**Noor Hasan**

**Prof. Colin D. Harrison**

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The Effect of the Plant Hormone Gibberellins on *L. Sativa* Growth

**Abstract:**

The purpose of this lab was to determine the amount of growth in a lettuce seedling after being exposed to different concentrations of the hormone gibberellins. Our hypothesis was that the petri dish of seedlings that had the most concentrated GA solution (10^-4) would have the greatest amount of growth in the seedlings following a week of being under the growing light. Our alternate hypothesis was that there would be the greatest growth in the seedlings exposed to the solution with the lowest concentration of GA. In order to test the effect of gibberellins on lettuce seed growth, we devised an experiment in which we placed 5 seedlings in 6 different petri dishes. We prepared 5 different concentrations of the gibberellins solution and used deionized water as the control. We put 3 mL of each solution in their respective dishes and 3 mL of the DI water in the control plate. The plates were then allowed to stay under a growing light for a week. The growth of both the stems and leaves in the seedlings was then measured in mm and the results were compared to the original lengths of the seeds before any growth. After recording all this data, we then ran a statistical test, which was a correlation coefficient statistical test in order to determine how correlated the groups of data from the different dishes are. The results of the weeklong growth time showed that the plate the highest average length of growth in both stems (average length of 94.7 mm) and leaves (6.8 mm) was the one with a 10^-5 M solution concentration of GA. For the correlation constant statistical test results, the plates that had the highest correlation were 10^-6 M and 10^-7 M, 10^-6 M and 10^-8 M, and 10^-7 M and 10^-8 M. The implications of these findings lie in the agricultural industry as understanding how much gibberellins affects seedling growth will aid the process of determining what the greatest possible crop yield is for certain plants while taking into account the state of the plant and its health.

**Methods**

With this experiment, we hoped to determine and gain more information on the effects of gibberellins on the growth of lettuce seedlings. In order to do that, we tested different solution of GA that each contained a different concentration and used the same number of seeds for each different concentration. We determined the effect of the GA on the plants by measuring the amount of growth the seed exhibited.

The first part of the experiment was setting up the petri dishes. It was 6 petri dishes in total, 5 being for the different concentrations of GA and 1 being for the control, which was Deionized water. The different concentrations of GA we tested were 10^-4 M, 10^-5 M, 10^-6 M, 10^-7 M, and 10^-8 M. We labeled each petri dish with whatever type of solution it would contain. We placed five seedlings in each petri dish, spaced out evenly (see picture 2). We made sure to measure each seed in each dish in order to be able to later make comparisons with our results. We then put 3 mL of each type of solution in its respective petri dish as well as the water in the control dish.

In order to make the different solutions, we used a micropipette to put 1 mL of the GA stock solution (10^-3 M) into a tube and added 9 mL of the deionized water in order to create a solution with a 10^-4 M concentration of GA. We then put 1 mL of the 10^-4 M solution into another tube using a micropipette and then mixed it with 9 mL of DI water in order to create the next concentration. This process was repeated until we had a solution with a concentration of 10^-8 M.

Following the weeklong growth period under the growing light, we measured the amount of growth of each seedling in regard to both stems and leaves for each petri dish and recorded the data. For stems we measured the stretched-out plant from the tip of the roots to the tip of the shoots (see picture 1) for each seed in each petri dish. For leaves we measured only one leaf from each plant, measuring from the base to the tip. Using this data, a correlation coefficient statistical test was run on the data to determine the amount of correlation between each of the 6 different groups.

**Results**

Our data found effectively disproved our hypothesis, as the greatest amount of growth in the seedlings was found to be in the petri dish that contained a solution with a 10^-5 concentration of GA. Although all the seeds in all the petri dish germinated and had some type of growth, it was the greatest when exposed to the 10^-5 M solution. The average growth was 94.7 mm. The dish that had the second greatest amount of growth was the plate with the most diluted concentration of GA, which was 10^-8 M. It had an average growth of 70.58 mm. The plate that had the least amount of growth was the plate with the highest concentration of GA with an average length of 38.72 mm (see Table 1). There was also greatest leaf growth in the 10^-5 M concentration group, which was 6.8 mm (see Table 2).

