of its flagship product, PheNode, a versatile, scalable, open sensor platform that fosters innovation and encourages the rapid integration of emerging technologies.

Areas of research: crop improvement, phenomics, digital agriculture, sorghum genetics, molecular breeding

Keith Slotkin, PhD, *Member; Professor, Division of Biological Sciences, University of Missouri - Columbia*

Keith's research seeks to uncover how plants determine which regions of their genomes should be expressed, which regions should not be expressed, and to create new technologies in plant biology.

Areas of research: epigenetics, transposable elements, DNA methylation

Nigel Taylor, PhD, *Member and Dorothy J. King Distinguished Investigator*

Nigel leads a number of projects related to the improvement of crops important to Sub Saharan Africa (Cassava, tef). His research in collaboration with colleagues in Kenya has advanced virus-resistant cassava into regulatory field trials in East Africa as a critical step toward delivering enhanced planting materials to farmers. Nigel is part of the International Institute for Crop Improvement (IICI).

Areas of research: crop improvement

Chris Topp, PhD, *Member*

Chris studies crop root system architecture and growth dynamics in response to environmental stress such as drought and rhizosphere competition. He has developed imaging technologies, computational infrastructure, and statistical methods that can capture and analyze morphologically complex networks over time and at high-throughput. Chris is also part of the Subterranean Influences on Carbon and Nitrogen Center (SINC).

Areas of research: root systems, rhizosphere, phenomics, x-ray imaging, growth modeling

James Umen, PhD, *Member and Joseph Varner Distinguished Investigator*

Jim's research uses green algae to investigate cell size control, growth regulation and carbon partitioning, and the evolution of sexual reproduction and multicellularity to enable development of improved algal crops and sustainable sources of biofuel and other high-value compounds.

Areas of research: algae, cell cycle, evolution of multicellularity, photosynthetic growth control, evolution of sex, functional genomics, synthetic biology, artificial chromosomes.

Sam Wang, PhD *Member; E. Desmond Lee Professor, University of Missouri - St. Louis*

Sam's research focuses on lipid metabolism and signaling in plant response to nitrogen/phosphorus/water deficiency and seed oil production.

Areas of research: cell signaling, lipid metabolism, vegetable oil production, P/N use efficiency, drought response

Bing Yang, PhD, *Member; Professor, Division of Plant Science and Technology, University of Missouri - Columbia*

Bing's research seeks to increase the understanding of plant responses to biotic and abiotic stresses that can be coupled with enabling technologies to develop improved crops. His group is focused on gaining a molecular understanding of host disease susceptibility and resistance to pathogenic microbes by using bacterial blight of rice as a disease model.

Areas of research: genome editing, disease biology, microbe-host interaction, crop improvement, genetic engineering, improved traits

Ru Zhang, PhD, *Associate Member*

Ru's areas of research include photosynthesis, heat stress in green algae and land plants. She studies how photosynthetic organisms, especially photosynthesis, respond to high temperatures in order to engineer more heat-resistant crops and algae for improved food and biofuel production.

Areas of research: photosynthesis, heat stress, abiotic stress, green algae, C4 plants

Directors

Kristine Callis-Duehl, PhD, *The Sally and Derick Driemeyer Executive Director of Education*

Kris's research program focuses on both K-12 education and undergraduate education through student engagement in content, participation in authentic science practice and improvement in science communication.

Area of research: education research, community engagement, outreach and internships

Kirk Czymmek, PhD, *Director, Advanced Bioimaging Laboratory*

Kirk's research seeks to understand aspects of plant-microbe interactions and fungal cell biology, with special emphasis on fungal-plant pathogenic interactions and the mechanisms of fungal hyphal tip growth using contemporary molecular cytology, preparation and imaging technologies. Kirk is the co-founder of Peptyde Bio, a startup that was acquired by Invaio Sciences in 2023.

Area of research: metabolic systems and synthetic biology, biotic and abiotic interactions, genomics, phenomics, and data science

Noah Fahlgren, PhD, *Director, Data Science Facility*

Noah's group develops methods to estimate plant traits through imaging. He co-developed a software project called PlantCV with Malia Gehan's group and is part of the New Roots for Restoration Project.

Area of research: high-throughput phenotyping, computer vision, machine learning, genomics, computational biology

Donald MacKenzie, PhD *Executive Director, Institute for International Crop Improvement*

The IICI Laboratory develops pre- and post-harvest yield protection and consumer-oriented quality traits for food security crops in Africa and Asia. In addition to new product development, Don's team provides support to seed certification agencies, and regulatory, biosafety, and project management to help move improved crop varieties into the hands of smallholder farmers.

