

Hydro Beans: Active Learning of the Scientific Method

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INTRODUCTION

Prior to conducting this experiment I had no previous experience with conducting my own scientific experiment, let alone growing any plants in a hydroponic environment. However despite my lack of knowledge on the particular experiment, not only did I expected to obtain accurate results that would answer the question of which bean will grow the longest in length (cm), but I also expected to learn about how plants in general will react and grow in a hydroponic environment. Throughout the duration of the experiment I successfully learned and applied the scientific method by formulating a hypothesis, collecting data, and developing my own conclusions. I also learned how to efficiently monitor and set up a basic but effective hydroponic environment that will promote the growth of beans using basic lab equipment provided to me by my professor.

Purpose: To learn and successfully apply the proper steps of the scientific method while exploring the topic of hydroponic environments and growth within one.

Question: "What seed (black, white, pinto) will grow the best (in length cm) when placed in a hydroponic environment over the course of 3 weeks?"

Hypothesis: "If the beans are placed under the same conditions over the duration of 3 weeks then the black beans will grow longer in length than the white and pinto beans." The reason that I hypothesize that the black beans will grow longer in length is because even though the black beans look smaller in size, this may be an advantage because I predict that the small size might require less energy to begin the germination process, thus having more time to grow than the other beans.

PROJECT SET-UP: MATERIALS AND METHODS

First the beans were soaked for a period of 24 hours to saturate the beans before placing them in the hydroponic garden set up. A label was then placed on each beaker labeling them Black, White and Pinto. Once the beakers were set up and labeled a filter paper was then placed inside each beaker. Each beaker contained 5 beans (pinto, white, and black). Using a pipette, 2mL of tap water was extracted from a separate flask and placed into each labeled beaker. The beakers with the beans inside them were then covered, re-watered every 48 hours and monitored every day (Monday-Friday) for a period of 3 weeks and recorded onto a Daily Journal.

RESULTS

The beans were monitored for a time period of exactly 3 weeks (21 days) and the day by day observations were listed in a Daily Journal. The tallest bean and first bean to germinate (day3) was a white bean, growing to (10cm) in length as seen in (Table 1: Average Length, Germination and State of beans). The beans with the highest average mold at the end of the experiment were the black beans (all 5 beans having mold), and the beans with the highest averaged death rates were the White and Black beans (80% decomposition rate) which can also be seen in (Table 1, Figure 1). The beans with the most successful germinations (4 germinated) and tallest average in length (3.8cm) were the pinto beans as seen (Table 1, Figure 2).

Table 1: Average Length, Germination and State of Beans

Five beans per group were assessed individually and averaged out to obtain more accurate results.

| Pinto beans | | | | |
|----------------|-------------|--------------|-------------|---------------|
| | Germination | Length (cm) | Mold | Decomposition |
| Bean 1 | ☑ | 3cm | ☒ | ☒ |
| Bean 2 | ☒ | 0cm | ☑ | ☑ |
| Bean 3 | ☑ | 2cm | ☑ | ☒ |
| Bean 4 | ☑ | 6cm | ☒ | ☒ |
| Bean 5 | ☑ | 8cm | ☒ | ☒ |
| Average | 80% | 3.8cm | 40% | 20% |
| White beans | | | | |
| | Germination | Length (cm) | Mold | Decomposition |
| Bean 1 | ☒ | 0cm | ☑ | ☑ |
| Bean 2 | ☒ | 0cm | ☑ | ☑ |
| Bean 3 | ☒ | 0cm | ☑ | ☑ |
| Bean 4 | ☒ | 0cm | ☑ | ☑ |
| Bean 5 | ☑ | 10cm | ☒ | ☒ |
| Average | 20% | 2cm | 80% | 80% |
| Black beans | | | | |
| | Germination | Length (cm) | Mold | Decomposition |
| Bean 1 | ☒ | 0cm | ☑ | ☑ |
| Bean 2 | ☒ | 0cm | ☑ | ☑ |
| Bean 3 | ☒ | 0cm | ☑ | ☑ |
| Bean 4 | ☒ | 0cm | ☑ | ☑ |
| Bean 5 | ☑ | 1cm | ☑ | ☒ |
| Average | 20% | 0.2cm | 100% | 80% |



Figure 1: Average Mold, Decomposition, and Germination Rates

Pinto, white, and black beans were assessed for 21 days under a hydroponic treatment. Mold, Decomposition, and Germination rates are displayed

