Nate Korth, Ph.D.

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Research Interests

Plant-microbe interactions in the rhizosphere
Host genetic control of microbial community assembly
Microbe-mediated plant stress resilience and disease suppression
Quantitative genetics and multi-omics for sustainable agriculture
Conserved mechanisms of microbiome regulation in plants

Education

Ph.D., Complex Biosystems, University of Nebraska-Lincoln 2022
Dissertation: Identification and Characterization of Microbiome Active Traits in Cereal Grains
Advisors: J.C. Schnable and A.K. Benson

B.S., Food Science and Technology, University of Nebraska-Lincoln 2017

Professional Appointments

Postdoctoral Fellow, North Carolina State University 2024 – Present

Project Lead: Lead an independently funded USDA-NIFA fellowship project characterizing maize genetic diversity that regulates the rhizosphere microbiome and improves crop resilience.

GERMs Framework: Developed the Genotype × Environment × Rhizosphere Microbiome (GERMs) framework to evaluate how these interactions mediate heat resilience in maize.

Field Validation: Designed and executed large-scale field trials to validate greenhouse-based microbial findings across diverse environments.

Interdisciplinary Research: Collaborated with plant breeders, extension specialists, molecular biologists, and agronomists to design experiments translatable to crop improvement.

Postdoctoral Researcher, University of Nebraska-Lincoln 2022 – 2023
Department: Food Science and Technology; mentor: A.K. Benson

Graduate Researcher, University of Nebraska-Lincoln 2017 – 2022

Microbial Mapping: Conducted a meta-analysis of diverse sorghum lines to identify genomic regions co-localizing with microbiome traits, bridging plant genetics and microbial community assembly.

Trait Evaluation: Evaluated how plant-derived molecules and genetic mutations (e.g., *waxy* sorghum, quality protein maize) reshape gut microbial communities and their functional activity.

Platform Development: Built experimental and bioinformatic pipelines for high-throughput microbiome screening, metagenomic analysis, and quantitative genetics.

Undergraduate Researcher, University of Nebraska-Lincoln 2014 – 2016
Program: Food Allergy Research and Resource Program, Dept. of Food Science and Technology; mentor: M.L. Downs

Publications

1. **Korth, N.**, Borrero, I., Rumley, K., Woodley, A.L., Choudoir, M.J. and Gage, J.L., 2026. Investigating GERMs: how genotype, environment, and rhizosphere microbiome interactions underlie heat response in maize and sorghum. *New Phytologist*, *251*(4), pp.2152–2167.
2. Suhr Van Haute, M.J., Yang, Q., **Korth, N.**, Happ, M.M., Kok, C.R., Miao, C., Clarke, J.L., Karnik, K., Eskridge, K.M., Urrea, C.A. and Hyten, D.L., 2025. Genetic variation and historical breeding patterns in common bean (*Phaseolus vulgaris* L.) affect fermentation patterns by the human gut microbiome. *Communications Biology*, *8*(1), p.1690.
3. de Oliveira, M.J.K., Yang, Q., Brandão Melo, A.D., Marçal, D.A., **Korth, N.**, Pavlovikj, N., Benson, A.K., Htoo, J.K.K., Brand, H.G., Hauschild, L. and Gomes-Neto, J.C., 2025. Fecal microbiome of pigs fed diets differing in protein and amino acid content raised in thermoneutral or cyclical heat stress conditions. *Frontiers in Microbiology*, *16*, p.1585374.
4. **Korth, N.**, Yang, Q., Van Haute, M.J., Tross, M.C., Peng, B., Shrestha, N., Zwiener-Malcom, M., Mural, R.V., Schnable, J.C. and Benson, A.K., 2024. Genomic co-localization of variation affecting agronomic and human gut microbiome traits in a meta-analysis of diverse sorghum. *G3: Genes, Genomes, Genetics*, p.jkae145. DOI: 10.1093/g3journal/jkae145
5. Yang, Q., Van Haute, M., **Korth, N.**, Sattler, S., Rose, D., Juritsch, A., Shao, J., Beede, K., Schmaltz, R., Price, J., Toy, J., Ramer-Tait, A.E. and Benson, A.K., 2023. The *waxy* mutation in sorghum and other cereal grains reshapes the gut microbiome by reducing levels of multiple beneficial species. *Gut Microbes*, *15*(1), p.2178799. DOI: 10.1080/19490976.2023.2178799
6. Gomes-Neto, J.C., Pavlovikj, N., **Korth, N.**, Naberhaus, S.A., Arruda, B., Benson, A.K. and Kreuder, A.J., 2023. *Salmonella enterica* induces biogeography-specific changes in the gut microbiome of pigs. *Frontiers in Veterinary Science*, *10*, p.1186554. DOI: 10.3389/fvets.2023.1186554
7. Yang, Q., Van Haute, M., **Korth, N.**, Sattler, S.E., Toy, J., Rose, D.J., Schnable, J.C. and Benson, A.K., 2022. Genetic analysis of seed traits in *Sorghum bicolor* that affect the human gut microbiome. *Nature Communications*, *13*(1), p.5641. DOI: 10.1038/s41467-022-33419-1
8. **Korth, N.**, Parsons, L., Van Haute, M.J., Yang, Q., Hurst, P., Schnable, J.C., Holding, D.R. and Benson, A.K., 2022. The unique seed protein composition of quality protein popcorn promotes growth of beneficial bacteria from the human gut microbiome. *Frontiers in Microbiology*, *13*, p.921456. DOI: 10.3389/fmicb.2022.921456
9. **Korth, N.**, Taylor, S.L., Clarke, J.L. and Downs, M.L., 2021. Gluten cross-contact in restaurant-scale pasta cooking. *Journal of Food Protection*, *84*(12), pp.2159–2162.

