How Perennial Groundcover Affects Maize Growth: Exploring Shade Avoidance Responses

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Research Experience for Undergrad (REU) Program

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Abstract

This third-year field experiment examines how Perennial Groundcover (PGC) intercropping affects maize growth under varying early-season competition. Seven treatments compared to a control (no PGC) with different PGC suppression timings at maize growth stages v4, v6, and v8 to create competition windows. Plant height, leaf angle, chlorophyll (SPAD), and yield were assessed. One treatment uses far-red LED lights without PGC to isolate light competition effects and the shade avoidance response (SAR).

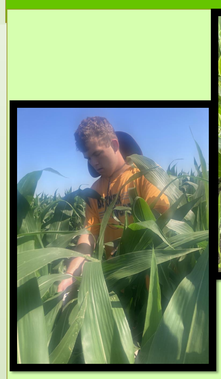
Background

Conventional farming leaves soil bare, causing soil erosion, nutrient loss, and increased chemical use. PGC intercropping grows grass between maize rows to protect soil and conserve nutrients. Though environmentally beneficial, PGC may compete with maize early and lower yields. Maize senses nearby plants via changes in red far-red ratio (R:FR) of the light, triggering SAR that leads to taller, weaker plants. Farmers worry PGC might reduce yield by competing for light, water, and nutrients early in the season.

Objective

Isolate the effect of light competition by manipulating R:FR and compare its impact on maize growth and yield to treatments with PGC competition.

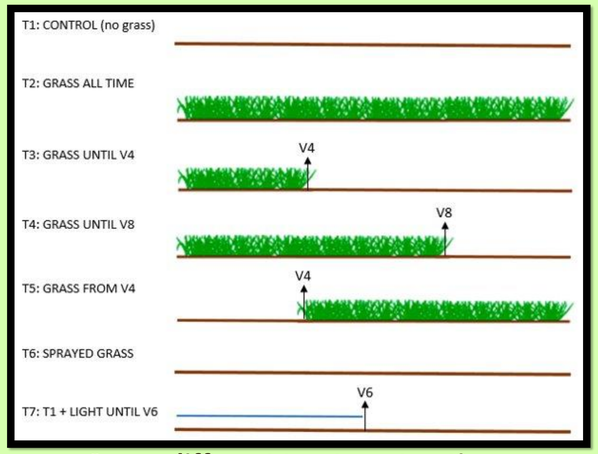
Methods



Measuring leaf chlorophyll content.

Recording leaf angles.

Recording Plant height and stages.



Seven different treatment options.

Results & Conclusion

Figure 1

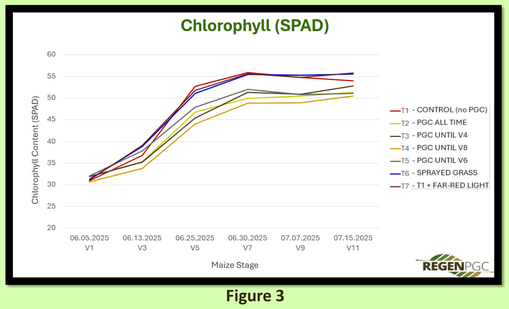


Figure 3

Figure 2

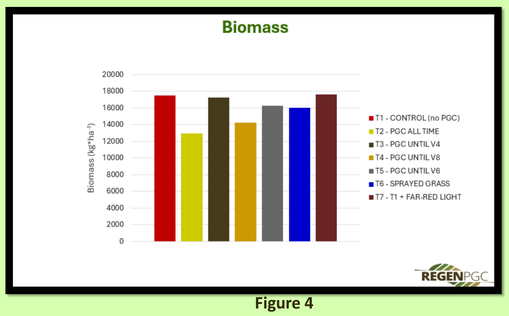


Figure 4

Data from 2024 showed similar biomass yields for the control and LED treatments, suggesting light competition alone isn't a major factor limiting maize growth. Yield reductions in other PGC treatments likely result from belowground competition for water and nutrients.

Classroom Application

NGSS: 2.2 Crosscutting Concepts: Cause and Effect:

CE-M1 – *Cause and effect relationships can be classified as causal or correlational.*

- Middle schools teach to distinguish cause from correlation by testing one variable at a time.
- In this experiment, far-red light simulated PGC shading without water or nutrient competition.

NGSS: Life Science:

LS2.A- Organisms, and populations of organisms are dependent on their environmental interactions both with other living things and with non-living factors.

- Middle school students learn that living things depend on each other and their environment.
- This experiment studied how PGC affects maize by altering light, water, and nutrients, showing how changes in one part of an ecosystem impact others.

Future Collaborations

This summer showed me the value of teamwork in solving real-world problems through research. I worked with mentors like Dr. Ken Moore, Patrick Galland, Rickiel R. Franklin da Silva, and grad students Cameron and Amina, who helped connect field research to the classroom. In the future, I hope to collaborate with local farmers and 4-H leaders to bring real agriculture into the classroom. Thanks to these connections I can always Zoom with my mentors for expert insight in future lessons.

Acknowledgements

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