Area of research: biotic and abiotic constraints to crop productivity, genetic transformation of food security crops (especially legumes), breeding, genomics, phenomics, and data science

Katie Murphy, PhD, *Director, Phenotyping Facility*

Katie's team measures plant phenotypes - the physical characteristics of plants - in order to facilitate research on crop improvement. Her research involves using high-throughput phenotyping in the Bellwether Phenotyping Facility, which includes automated watering, weighing, and plant imaging, as well as in-field phenotyping systems to characterize plant growth, development, and health in both roots and below-ground tissue. Katie's team contributes to PlantCV and collaborates with the Taylor Geospatial Institute for field-based phenotyping using UAV and satellite imagery.

Areas of research: plant phenotyping, environmental stress, metabolism, data science

Veena Veena, PhD, Director**,** *Plant Transformation Facility*

Veena and her lab develop and explore genetic engineering technologies to develop plants with improved traits.

Areas of research: plant transformation, genetic engineering, genome-editing, genome-modification technology, agrobacterium, crop improvement

Russell Williams, PhD, *Director, Bioanalytical Chemistry Facility*

Using state-of-the-art instrumentation, the Proteomics & Mass Spectrometry Facility generates proteomic and metabolomic data which provides crucial information to scientists seeking to establish a molecular basis for observed phenotypes.

Areas of research: targeted and untargeted metabolomics, proteomics, root exudates, and secondary metabolites

Senior Research Scientists

Sandra Arango-Caro, PhD, *Senior Research Scientist*

Sandra's work focuses on advancing STEAM+Ag education and outreach through collaboration with educators, students, scientists, and the public. She leads a team dedicated to curriculum design, program implementation, workforce development, and impact assessment.

Areas of research: The impact of authentic research experiences, mentoring, productive failure, and technology on the development of student identity and career interest in STEAM+Ag.

G. Cody Bagnall, PhD, *Senior Research Scientist*

Cody's research takes a systems-based approach to understanding the role of roots in regenerative agriculture. He focuses on developing and utilizing innovative phenotyping systems and conducting field-based experiments on cover cropping, nitrogen use, and mechanical farming systems.

Getu Duguma, PhD, *Senior Research Scientist & Senior Manager of Regulatory Science*

Getu's research is focused on the improvement of crops important for Sub Saharan Africa including cassava and tef. He is part of the Institute for International Crop Improvement (IICI).

Areas of research: trait enhancement, plant and panicle architecture

Ruth Kaggwa Asiimwe, PhD, *Senior Research Scientist*

Ruth's education-focused research aims to create a reality where all aspiring scientists have equal access to pursue careers in STEM. She is particularly interested in understanding how a variety of social systems can be improved to better serve under-resourced and racially minoritized students. Her research develops, implements, and assesses outcomes of STEM learning interventions like authentic research experiences, culturally responsive and relevant curricula, and effective professional development approaches.

Areas of research: diversity in education, equal access in STEM fields

Mao Li, PhD, *Senior Research Scientist*

Mao works with two-dimensional (2D) and three-dimensional (3D) data and was one of the first people to apply persistent homology-based mathematical approaches to plant science. These new approaches help scientists capture large amounts of information about leaf shape or inflorescence topology that previously went undetected, ultimately increasing our understanding of plant forms.

Areas of research: plant morphology quantification and modelling, geometric and topological data analysis, phenomics, 2D/3D imaging analysis

Narayanan Narayanan, PhD, *Senior Research Scientist*

Narayanan has been working on research to improve staple food crops, primarily cassava, a staple food crop in eastern and western Africa His research is focused on three main areas: plant nutrition to make the plants that we eat even more nourishing, virus resistance to improve plants' resistance to diseases that could otherwise wipe out entire harvests and crop protection that pursues solutions for pests and other environmental factors that threaten plants.

Areas of research: plant nutrition, disease resistance

Bala Venkata, PhD, *Senior Research Scientist*

Bala's research aims to develop safe, specific and sustainable biopesticide alternatives for climate-resilient agriculture, food security and human health that are healthier for farmers, consumers, pollinators, and the environment, while maintaining or even improving crop yields for food security.

Bala has proven success in driving groundbreaking innovations to bring new products for farmers and enterprises and is actively involved in developing safe, specific and sustainable bio-pesticides for climate-resilient agriculture, food security, and human health.

He co-founded RNAissance Ag LLC, a St. Louis-based startup focused on developing sprayable RNAi based biopesticides.

Areas of research: entomology, plant-insect interactions, biopesticide development for sustainable crop pest protection