Photomorphogenesis of Plants

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ABSTRACT

Photomorphogenesis explores plant growth in relation to various wavelengths of light. Prior research concluded that plants were more sensitive to blue light. In this experiment, we will assess the growth of lima beans in relation to six various wavelengths to understand the unique characteristics wavelengths offer to the given plant. **We hypothesize** that shorter wavelengths will yield more growth in respect to height and leaves produced of the lima bean plant than that of a longer wavelength light. The plants were supplied with 100 mL of distilled water for every two days and kept at a temperature of 23C .The growth and shape of lima beans were recorded that were grown under various wavelengths of light. The company Norman Lamps sells inexpensive colored LED bulbs that emit the following wavelengths in nm: purple (443), pink (632), white (660), amber (572), red (680) and blue (470). We tested growth in height, number of leaves, leaf area (using Image J), and dry and fresh weight of lima bean plants grown under purple, amber, blue, red, white, and pink lights. Initial experiments have revealed that plants grow well when placed under the following lights: (4 plants under each wavelength) pink (632 nm), purple (443 nm), blue (470 nm) and amber (560 nm). Plants grown under purple and amber lights had the greatest number of leaves (30 and 30 respectively versus 20 for the blue and 20 for the red wavelengths). However, even though plants grown in blue and red light produced less leaves, they also had a difference in average height (20.25 cm. for the blue) or greater (23 cm for the red), which might indicate that the plants grown under those wavelengths allocate growth resources to height rather than leaf number. In the future, we will add stem diameter and the effects of shading and competition by other plants to our measurements.

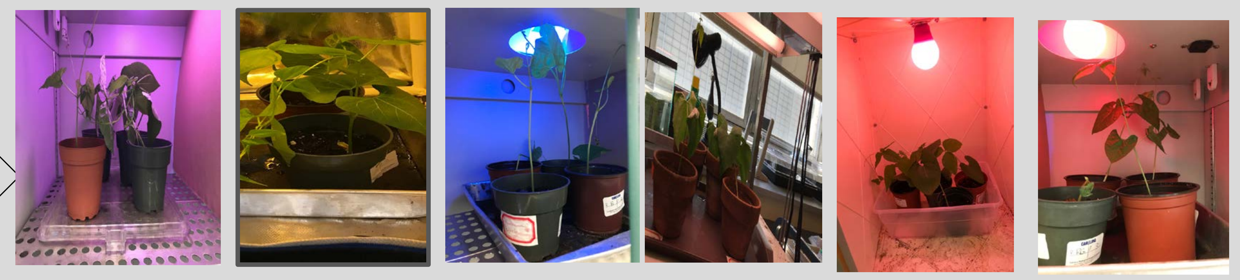
INTRODUCTION

As the population increases, the need for agricultural food also increases, suggesting a direct correlation between population growth and quantity of food demanded. Humans rely on healthy plants as a source of nourishment; therefore, a rapidly growing population results in the necessity for growth in plant production. Life, on earth, is dependent on the process of photosynthesis, which is performed by plants in order to convert solar energy into chemical energy. In this process, plants utilize pigments such as chlorophyll a and b to convert carbon dioxide, water, and radiation to organic compounds. Thus it is important to understand the physical effects of solar energy on plants, which is a process called photomorphogenesis.

METHODS

1. 24 lima beans were germinated and potted
2. 12 pots were used, each with four lima beans
3. 100 mL of water was given every two days
4. Plants paced under each light, pink (632 nm), purple (443 nm), blue (470 nm), amber (560 nm) red(689nm),and as a control white light(660nm)

1. Leaf area (ImageJ), leaf count, height were measured weekly
2. Fresh and dry mass were calculated after experiment



Purple LED Amber LED Blue LED White LED Pink LED Red LED

Table 1. Leaf Count

A.

