Effect of Auxin (IAA) Hormone on Bean Seed

(*Phaseolus Vulgaris*)

in Response to Light and Darkness

Lauren A. Law

Youngju

Ahmad

Azeem

Lab 4- Exercise 13

Biology 2108

September 15, 2015

ABSTRACT

The action of auxin (IAA) plant hormone on *Phaseolus Vulgaris* was carefully calculated in six individual beans. Auxin (IAA) allowed for increased growth when exposed to particular environmental conditions as well as varying the amount of Auxin (IAA) administered. Seed germination is controlled by many components- temperature, light, auxin, and moisture. The presence of auxin (IAA) is known to promote growth and development, root initiation, leaf abscission, apical dominance, and cell elongation in plants. This hormone moves away from light, yet causes plants to move in the direction of light (phototropism), but always moves downward in the direction of gravity (gravitropism). I outline the effect auxin (IAA) presents on the germination of the *Phaseolus Vulgaris* bean seeds in varying light conditions- light, partial light, and darkness. The advancement of germination significantly increased in those plants receiving partial light with one pipette of auxin (IAA) vs. full light and no light subjects receiving both one and two pipettes of auxin (IAA) by at least 65% in the first week. Upon examining the significance of germination between the light and dark treatments in the first week, there were none;

however, week two results greatly differed in the uncovered, fully exposed plant receiving one pipette of auxin (IAA), instead of two pipettes, by at least 100%. These data yield strong

evidence to support the hypothesis that auxin (IAA), given in the right amount of doses, is pivotal in seed germination, especially in combination with exposure to partial sunlight rather than full sunlight or no sunlight.

INTRODUCTION

Seeds of all species possess auxins. Almost all, however, possess auxin indole-3-acetic acid (IAA), in specific, in order to provide certain key elements for a plant to be successful in germination. These key elements include cell elongation, cell division, root growth and development, tropisms, apical dominance, leaf abscission, and flowering (NewWorldEncyclopedia, 2012). Factors regulating growth are well known by the majority as being light and temperature, but many may not be so aware of particular hormones that are involved in the process of germination, which is why this study is so important. Much can be learned about effects on agriculture and even human beings from studying this hormone.

Auxin (IAA) natural provides plants the ability to grow and develop after a period of dormancy. Many studies yield positive effects of this hormone promoting actions such as growth behavior- phototropism, geotropism, apical dominance, lateral branching inhibition, shoot elongation and sprouting of fruit or flowers, using coordinative signaling (NewWorldEncyclopedia, 2012). In 1881, Darwin and his son, Francis, would discover auxin and the extraordinary effects this hormone exhibits on plants' directional growth- toward light (Hoot, 2009, p. 19-21). According to Dr. Stephen G. Saupe (2009) at the College of St. Benedict/ St. John's University, there are several different types of auxin- auxin indole ethanol, indole acetaldehyde, indole acetonitrile, phenylacetic acid (PAA), and 4-chloro-indoleacetic acid.

Auxin (IAA) always moves in polar transport, meaning it always moves toward the base of the plant. It does this by diffusion within parenchymal cells.

Since in depth research and evidence provided by Dr. Saupe (2009) has shown that auxin (IAA) passes through the lipid membrane by way of protons strategically being pumped out of the cell and forming a bond with other molecules, then ionizing itself in order to increase its pH to pass back through the membrane to ultimately move as a group out of the bottom of the cell and then into other cells, all to produce growth and development actions, the hypothesis produced is that if seeds get partial light and hormone, then the seed will germinate more than any of the rest of the plants.

The role of light and the effects it has on the production of plants is another very important factor that must be considered when appraising the results this experiment concludes. Without light, it is known that plants cannot undergo photosynthesis. According to Dictionary.com (2015), photosynthesis is "the complex process by which carbon dioxide, water, and certain inorganic salts are converted into carbohydrates by green plants, algae, and certain bacteria, using energy from the sun andchlorophyll." Plants need this interaction in order to be successful in germination and growth. Based on this inductive reasoning, the experiment is designed to test the effects of auxin (IAA) natural on seeds before germination, in three different light-controlled environments.

