AGRONOMY SEMINAR SERIES
SPRING 2025

Monday, April 28, 2025
2:30 p.m. LILY 2-425

Attend virtually via Zoom
Seminar links will be posted at: purdue.ag/agryseminars

DR. JEAN-MICHEL ANE

PROFESSOR IN BOTH
THE DEPARTMENT OF BACTERIOLOGY AND
THE DEPARTMENT OF PLANT AND AGROECOSYSTEM SCIENCES
UNIVERSITY OF WISCONSIN-MADISON

Faculty Host: Dr. Jianxin Ma

Dr. Jean-Michel Ané serves as a Professor in both the Department of Bacteriology and the Department of Plant and Agroecosystem Sciences at the University of Wisconsin–Madison. His primary research aims to uncover the molecular mechanisms underlying efficient symbiotic relationships between plants and microbes, with the goal of applying this knowledge to enhance agricultural sustainability for food, feed, and biofuel production.

His specific objectives include:

1. Investigating the genetic and molecular mechanisms that facilitate the establishment of mycorrhizal and nitrogen-fixing associations in plants.

2. Exploring the evolution of these mechanisms to identify key innovations that have fostered the development of these symbiotic relationships.

3. Leveraging this understanding to engineer more effective partnerships between crops and microbes.

Biological Nitrogen Fixation on the Aerial Roots of Maize and Sorghum for Sustainable Agriculture

Cereals, such as Maize (*Zea mays*) and Sorghum (*Sorghum bicolor*), are essential crops that sustain millions of people and serve as livestock feed. Sorghum also holds promise as a sustainable bioenergy crop due to its high biomass yield. Our research has demonstrated that particular maize landraces from southern Mexico derive 29%–82% of their nitrogen from the atmosphere by harboring nitrogen-fixing (diazotrophic) communities in a mucilage produced by their aerial roots after rainfall.

More recently, we have demonstrated similar nitrogen-acquiring traits in specific sorghum accessions. Through acetylene reduction,15N gas enrichment, and 15N isotope dilution assays, we have shown that the sorghum plants with this trait can acquire nitrogen from the atmosphere through diazotrophs in the mucilage, obtaining approximately 43% of their nitrogen from this process. The mucilages of maize and sorghum are similar and produced by border cells that detach from the aerial root cap, resembling the process on underground roots. However, border cells are more abundant and larger in the mucilage from aerial roots than in underground ones. We have conducted a comprehensive study of the aerial root development in various maize landraces and sorghum accessions, elucidating the influence of both genetic and environmental factors. Using QTL and GWAS approaches, we have identified genetic regions governing this trait in maize and sorghum.

Contrary to our initial expectations, humidity and soil nitrogen levels were found to have only a limited impact on aerial root development in these genotypes. Our research also allowed the isolation of over 400 distinct diazotrophs from maize and sorghum mucilage, along with the development of non-fixing mutants as controls and ammonium-excreting mutants from some of these isolates.