**Independent Project Proposal**

**Intro to R – Fall 2023**

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**Introduction**

Plant root exudates play a key role in influencing a plant’s interactions with its rhizospheric microbiome and with other plants (Bais et. al 2006). The Schachtman Lab has investigated the role of root exudates, specifically sugars and phytohormones, in shaping the rhizospheric microbiome of different maize genotypes and found that the exudate concentration secreted from a plant can influence the composition of its rhizobacterial communities (Lopes et. al 2022). In the exudate collection experiments, the Schachtman Lab also accumulated data on amino acid exudation and plant phenotypic traits of multiple different maize genotypes. Because plant exudate concentration can affect bacterial communities in the rhizospheres of plants, it is hypothesized that this can indirectly then influence the phenotypic traits of plants. In my project, I am wanting to make connections between the concentration of amino acid exudation and plant phenotypic traits among various types of maize genotypes. The overall question is whether amino acid exudation can affect the phenotypic traits of plants across genotypes.

**Objectives**

1. Calculate and visualize correlations between amino acid exudation and plant phenotypic traits in different maize genotypes.
2. Calculate and visualize total amino acid concentrations in the root exudates of the different maize genotypes.
3. Calculate and visualize correlations between different amino acids within a given maize genotype.
4. Calculate and visualize correlations between different phenotypic traits within a given maize genotype.

**Methods**

The methods for collecting maize root exudates from a controlled environment, closely resembling a natural growth environment for maize plants, was developed by the Schachtman Lab, and outlined in the paper, *A glass bead semi-hydroponic system for intact maize root exudate analysis and phenotyping* (Lopez-Guerrero et al. 2022). The exudates were gathered in a semi-hydroponic system, using glass-beads to simulate natural impedances roots would encounter in the soil, along with drip irrigation. Multiple different genotypes of maize were grown in this system, to collect and compare the exudates secreted from each genotype. Certain phenotypic traits, such as root and shoot weights, water content, plant height, number of leaves, leaf area, etc. were also collected from the multiple different maize genotypes grown. The types of exudates that were collected included, phytohormones, sugars, and amino acids, Amino acids will be the focus of this project. Not all amino acids had a good recovery in this system, therefore, the amino acids that did perform well in recovery, will be used in the analysis.

**References**

Bais, H.P., Weir, T.L., Perry, L.G., Gilroy, S., Vivanco, J.M. The Role of Root Exudates in Rhizosphere Interactions with Plants and Other Organisms. *Annual Review of Plant Biology.* 57:233-266 (2006). <https://doi.org/10.1146/annurev.arplant.57.032905.105159>

Lopes, L.D., Wang, P., Futrell, S.L., Schachtman, D.P. Sugars and Jasmonic Acid Concentration in Root Exudates Affect Maize Rhizosphere Bacterial Communities. *Applied and Environmental Microbiology.* 88, 18 (2022). doi: [10.1128/aem.00971-22](https://doi.org/10.1128%2Faem.00971-22)

Lopez-Guerrero, M.G., Wang, P., Phares, F., Schachtman, D.P., Alvarez, S., van Dijk, K. A glass bead semi-hydroponic system for intact maize root exudate analysis and phenotyping. *Plant Methods.* 18, 25 (2022). https://doi.org/10.1186/s13007-022-00856-4