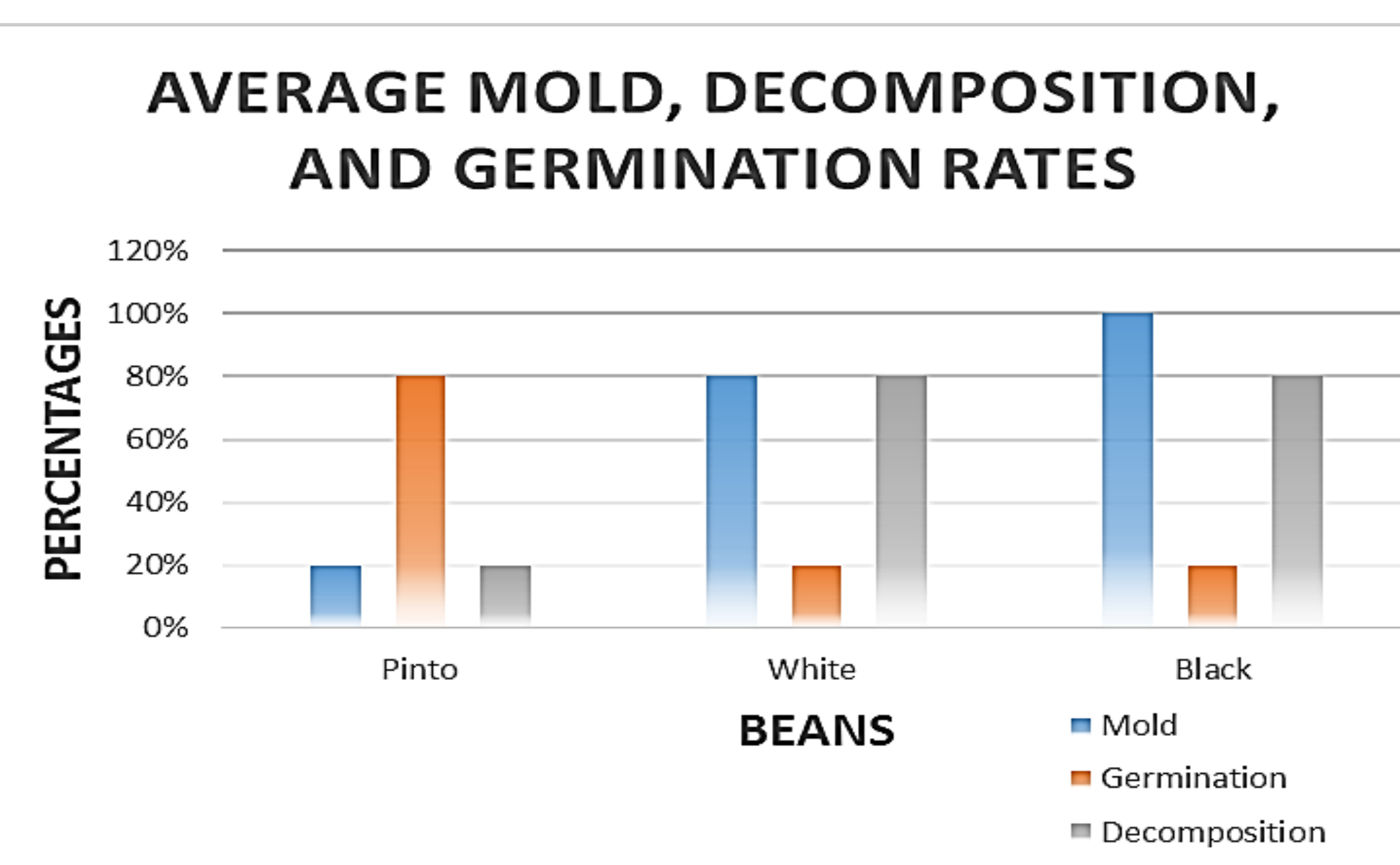
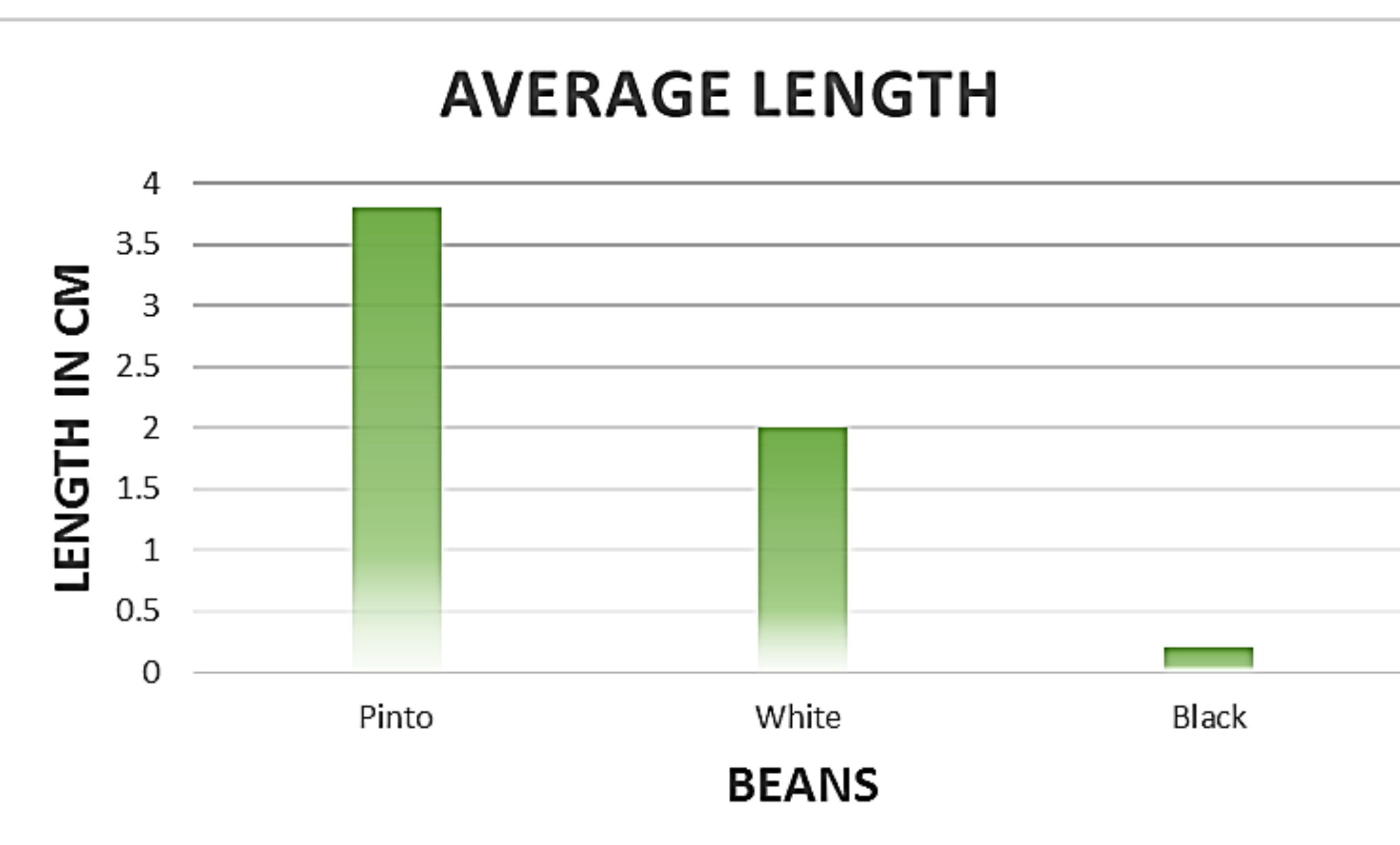