Manuscripts in Preparation

1. Hunter, C., Gautam, M., **Korth, N.,** Grunden, A., *Paenibacillus-based nitrogenase production platforms. In preparation*
2. **Korth, N.**, et al. Working title: *Heirloom maize nitrogen uptake and recruitment of N-cycling rhizosphere microbes under low N. In preparation*
3. **Korth, N.**, et al. Working title: *Rhizobacterial D-amino acids prime maize heat-response pathways. In preparation*

Research Grants and Fellowships

USDA-NIFA Education and Workforce Development Postdoctoral Fellowship $225,000
Characterizing Untapped Genetic Diversity in Maize and Its Relatives to Regulate the Rhizosphere Microbiome and Improve Crop Resilience
USDA National Institute of Food and Agriculture, Award No. 2025-67012-44807
Role: Principal Investigator, 2025 – Present

Genetics and Genomics Academy Summer Research Mini-Grant $4,500
The Genetic Basis of Microbiome Modulation and Nitrogen-Stress Resilience in Maize
North Carolina State University, Genetics and Genomics Academy; supports an undergraduate researcher studying heirloom maize root microbiomes under nutrient stress
Role: Research Mentor, Summer 2026

Foundation for Food & Agriculture Research (FFAR) Fellowship $97,500
Identification and Characterization of Microbiome Active Traits in Cereal Grains
Competitive national fellowship bridging industry and academic research to identify nutritional and gut microbiome-modulating phenotypes of diverse crop species
Role: Doctoral Fellow, 2019 – 2022

Presentations

Invited Talks

"A Case for GERMs: Genotype × Environment × Rhizosphere Microbiome Interactions – to Uncover Microbiome Mediation of Crop Resilience." Plant and Microbial Biology Departmental Seminar, North Carolina State University. Spring 2025.

Oral Presentations

"Fixing Fertilizer: New Traits from Old Crops" NCSU Postdoc Pitch Competition, Fall 2026, **Third Place**

"Investigating GERMs: How Genotype x Environment x Rhizobial Microbiome interactions underlie heat responses in maize and sorghum." Genetics of Maize Microbiome Interactions symposium, Cologne, Germany. Spring 2026.

"Understanding GERMs: Genotype × Environment × Rhizobial Microbiome Interactions." Genetics of Maize Microbiome Seminar, online. Spring 2025.

"Characterizing Untapped Genetic Diversity in Maize and Its Relatives to Regulate the Rhizosphere Microbiome and Improve Crop Resilience." NCSU Plant Molecular Biology Retreat, Raleigh, NC. Fall 2024.

"Using Teosinte to Improve the Maize Microbiome." NCSU Plant Breeding Consortium, Raleigh, NC. Spring 2024.