MATERIALS AND METHODS

Six *Phaseolus Vulgaris* seeds were acquired from lab professor, Kate Thornton, Department of Biology, Georgia State University, GA. Seeds were sustained in regular soil at

room temperature in the laboratory and were provided no auxin (IAA) natural hormone or water in the negative control, dark environment. Each seed was placed into it's own square within a styrofoam holder. Solutions of auxin (IAA) were prepared at one pipette and two pipettes. Two plant seeds preparing for reception of the positive control- full fluorescent light exposure, were given one and two pipettes of auxin (IAA), respectively, along with ten milliliters of water. Another two seeds, preparing for partial fluorescent light exposure, were each given one and two pipettes of auxin (IAA), respectively, along with ten milliliters of water and then covered with a thin napkin. The last two plant seeds, however, which were prepared for no light/full dark exposure, were provided negative controls of no light, no hormone, and no water. Light and hormones were our independent variables, making growth (length) our dependent variable. Germination, or lack of germination, was measured in centimeters and recorded once a week for three weeks. Any growth in the stalk (stem), in centimeters, was accepted as the operational definition.

RESULTS

In the light-exposed seeds, successful growth was significant compared to the negative control of no light, by greater than 100%. Similarly, there was a significant increase in germination in those plants that received a perfect balance of auxin (IAA) and received light.

Upon examining the plants that received full light exposure, it was observed that there was a significant difference between the plant that had received one pipette of auxin (IAA) compared to the other, which had received two pipettes. The first had an overall growth of 17.5

cm, while the latter had no growth. It was clear that giving two pipettes of the hormone was too much.

Next, it was discovered that germination seemed to happen more rapidly in the seeds exposed to partial light and one pipette of auxin (IAA), amounting to 12.5 cm., compared to the full light with hormone. Surprisingly enough, there was growth in both the one and two pipettes subjects exposed to partial light, with two pipettes of hormone yielding an overall growth of 4 cm.

As expected, our negative control in the experiment yielded no growth. With no water, light, or hormone, this was no surprise and provided a basis for us to compare and contrast our

positive control to. Overall growth in this group was 0 cm.

