**Background**

Food security and agriculturally unfavorable climates are driving concerns, especially when considering Earth's rapidly growing population and diminishing resources, including water, land, and irrigation. A common and vital agricultural practice, but results in the salinization of land. Increasing soil salinity is the primary cause of the declining amount of land being used for conventional farming. Saline soil, coupled with consequential abiotic stress such as osmotic stress, largely effect crop productivity, resulting in lower yields, decreased biomass and poor plant health. Therefore, it is critical that methods for alleviating salt stress and increasing plant growth are developed.

Circadian genes govern various developmental processes from seed germination to flowering, thus influencing stress response, including salinity. Understanding plant response to adverse conditions is essential to improving salt tolerance of crops in the future. In my research, 3 important circadian genes, CCA1 (g2), FKF1 and CCA1-ENHANCED CIRCADIAN PHASE (CCP1), along with wildtype (Col-0) Arabidopsis thaliana have been studied for salt and osmotic stress tolerance.

**Experimental Design**

This project aims to employ and examine a combination of non-mutant Bacillus strains and circadian genes to maximize plant growth under salinity and osmotic stress. Furthermore, this study examines the influence of circadian genes on plant response to various external stimuli, including abiotic stress and microbial volatile compounds. It was initially hypothesized that all Bacillus strains used (please refer introduction) will improve plant growth in:

- FKF1, CCA1 OR and g2-2 circadian mutants and wildtype plants will respond differently under stress in terms of plant yield and germination ability
- Circadian genes will regulate/plant response to volatile compounds produced by bacteria

Different conditions/experiments were later explored based on obtained results.

**Discussion and Future Work**

In the future, I am planning on improving plant abiotic stress tolerance by:

- Identifying molecular mechanisms behind the observed trichome variation and resilience of FKF1 to abiotic stress during germination.
- Developing microbial volatile compounds produced by B. subtilis.

Furthermore, in my study on undivided plates (please refer introduction) I noticed that in 1 plate, the bacterial colony morphology had changed to a branch-like structure due to its response to signals from the plants. The bacterial colony morphology had changed to a branch-like structure due to its response to signals from the plants. I would like to further study bacterial response to plant signals and how it changes bacterial effect on plant growth.

**Conclusions**

**Impact**

Studying circadian genes is vital for agricultural sustainability, given that they regulate major key processes. Furthermore, understanding the influence of circadian genes from germination to early stages of plant development allows for developing methods to improve plant yield during the cultivation process itself. Trichomes, a key agronomic trait, are an important part of certain crops, such as cotton, basil and melon. Understanding trichome development can allow us to apply its properties and functions to staple crops. The microbial volatile compounds produced by beneficial bacteria are underappreciated. Utilizing these compounds (including those from endophytes like B. subtilis) increases the viability of Bacillus strains as inexpensive, future biocatalysts. Specifically expressed in plant roots, this response to these volatile compounds can aid in identifying pathways through which these compounds work in engineering stress tolerant, higher yielding crops.