Planting Methods: Can They Improve Yield and Plant Health?

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Introduction

In Arkansas, there are many counties with high amounts of people experiencing food insecurity. Many require community gardens or locally grown foods as a food source and depend on the yields from these resources. Pesticides have detrimental effects on the crop's nearby habitats, and studies such as ours aim to find more natural ways to protect crops while still increasing yield. The study is a subset of research in an ongoing experiment examining whether various planting and mulch methods increase crop yield through increased natural enemy diversity (NED) and integrated pest management (IPM) to reduce pests.

Abstract

The subset of the study that I performed is a focus on the chlorophyll content and quantum efficiency in relation to yield amount. Research has shown plant structural complexity increases IPM. Also that chlorophyll content and quantum efficiency are an indicator of plant health.
We hypothesize that with the polyculture plant structural complexity healthier plants will have higher yields due to an increase in IPM.
For this study, monoculture (MC) and polyculture (PC) structural methods were implemented for five weeks. We used a SPAD meter to measure approximate chlorophyll content and an OS30P+ fluorometer for PSII quantum efficiency in recording the amount of fluorescence which both were recorded once a week. I took averages from the data we collected and created two linear graphs alongside a bar graph representing the plants' yields. From the data analysis, we found PC and MC planting structures to not influence fluorescence and chlorophyll content in plants. Possibly due to the lack of natural enemies for herbivores and arthropod data for this experiment, we did not observe a difference in the effects of MC and PC planting.

Methods: Collection

- The data was collected in Clarksville, Arkansas, at the University of the Ozarks Food for Thought Garden in August 2019.
- For five weeks, all plants were sampled with the SPAD 502 Plus Chlorophyll Meter and the OS30p+ Research Chlorophyll Fluorometer.
- The SPAD meter would be calibrated and then clamped on three different leaves on each plant. Each measured the amount of chlorophyll content.
- Using the Fluorometer, we would place dark clips on three separate leaves that blocked the sun for 20 mins. After we slide the clip open, then take a reading on the quantum efficiency.

Methods: Data

- The overall average of the chlorophyll content for each plant and plot for the week was used to make a linear graph.
- For the fluorescent meter, we only used a single number from the three to represent our quantum efficiency, which was also plotted in a linear graph
- Lastly, in the end, all the swiss chard plants yield amount was put into a bar graph to be compared.

Results

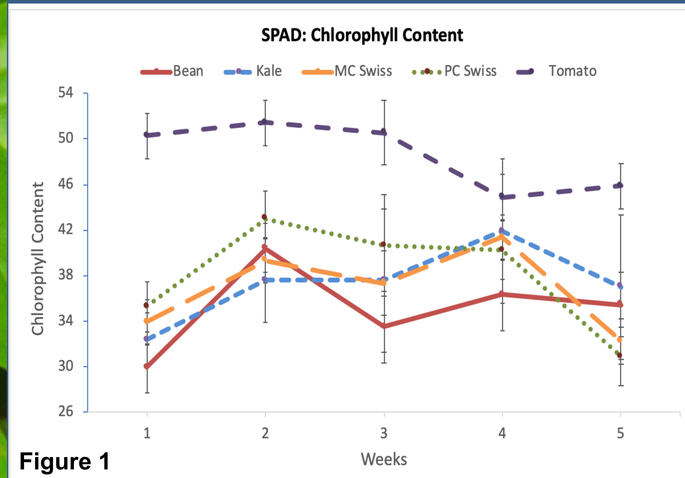

Figure 1

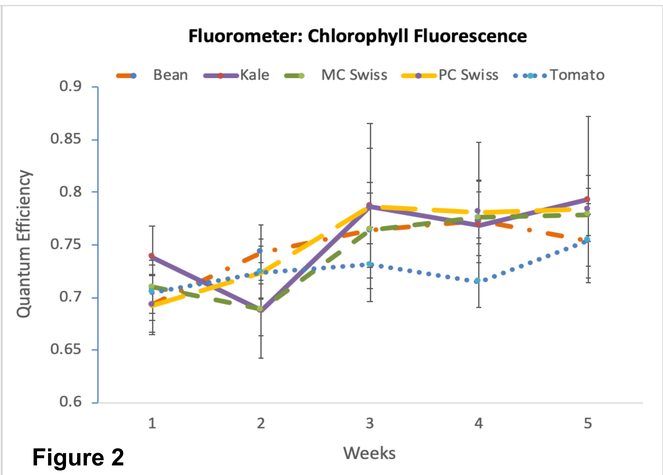

Figure 2

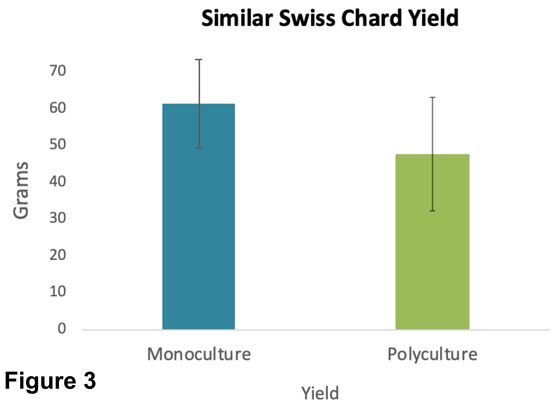

Figure 3

Figure 1: The higher the chlorophyll content, the healthier the plant or the plant naturally has a prominent ability to take in light. The MC swiss chard plant had lower chlorophyll content overall compared to the PC swiss chard. The dips signify moments of stress and the plants chloroplasts were possibly damaged.

Figure 2: The quantum efficiency shows how well photosynthesis 2 is occurring. The data was inconclusive due to the lack of variances and the insignificant p-value.

Figure 3: The MC swiss chard had only slight increased yield compared to the PC swiss chard. Meaning the higher yield had no correlation to PC swiss having higher chlorophyll content.

We did not observe any direct correlation between the variables analyzed.

Discussion

Due to the swiss chard yield amount of the monoculture (MC) being only slightly more than the polyculture (PC) and the chlorophyll content to favor polyculture, we failed to reject our null hypothesis. Though we found no comparison there are many other aspects that could have affected our data analysis.

Not having the arthropod data meant not knowing what was interacting with the plants, how the planting structure affected NED and IPM, and possibly the inability to draw correlations between the data without the arthropod information.

Also the herbivores could have been making the plants worse off due to the lack of natural enemies so the effects of the MC or PC structure could not be measure accurately, but overall this is a complex system with a vast amount of variables influencing each plant so it is difficult to say one part affected the data we received.

Conclusions

From the data analysis, we found MC and PC to have the same effect on chlorophyll content and fluorescence.

Until we have arthropod data we are unsure of the realtioship between the plant health indicators and planting structure.

Due to the swiss chard yield of the MC and PC being similar we were unable to see a relationship and the positive effect on PC and plant yield.

Therefore in our experiment, we found that MC and PC affect chlorophyll content, quantum efficiency, and yield amounts similarly, contrary to our hypothesis.

The study will be repeated to observe a pattern and obtain better information to determine the relationship of PC on yield.

For more information, contact me at Christinawaddle17@gmail.com

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