CISA Student Showcase

How Soil Microbes Affect Drought Tolerance in Agricultural Crops

Cassidy Kyler
School of Sustainability, College of Global Futures, Arizona State University

Background:

Drought has become an ever increasing threat to agriculture in the southwest. As the weather gets drier, farmers must learn how to grow food in the same capacity as before but with less water. One promising solution is the use of drought-resistant microbes being introduced into the soil microbiome.

What is soil microbiome?

Soil microbiome includes all living things that interact in soil. These include bacteria, fungi, microorganisms, and the plants themselves.

Objectives

The objectives of this literature review is to:

- Investigate how the drought tolerant bioinoculants are selected
- Discuss how different types of inoculation affect the overall drought tolerance of the plant
- Explore the most commonly used bioinoculants

Methods

A total of five peer-reviewed papers were selected for this review.

- Search engine: ASU Library One Search
- Keywords: agriculture, bioinoculant, drought resistant, endophytes, microbiome, bacteria
- Search duration: Sept – Nov 2022

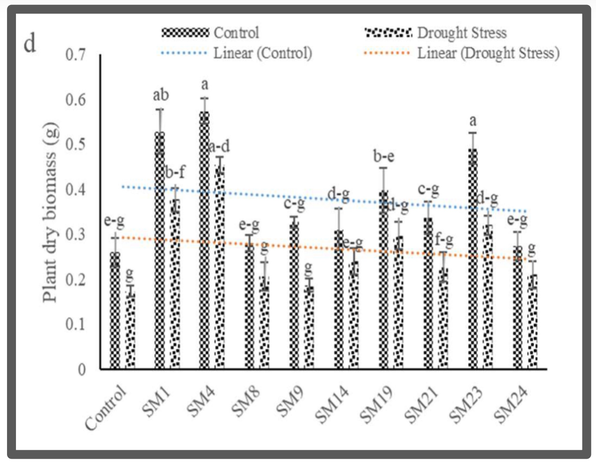

Figure 1. Comparison of different strains of seed endophytes on plant dry biomass of Maize (*Zea mays L.*)

Siddique, S., Naveed, M., Yaseen, M., & Shahbaz, M. (2022). Exploring Potential of Seed Endophytic Bacteria for Enhancing Drought Stress Resilience in Maize (Zea mays L.). Sustainability, 14(2), 673. MDPI AG. Retrieved from http://dx.doi.org/10.3390/su14020673

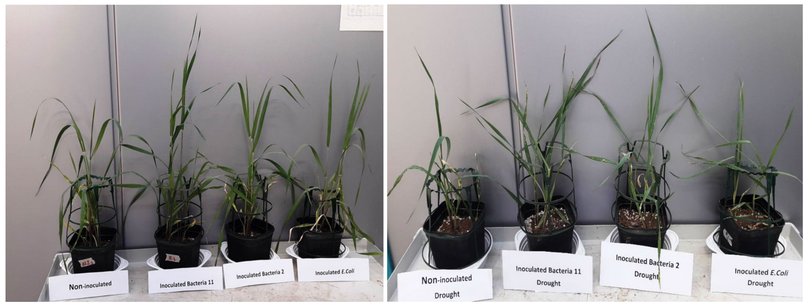

Figure 2. Comparison of shoot length for *Hordeum vulgare* in well-watered and drought stressed inoculated with either *Pseudomonas* sp. (Group 11), *Pantoea* sp. (Group 2), or *E. coli.*

Abideen, Z., Cardinale, M., Zulfiqar, F., Koyro, H., Rasool, S. G., Hessini, K., Darbali, W., Zhao, F., & Siddique, K. H. (2021). Seed Endophyte bacteria enhance drought stress tolerance in Hordeum vulgare by regulating, physiological characteristics, antioxidants and minerals uptake. Frontiers in Plant Science. https://doi.org/10.3389/fpls.2022.980046

Results

- Compared to the uninoculated control, plants inoculated with any bacterium performed better across the board.
- Common bioinoculants include:
  - *Zea mays* L (Corn): *Arthrobacter arilaitensis, Streptomyces pseudovenezuelae, Bacillus subtilis, Bacillus safensis, Bacillus subtilis strains*
  - *Oryza sativa* L. (Rice): *Bacillus megaterium, Bacillus altitudinis, and Bacillus endophyticus*
  - *Sorghum bicolor (Sorghum/Millet): Streptomyces sp., Nocardiopsis sp., Streptomyces laurentii, Penicillium sp.*

Vidal, C.; González, F.; Santander, C.; Pérez, R.; Gallardo, V.; Santos, C.; Aponte, H.; Ruiz, A.; Cornejo, P. Management of Rhizosphere Microbiota and Plant Production under Drought Stress: A Comprehensive Review. Plants 2022, 11, 2437. https://doi.org/10.3390/ plants11182437

Conclusion(s)

- Using bioinoculants have strong promise to improve drought tolerance in agricultural crops.
- However, they still do not perform as well as their well-watered counterparts.
- In order to justify the use of bioinoculants, more studies are needed to investigate the economic tradeoffs associated with using bioinoculants in an industrial setting.