Figure 2: Average Bean Length

Pinto, white, and black beans were assessed for 21 days under a hydroponic treatment. The beans were measured from tip of root to shoot tip. Average length in centimeters is shown.



CONCLUSIONS

My initial hypothesis stating that the black beans were going to be the longest in length was proven wrong when in reality the pinto beans were. Even though my hypothesis was proven wrong, the results were not very clear and as precise as I wanted them to be because of other natural factors not expected in the initial experiment such as mold and decomposition rates. The mold really played a huge role in my experiment and that is why I would like to add future recommendations for this experiment such as introducing an anti-mold and anti-fungal agent into the hydroponic environment where the beans were grown in order to reduce any chance of this having a negative effect on the germination and final length of the beans.

DISCUSSION OF EXPERIENCE

The experiment was very intriguing and educational to me in general. Not only did I learn how to set up a hydroponic environment in which I grew the beans and can now apply to other plants, but I also learned from firsthand experience that when conducting a science experiment one does not always obtain the expected results. As the experiment was coming to a conclusion I realized that sometimes unexpected factors may have a lot of influence in the production of unexpected results of an experiment.

I grew intellectually as the experiment progressed and was challenged multiple times. I faced adversity but found ways to overcome in situations such as gaining access to the green house to record data on days that I did not have class. The daily journal that I kept helped me notice small key things in my experiment and also helped me grow as an observer. Even though my hypothesis was proven to be incorrect according to the results that were obtained, I actually acquired more knowledge and data than expected.

This experiment helped open up my eyes to what science in general is all about. I am excited to say that this will be the first of many experiments that I will be doing throughout my undergraduate education as I begin my journey with the hopes of becoming a doctor in the near future.

REFERENCES

"Heirloom Pinto Bean Seeds | Grow Pinto Beans." www.mypatriotssupply.com. Web. 9 Oct. 2014.
"Yatayat Universal." Import Export White Beans. Web. 9 Oct. 2014.
"Black Beans." - 6 Surprising Superfoods. Web. 9 Oct. 2014.

Acknowledgements:

This project was supported in part by the UIU science department. Special thanks to Dr. Schmidt, Mrs. Cline, and Dr. McCarville for assisting with this project.