Quantitative Analysis of Phosphorus Deficiency and Toxicity on Brassica rapa

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Introduction

Phosphorus is an essential nutrient for plant growth and development. It plays a necessary role in many molecular processes including flower and seed development, regulating genetic processes, promoting cell division, and photosynthesis. For a plant to function properly, it must be subjected to an appropriate balance of phosphorus with other essential nutrients such as nitrogen and potassium. Too high or too low of a concentration of a certain nutrient can hinder a plant's ability to successfully uptake other nutrients it needs for growth. Our question was what would be the effect of varying concentrations of phosphorus on Brassica rapa's vegetative growth and flower development. We chose to use this plant because we would be able to study the effects of phosphorus treatment over a plant's life due to the short life span of Brassica rapa. We hypothesized that as the concentration of phosphorus is increased, we will see a negative trend in vegetative growth and a positive trend in mature growth such as flowering.

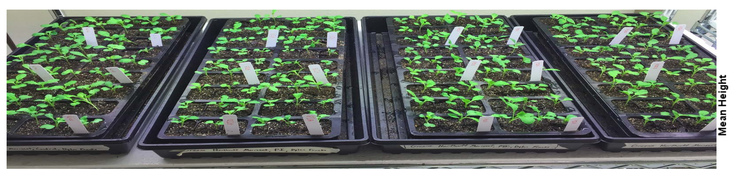
Materials and Methods

- 216 Wisconsin Fast-Plant Seeds (1 Fast-Plant seed per cell, 6 groups of 9 cells in each tray, 4 trays, 216 seeds total)
- 4 trays with 56 cells in each
- Fertilizing solutions containing altered phosphorus levels – 0x, 1x, 3x, and 5x
- Syringe capable of holding at least 2 mL
- Ruler/Measuring tape
- Basic plant necessities (lighting, water, ventilation)

After planting a seed in each of the 216 cells, we watered them and let them germinate until the following week. Once established and above the soil, we applied 2 mL of fertilizing solution to each treatment - P0, P1, P3, and P5, with each number representing the treatment group's phosphorus concentration (0x, 1x, 3x, 5x strength). Our phosphorus deficient treatment, P0, served as our control for this experiment. Each week the plants were fertilized and watered, and measurements were taken to find the height, number of leaves, and number of flowers of each plant for analysis.

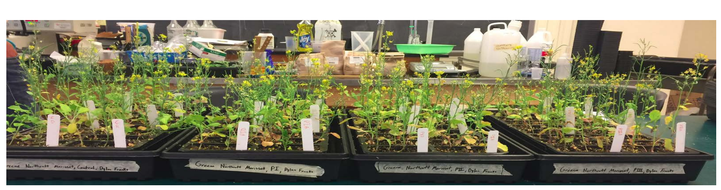
Results

According to the graphs below, we are shown that vegetative growth and flowering are both dependent on phosphorus concentration. Each set of data is illustrated by two graphs, a and b, which display the same set of data for each measurement. From our ANOVA we are able to see that the two lower concentrations, P0 and P1, of phosphorus experienced a higher rate of vegetative growth (height and leaf count), while the two groups with a higher phosphorus concentration, P3 and P5, experienced a higher flowering rate.



Week 1

Week 2



Week 3

Conclusion

Our original question we were trying to solve was what effect do various concentrations of phosphorus have on vegetative growth and flowering of Brassica rapa? We hypothesized that the lower concentrations of phosphorus (0x-P0 and 1x-P1) would have a positive effect on vegetative growth while the higher concentrations of phosphorus (3x-P3 and 5x-P5) would have a positive effect on flower development. From the analysis of our data, we are able to conclude that our hypothesis was correct, that higher concentrations of phosphorus had a negative effect on vegetative growth while it had a positive effect on flowering, and that the lower concentrations of phosphorus had a positive effect on vegetative growth while they had a negative effect on flowering. We believe this is because toxic or deficient concentrations of phosphorus affect the plant's ability to uptake other nutrients required for growth and development, hindering it's ability to function properly. From this experiment we have observed the effect of varying phosphorus concentrations and the importance of nutrient balance in plants.

Literature Cited

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Figure 1a - Plant Height of Each Treatment by Week

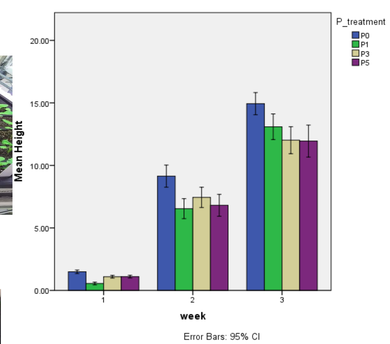

Figure 2a – Number of Leaves of Each Treatment by Week

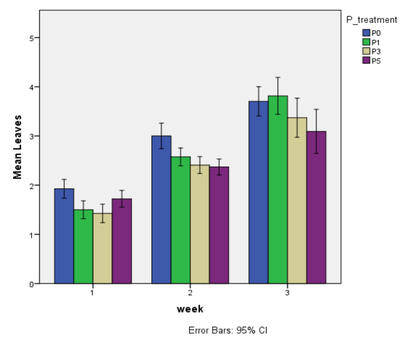

Figure 3a – Number of Flowers of Each Treatment by Week

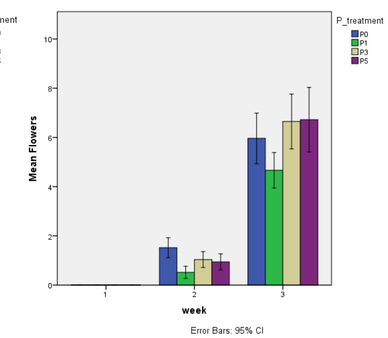

Figure 1b - Plant Height of Each Treatment by Week

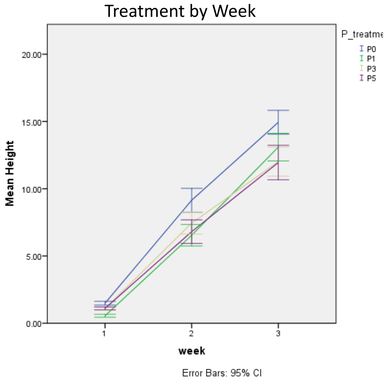

Figure 2b – Number of Leaves of Each Treatment by Week

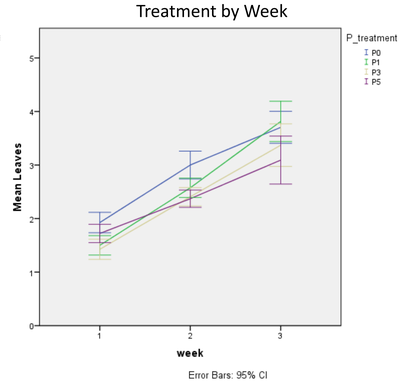

Figure 3b – Number of Flowers of Each Treatment by Week