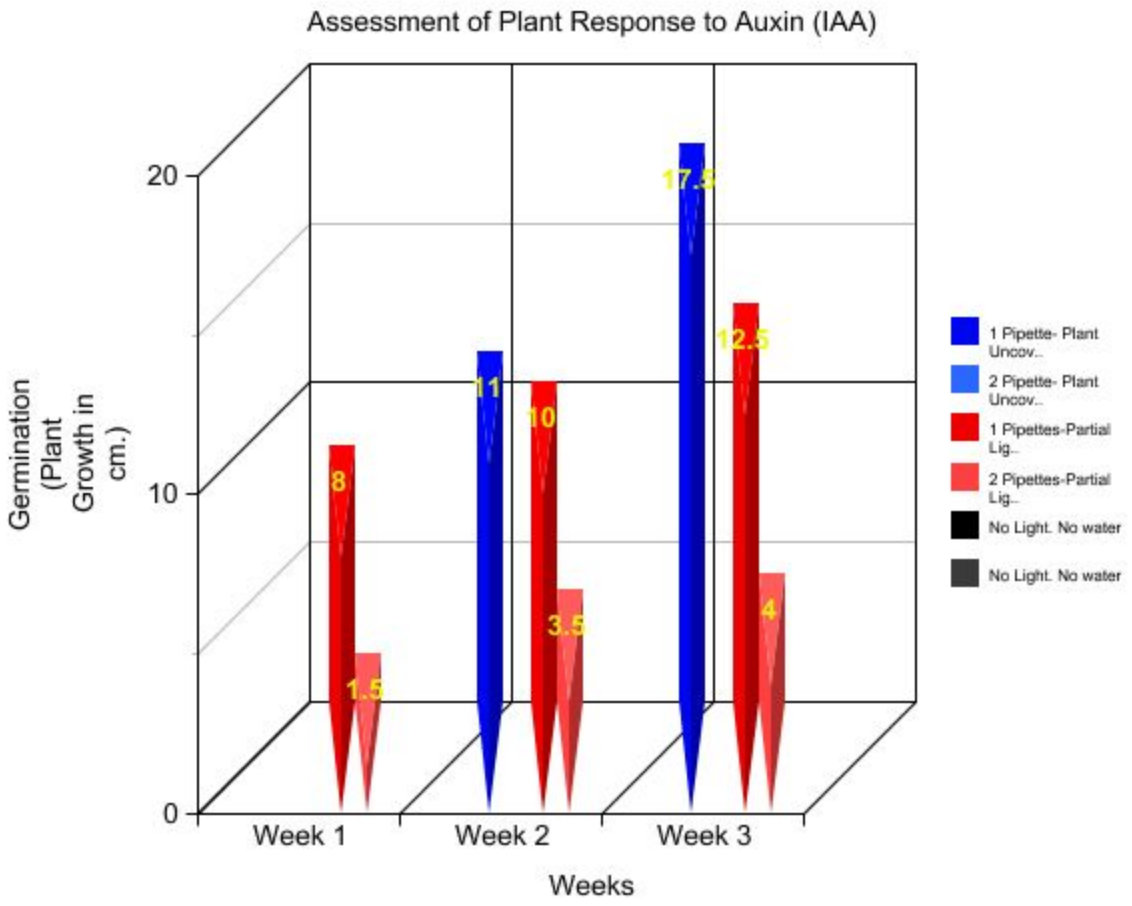

Table 1. Auxin and Light effectors on Germination in *Phaseolus Vulgaris*

Plant	Week 1	Week 2	Week 3
Uncovered (1 pipette of auxin)	= 0 cm. growth	11 cm. growth	17.5 cm. growth
2 pipettes of auxin	= 0cm. growth	0 cm. growth	0 cm. growth
Partial Light (1 pipette of auxin)	= 8 cm. growth	10 cm. growth	12.5 cm. growth
2 pipettes of auxin	= 1.5 cm growth	3.5 cm. growth	4 cm. growth
No Light/No Water/ No Hormone (1 pipette of auxin)	= 0 cm. growth	0 cm. growth	0 cm. growth
2 pipettes of auxin	= 0 cm. growth	0 cm. growth	0 cm. growth

DISCUSSION

In order to test the effects of hormone auxin (IAA) and the effects it has on the development and growth of plants, this experiment was designed using three different light settings and two different amounts of the hormone.

Germination of *Phaseolus Vulgaris* seeds increased upon being exposed to light and moderate amounts of auxin (IAA) natural. Our results, undeniably, showed that not only did light and auxin (IAA) play a significant role in the growth and development of plants, but that the amount administered made all the difference. Too much auxin (IAA) resulted in overdosing the plant. Likewise, too much light in combination with the hormone did not yield to be as effective

as the hormone with moderate light. Our hypothesis that plants would grow more in partial light exposure, with auxin (IAA) hormone present, was accepted.

It was interesting to see that the seed exposed to the partial light, at one pipette, had grown more than the full light subject, at one pipette. Not only did it grow more than the full light subject, but the full light subject had not grown at all at this point (week one). The napkin covering the plant could have provided for shade and protection, thus allowing for successful germination, just as a baby might have a hard time opening their eyes for the first time.

Experiments in the future could be done to differentiate between different levels of auxin (IAA) administered. Instead of using only two different amounts, as we did in this experiment, forty different levels could be tested individually and then compared and contrasted to find a mean average of what levels plants grow best when subjected to auxin (IAA) hormone. A "goldilocks" zone could be found using this method.

Furthermore, more studies can be done regarding the light effects. Germination not occurring at all in the dark control could have been a result of having no water, instead of a result of not having any light or hormone. It would be interesting to see if the seed would germinate in the dark if provided water and hormone. This would yield better evidence for successfulness of auxin (IAA) hormone and potentially provide a greater understanding for the importance of this hormone.

ACKNOWLEDGEMENTS

I thank my lab partners, Youngju, Ahmad, and Azeem for their participation and help in this experiment. I also thank my lab professor, Kate Thornton for all of her constructive advice and support whenever I had any questions regarding the material.

REFERENCES

Auxin. (2012). In *New World Encyclopedia online.* Retrieved from http://www.newworldencyclopedia.org/entry/Auxin.

Hoot, Sara B. (2009). Charles Darwin: Botanist. *Charles Darwin: Botanist. Vol. 29.* 19-21. http://ncse.com/rncse/29/1/charles-darwin-botanist

Saupe, Stephen G. (2009). *Plant Hormones: Auxin.* Retrieved From Lecture Notes Online Web Site: http://employees.csbsju.edu/ssaupe/biol327/Lecture/hormone-auxin.htm

photosynthesis. (n.d.). *Dictionary.com Unabridged*. Retrieved October 18, 2015, from Dictionary.com website:http://dictionary.reference.com/browse/photosynthesis