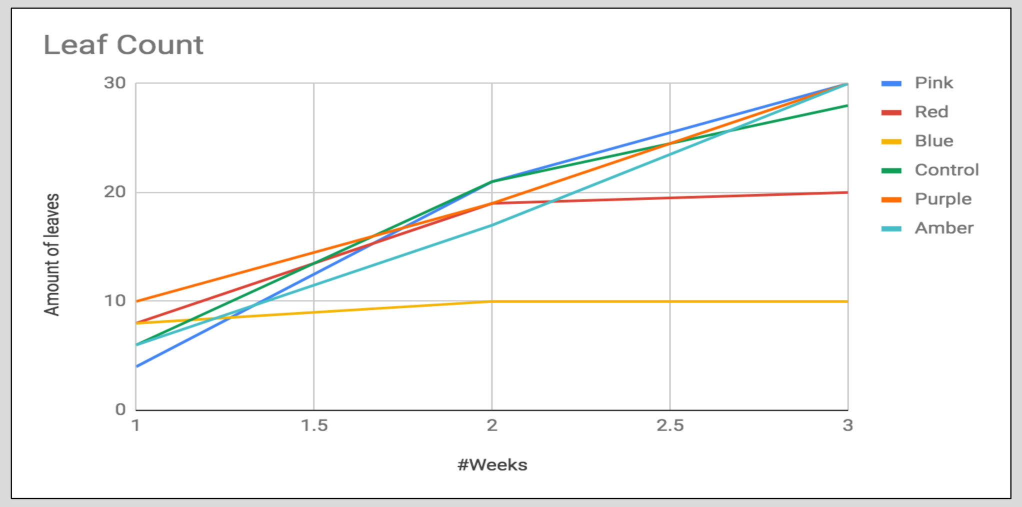


Figure 1. Leaf count under various wavelengths (A) shows the amount of leaves produced under different wavelengths .*

Table 2. Leaf Area

A.

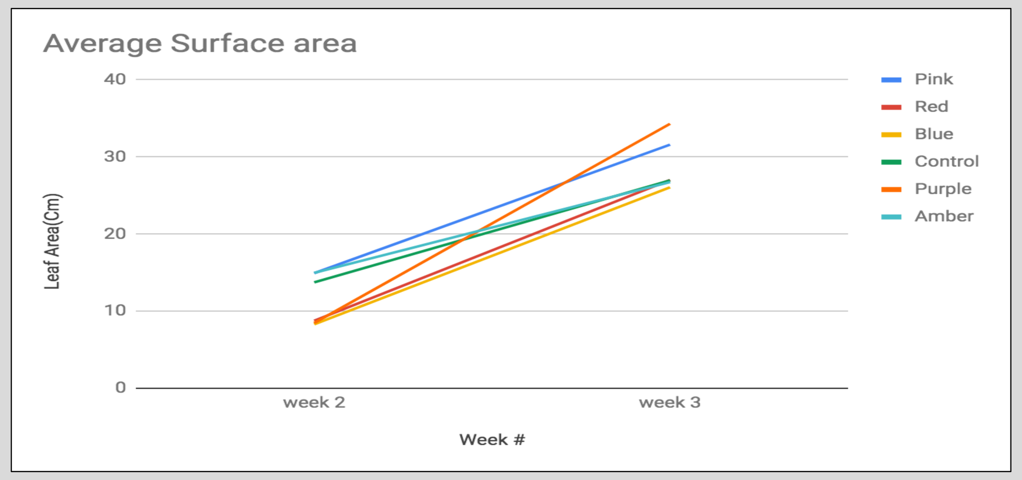


Figure 2. Average Surface Area of plants under various wavelength (A) shows the surface area of leaves when isolated and to a specific wavelength

Table 3. Plant Height

A.

