Stressed Out: Why Does Ancient Maize Thrive in High-Stress Conditions?

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Why is understanding stress response in maize so important?

- Maize, along with rice and wheat, provide at least 30% of calories to over 4.5 billion people[1]
- Increases in flooding events has heavily impacted natural vegetation and crop production[2]
- Combinatorial stresses, particularly flooding and herbivory, remain understudied for both modern and ancient verities of maize
- Ancient maize may be a superior genetic resource for flood-tolerant corn[3]

Questions

1. How do biochemical responses to flooding and herbivory stress differ between modern and ancient maize?
2. Does combinatorial stress lower plant defense?

Experimental Breakdown

Step 1: Grow plants in greenhouse

Step 2: Induce no flood and flood treatments

Step 3: Induce no herbivory and herbivory treatments

No Herbivory

Herbivory

No Herbivory

Herbivory

Results

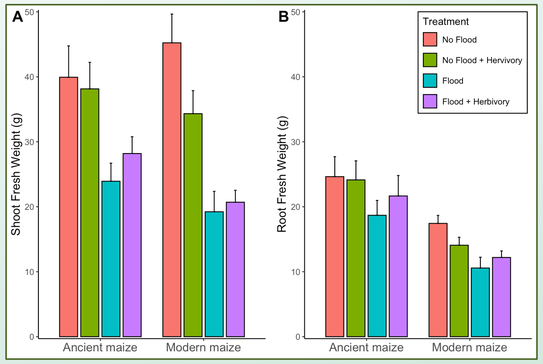
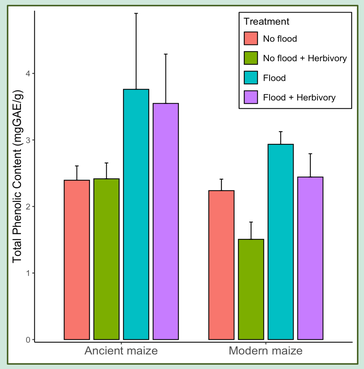


Figure 1 – Biomass (n=8)

- Growth of modern maize shoots under flood, and combinatorial flood and herbivory stress was reduced by <u>at least 55%</u> compared to unstressed treatments
- Ancient maize shows less variation in biomass across treatments, indicating it has improved ability to minimize the biological damages of stress

Figure 2 – Phenolic Content (n=4)

- Phenolic compounds are an important secondary metabolite that help plants acclimate to stress
- Ancient maize produced more total phenolic compounds on average, which may allow harmful oxidizing compounds that form under flood conditions to be neutralized



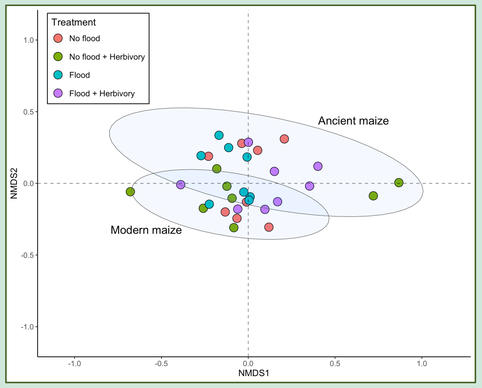


Figure 3 – Volatile Emission Clustering (n=4)

- Volatile organic compounds are chemicals emitted from plants that signal their current conditions to their surroundings
- When under stress, the mixture of volatile compounds change as biochemical responses to the stress occur
- Total volatile emissions of ancient and modern maize cluster differently

Striking Difference!

Unexpected differences were observed in the color and density of the root system between <u>flooded</u> ancient and modern maize samples

Ancient

Modern

Conclusion

- The purpose of this study was to identify biochemical differences in modern and ancient maize under the effects of flood and herbivory stress
- We have observed that ancient maize shows increased phenolic content and a distinct volatile makeup that may contribute to its ability to minimize drastic changes in biomass under combinatorial flood and herbivory stress

Ongoing & Future Work

We are currently concluding a larger scale run of this experiment to increase the accuracy of our dataset, and plan to further explore the differences observed in the roots of ancient maize

Future research should be focused on additional pathways involved in stress-response, such as the biosynthesis of specific flooding and herbivory induced phenolic and volatile compounds

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PRECS Phenotypic Plasticity Research Experience for Community College Students

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