"Identification and Characterization of Human Gut Microbiome Active Traits in *Sorghum bicolor*." American Society for Microbiology Regional Meeting, Manhattan, KS. Spring 2023. **First Place, Outstanding Postdoc Presentation.**

"The Gut Microbiome as a Human Health Phenotype of *Sorghum bicolor* in a Genetic Mapping Study." Nebraska Plant Science Symposium, Lincoln, NE. Spring 2023. **First Place, Excellent Oral Presentation.**

"Breeding Food for Health: The Human Gut Microbiome as an Agronomic Trait." Nebraska Food for Health Center Seminar Series, Lincoln, NE. Fall 2022.

"Identification of Substrates from Quality Protein Popcorn that Promote Growth of Specific Beneficial Bacteria in the Human Gut Microbiome." UNL Food Science Symposium, Lincoln, NE. Spring 2022.

"Breeding Food for Health: Identification of Substrates from Quality Protein Popcorn that Promote Growth of Specific Beneficial Bacteria in the Human Gut Microbiome." Plant and Animal Genome Conference, San Diego, CA. Spring 2022.

"Do the Major Changes in Seed Proteins in Quality Protein Popcorn Influence the Growth of Beneficial, Health-Promoting Bacteria in the Human Gut?" Maize Genetics Conference, online. Spring 2021.

"Mapping the Effects of Plant Diversity with Disturbances in the Gut Microbiome." Nebraska Food for Health Center Seminar Series, Lincoln, NE. Fall 2018.

Awards and Honors

Postdoc Pitch Competition (Third Place), North Carolina State University 2026
Outstanding Postdoc Presentation (First Place), ASM Regional Meeting 2023
Excellent Oral Presentation (First Place), Nebraska Plant Science Symposium 2023
Nebraska Food for Health Center Fellowship, University of Nebraska-Lincoln 2018 – 2022
Milton E. Mohr Biotechnology Undergraduate Research Scholarship, UNL 2016 – 2017

Teaching Experience

Graduate Teaching Assistant

Cellular Biology Laboratory (LIFE 120), University of Nebraska-Lincoln Fall 2017

Guest Lectures

Microbiome Analysis (BIT 588), North Carolina State University Fall 2025
"Multivariate Analysis in Microbiome Studies"

Complex Biosystems 582 (Bioinformatics series), University of Nebraska-Lincoln Spring 2023
"A Crash Course on the Tools of Quantitative Genetics"

Microbiology 101, University of Nebraska-Lincoln Fall 2021
"Characterizing the Effect of Plant-Derived Molecules on the Human Gut Microbiome"

Bioinformatics (LIFE 891), University of Nebraska-Lincoln Fall 2020
"Microbiome Metagenomic Analysis"

Workshops

Workshop Instructor, North Carolina State University Fall 2024
"Crafting Technical Talks for a Diverse Audience"

Food Science and Technology Symposium, University of Nebraska-Lincoln Spring 2023
"Technical Talks for a Diverse Audience: Slide Design"

Mentoring

Research Mentor: Directly supervised 6+ undergraduate and graduate students on independent research projects, experimental design, bioinformatics training, and career development (2021 – Present).

FFAR Fellows Program: Mentored graduate students in the FFAR Fellows program, focusing on professional development and technical skill-building.

North Carolina Youth Institute (World Food Prize): Guided high school students through writing and presenting a research paper on a global agricultural problem and potential solutions (2025 – Present).

Maize Genetics Cooperation: Mentor to incoming members, particularly at the Maize Genetics Meeting, offering professional advice and helping them connect with the community (2026 – Present).

Service and Outreach

Seminar Organizer: Lead organizer, INTRINSyC Plant Biology Seminar Series; developed science communication workshops for diverse audiences (2025 – 2026).

Committee Member: Maize Genetics Cooperation Committee on Outreach, Diversity, Inclusion, and Education (CODIE); advocate for equitable practices and accessibility in plant genetics research (2026 – Present).

Graduate Student Council: Member, Nebraska Food for Health Center (2020 – 2022).

Peer Review: BMC Plant Biology

Professional Memberships: American Society for Microbiology; Maize Genetics Cooperation

Technical Skills

Microbiome & Molecular: Rhizosphere ecology, microbial establishment and persistence, strain tracking, metagenomics, amplicon sequencing, qPCR, DNA/RNA/protein extraction, sequencing library preparation.

Computational & Design: Advanced R and Linux; multivariate statistics, quantitative genetics, machine learning; greenhouse-to-field experimental design for G × E × RM studies.