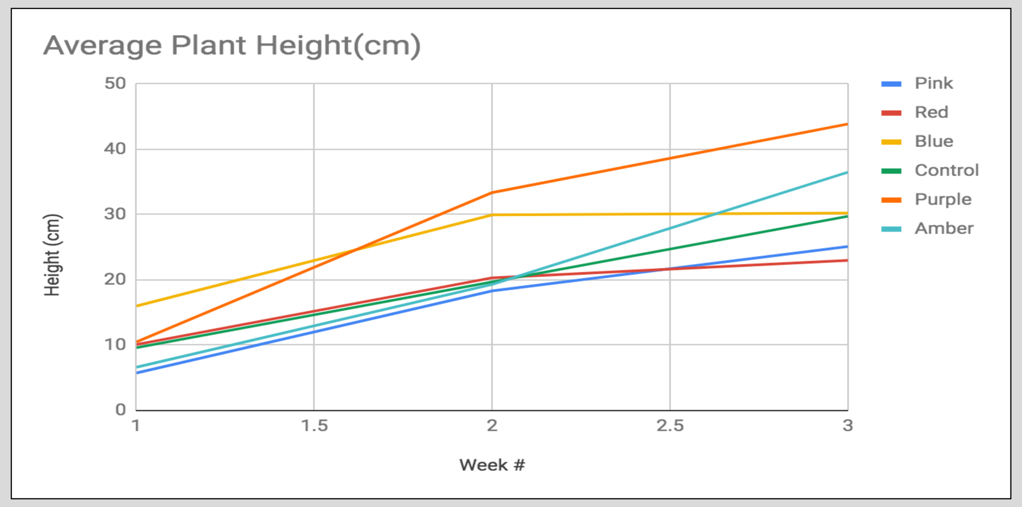


Figure 3. Average plant height (A) Shows the average plant growth of plants over a given period of time.

Table 4. Plant Mass

A.

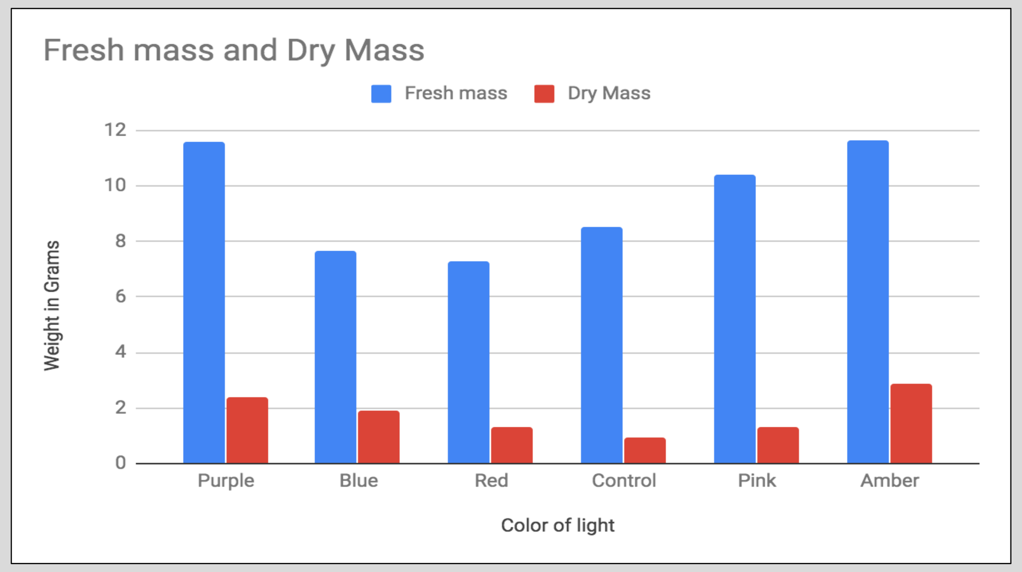


Figure 4 Fresh mass and Dry mass of lima bean plants (A) Fresh mass was calculated and compared to that of Dry mass.

Purple Pink Blue Amber

* *Note:* The first two leaves in the lima bean are simple; all others are compound with three leaflets. Students recorded leaflets separately.

RESULTS

- Plants under purple light had the most overall growth
- Amber light had the second to most growth
- Under blue light, the plants grew the least which was different from previous research (Snowden, 2015).
- Pink light had the highest growth = not the ideal light
- Results of a t-test provided statistical data that would reject the hypotheses providing a “p” value of less then .005,resulting in the abnormal trends that were observed .

LIMITATION

- Different length after germination
- Dried under white light
- Some plants failed to grow due to canopy effect

CONCLUSION

- This research was done to determine the ideal light source that would contribute to the best growth
- The plants under purple light had the most overall growth when comparing all factors of height,surface area,plant mass and leaf count
- Purple light contributed to 30 leaves,34.31cm of leaf area, and the average fresh and dry mass of 11.607g and 2.38g respectively.

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