Color Me Crazy: Effects of Food Dye on Plant Growth

Tiana Sanders[1] Tori Jeffries[2] Franci Hernandez[3]

Howard Hughes Medical Institute

Introduction

The use of dye has been utilized to test different processes in plants such as the capillary action for which the plant takes in water and new root growth[1,3]. Plants have been known to be affected by dye, but the physiological effects the dye has on the plant has not been studied in-depth. Based on past studies we hypothesize that the dye will not have an effect on the growth and development of the plants because the roots filter out most of the potentially harmful chemicals[2]. We propose to test whether adding food dye to the water will have an effect on the plants' growth and development. In order to observe if different color dyes have an effect on the growth of plants we had two treatment groups that were exposed to red and blue food dyes in two different species of plants, Soybeans and Wheat. Using two species allows us to compare the different effects the dye has on a monocot and eudicot species. Additionally preparing cross-sections will allow us to determine if, in what area of the plant the dye is taken up in.

Methods

The materials used were digital calipers, 6 plant pallets with 10 large pots in each pallet, miracle grow potting mix, red and blue food dye, and two species of plants, Soybeans and Wheat. In the first week, one person from our group planted 3 seeds per pot of each plant species in 1 cup of soil as specified by the setup to insure consistency. When allowing the plants to germinate, the plants were watered with regular water, and pots with more than one plant were thinned such that the remaining plants showed little variation. The next time the plants were watered, the solution for the dye concentrate was approximately 28 drops per 500 ml. The following weeks the plants were checked every couple days to be watered with the specific water concentrate. Once a week the entire group met to collect data from the growing plants. Our group measured the shoot width in mm and length in cm with a digital caliper and counted the number of leaves for each plant. During the final week the final growth data was collected, analyzed, and further recorded onto the excel spreadsheet. Cross sections were prepared using a nut and bolt microtome.

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Results

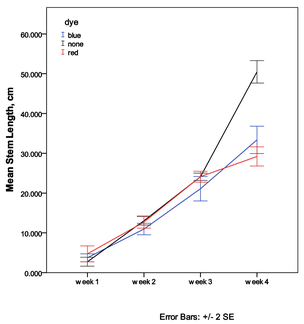


Figure 1: The difference in stem length of the Soybean plant groups over four weeks.

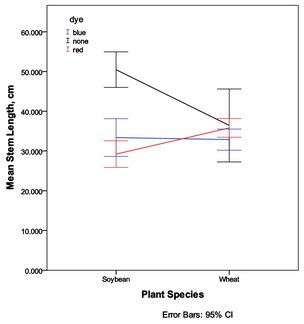


Figure 2: The difference of both the Wheat and Soybean treatment groups compared with the control.

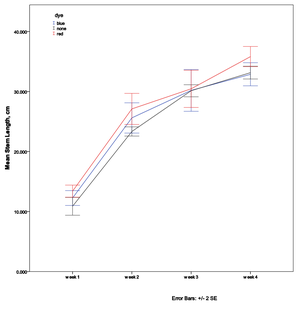
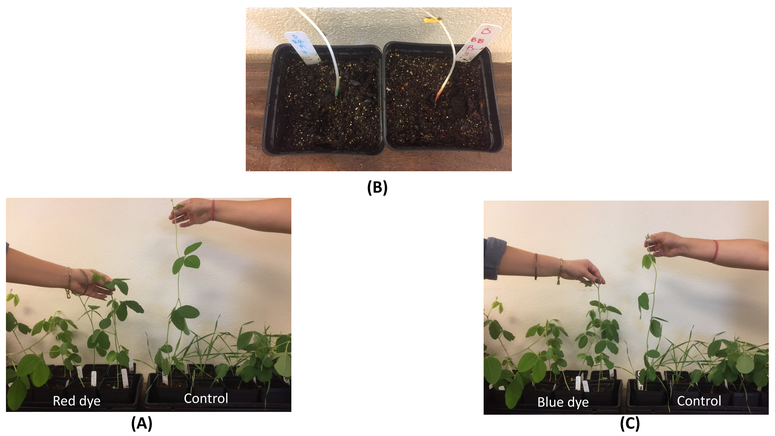


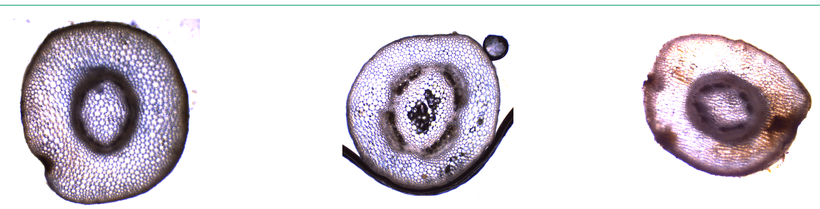
Figure 3: The difference in stem length of the Wheat plant groups over four weeks.

An ANOVA analysis was utilized to compare the stem length, stem width, and leaf number of the treatment groups to the control group. We found that the stem length was most significantly affected by the dye in the Soybean plant (p=1.002E-08). The Wheat plants did not have a significant difference in stem length between the treatment and control groups. While leaf number and stem width were also measured these were insignificant between the treatment groups.



(A) (B) (C)

Figure 4: The difference in stem length between the treatment groups and control in the Soybean. (A) is the red dye treatment compared with the control. (C) is the blue dye treatment compared with the control. Image (B) depicts Soybeans grown in the dark and the uptake of red and blue dye.



(A) (B) (C)

Figure 5: The differences in the cross sections of the Soybean plants grown in the dark that were given the dye treatment. (A) was treated with blue dye (B) is the control and received no treatment (C) was treated with red dye.

Conclusion/Discussion

Several significant variations were seen from adding dye to the plant groups. In opposition to our hypothesis, we found the dye is taken up by the plants. The cross sections in figure 5 show that the dye is taken up in multiple areas of the plant. Although, the group of plants we had in the light did not show signs of color intake, you can see the intake of color in the dark Soybean plants in figure 4-B. We assume this is because when the plants were grown in the dark they did not have a chance to turn green from the light. The chlorophyll in the light plants blocked us from being able to detect the color change. You can also see the color intake and compare the red, blue, and control in the cross sections in figure 5. With a p-value of $1.008*10^{-08}$ our experiment showed some significant results in differentiation between the stem length in Soybean plants that received blue dye verses Soybean plants which received no dye. As you can see in figure 4-A and C it is clear that the dye had some sort of inhibition factors in plant growth. This difference did not start to show up until about the 4th week as you can see in figure 1. The Wheat plants did not have as much of a color change as the Soybeans nor did it have a significant height difference. If we could further research this topic we would have a bigger sample size and several different types of plants to see what characteristics cause the variation of results that we received. As you can see in figures 1 and 3 during week 1 the plant heights had a large scale from smallest to biggest. If this were smaller then we might have seen a significant difference between red dye Soybeans and blue dye Soybeans. If this experiment were to be continued the samples would all need to be more homologous from the start. We could also test different types of dyes such as natural vs. unnatural to try and find one that does not inhibit growth. Dying plants to create a more desirable color for consumers could be very useful and profitable, but not if it negatively affects plant growth. That is why further research on this topic is important. Over all we found that the plants did take in a small amount of color and the dye did inhibit growth in Soybeans.

References

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