After running the correlation coefficient test, it could be determined that certain plates had a high correlation (0.8-1.0 correlation coefficient) with other plates, while the majority had a lower correlation (0.4-0.6 correlation coefficient) or basically no correlation (0.1-0.3 correlation coefficient). The plates that had the highest correlation were 10^-6 M and 10^-7 M, 10^-6 M and 10^-8 M, and 10^-7 M and 10^-8 M (see Table 3).

**Discussion**

The results of the data demonstrates that the highest concentration of GA doesn’t necessarily translate into more growth. The highest average growth was in the second highest concentration of GA, being 94.7 mm and second highest average growth was in the lowest concentration of GA, being 70.58 mm. This shows that there may be other factors that promote plant growth apart from the plant hormones. There was some correlation between the 10^-4 M and 10^-5 M concentrations, as those two groups had very similar leaf lengths although the stem length was different. We can confidently say that GA concentration affects the growth in both the steams and the leaves. Surprisingly we found that there was little similarity in the results of the 10^-8 M and control groups even though 10^-8 M had very little GA and the control group had no GA. The control group had a slight correlation with the 10^-4 M, 10^-7 M, and 10^-8 M groups and had a very similar stem length to the 10^-4 M and 10^-7 M groups. There could be several different environmental factors that played a part in how the seedlings germinated and grew, such as how long the plates were uncovered before they were sealed and how good the condition of the seeds used. It may be that the 10^-4 M concentration is too strong to have beneficial effect on the plant growth, but a super low concentration of GA may be more detrimental to plant growth than no concentration of GA.

A source of error could be human error when creating the different concentrations or when putting the 3 mL of each solution into all the petri dishes. We could have also damaged the seeds in some way when placing them into the petri dish. Additionally, in order to better the accuracy of the data for the leaf length, we could have measured all or more of the leaves from multiple plants. We could have also not mixed the GA solution very well which may have affected how cohesively spread of the GA was in the solutions. The implications of this experiment could be the uses of plant hormones and fertilizers in agriculture that help promote plant growth. Understanding the exact ratio of a certain hormone that results in the greatest amount of growth in a plant is extremely important as it creates a more efficient agricultural system. We could also possibly explore how GA may affect the eventual overall plant after it is fully grown, as it may have an effect on quality of the plant in addition to how fast it germinates and grows.

**Figures and Tables**

**Table 1: Length of stem growth in each seedling**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Plates** | **Seedling 1 (mm)** | **Seedling 2 (mm)** | **Seedling 3 (mm)** | **Seedling 4 (mm)** | **Seedling 5 (mm)** | **Average** |
| **10^-4 M** | **9.5** | **56.4** | **47.5** | **28.1** | **52.1** | **38.72** |
| **10^-5 M** | **93.1** | **97.2** | **101.1** | **91.3** | **90.8** | **94.7** |
| **10^-6 M** | **68.7** | **46.3** | **30.9** | **56.1** | **51.5** | **50.7** |
| **10^-7 M** | **51.5** | **48.6** | **0** | **48.9** | **57** | **41.2** |
| **10^-8 M** | **93.5** | **70.5** | **36.9** | **80.7** | **71.3** | **70.58** |
| **Control** | **0** | **90.3** | **13.2** | **88.4** | **3.7** | **39.12** |

Table 1 contains the data of seedling stem growth from each of the 6 petri dishes, as well as the average length of all the seedlings for each petri dish. Stem growth was measured from root to tip of the plant.

**Table 2: Length of the leaf growth**

|  |  |
| --- | --- |
| **Plates** | **Leaf length (mm)** |
| Control | 3.8 |
| 10^-4 | 6.6 |
| 10^-5 | 6.8 |
| 10^-6 | 3.9 |
| 10^-7 | 3.6 |
| 10^-8 | 3.8 |

Table 2 contains the data on each individual leaf measured for each concentration group. This was done by measuring from root to tip of the leaf.

A table with numbers and a number on it

Description automatically generated**Table 3: Correlation coefficient statistical analysis**

Table 3 contains all the data of the correlation coefficient statistical test carried out for the data found on the stem growth of the seedlings.

A pair of hands measuring a string

Description automatically generated**Picture 1: Measuring the stem of a plant**

How the stems of each seedling were measured.

A round plastic container with numbers and a number on it

Description automatically generated**Picture 2: Seedlings before the week long growth period**

The petri dishes before the weeklong growth period or before any germination has happened.

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