

The Effect of 0.2M NaCl on the Rate of Germination of *Sorghum bicolor*

Abstract

The study was conducted to investigate the impact of 0.2M NaCl (salinity) on germination and seedling features of *Sorghum bicolor*. The laboratory experiment was conducted by growing the seeds of the variety in salinity condition and deionized water in a zippered bag. The bags were labeled to avoid confusion. The results of the experiment were collected and analyzed. The presentation was done using a bar graph for easy interpretation and understanding. During the experiment, the bags were placed on the window to allow for the penetration of light. Light is an essential factor for the growth of the seedling as it helps in photosynthesis. Decrease in germination percentage and seedling features were greatly experienced in seeds grown in 0.2M NaCl as compared to deionized water. Deionized water acted as a control experiment providing a platform in which the seedlings' growth results can be compared for an effective conclusion to be drawn. The average growth in deionized water was 9.5625, and in 0.2M, NaCl was 8.25 showing a significant difference of 1.3125. There was a decrease in radical and plumule lengths in the salinity conditions. The results of the experiment indicated that *Sorghum bicolor* is sensitive to salinity. An increase in salinity conditions reduces the growth of *Sorghum bicolor* hence the yield.

Introduction

Background Information

Seed dormancy and germination are different physiological processes. The change from dormancy to germination is a critical development process in plants determining the success or failures of the seedlings. Germination of the seeds commences with the uptake of water (imbibition), ending with protrusion of radicle. Salinity, high temperature and drought are some of the factors that impact seed germination.

Salinity results in a decrease in germination features and seedling growth of *Sorghum bicolor*. The high salinity of above 0.1M leads to a decrease in osmotic pressure of the soil water resulting in a decrease in imbibition. The absorption of Cl^- and Na^+ ions from the soil causes ionic imbalance disrupting the biochemical processes such as respiration and energy production (Daniells et al., 2001). Thus, as salinity increases, there is a significant decrease in germination rate, percentage, and mean germination.

The objective of the study

To investigate how an increase in salinity affects the growth of *Sorghum bicolor*.

To use the result and provide an optimum condition for the growth of *Sorghum bicolor*, thus maximizing the yield.

Hypothesis

When seeds of *Sorghum bicolor* are grown in 0.2M NaCl solution, the average germination after seven days is less than the average germination of seeds in deionized water.

Methods and Materials:

In this experiment, two paper towels were placed into two zippered bags. One zippered bag was labeled “experiment control” and the other was labeled “control”. 20 Sorghum seeds were given. 10 seeds were placed into the “control” zippered bag and the 10 seeds were placed into the “treatment” zippered bag. 10 mL of the 0.2M Sodium Chloride solution was added to the bag labeled “treatment.” 10 mL of water was added to the bag labeled “control.” Each bag was to be placed at a window for a light source. For seven days, the germination was observed and recorded. The control group in this experiment is the bag with 10 Sorghum seeds and water. The experimental group in this experiment is the bag with 10 Sorghum seeds and 0.2M Sodium

Chloride solution.

Key Phrases:

- Germination
- Seed
- Experiment
- Embryo
- Stem

Primary Source Article List:

❖ CSE Citation (Article 1)

Casal JJ, Sanchez RA. 1998. Phytochromes and Seed Germination. Seed Science Research. 8(3): 317-329.

➤ Summary (Article 1)

Phytochrome is a photoreceptor used by plants to detect light sources. In other words. It's a pigment used to manage a plant's development. Essentially it aids the plant with it's seed germination process, as well as reproduction. Phytochrome is a small group of the photoreceptor family. Phytochrome B and Phytochrome A are distinct from one another. Aside from those two genes, there are others.

Phytochrome A is most likely to be the gene involved when there is a high amount of radiant energy. Phytochrome B is involved in dark, dry seeds which eventually affects the plants process of growth and germination. Red light can come from direct sunlight which will have a great effect on the seed. Far red light correlates with darkness but also has an effect on germination. The embryo growth acts on the phytochrome and its role. Phytochrome research is slowly gaining more knowledge due to data collected based off of observations.

❖ CSE Citation (Article 2)

Vazquez- Ramos JM, Sanchez MD. 2003. The Cell Cycle and Seed Germination. Seed Science Research. 13(2): 113-130.

➤ Summary (Article 2)

The cell cycle is a series of development steps in order to reach the creation of two daughter cells within an organism. The participation of genes in the cell cycle can vary from hundreds to thousands. The protein types stay the same among animal and plant cells, as well as the same pathways. Seed germination is essentially a very great way to study plants due to the delicate process of growth

and development it allows an individual to observe. The G(1) checkpoint control guides many processes like the initiation of the germination process. G(1) and G(2) cell proteins appear to activate during specific times of the process, essentially meaning there's some sort of regulation happening within the organism. Regulation is necessary to keep an organism up to date with what needs to get done to keep it healthy and strong. The cell cycle's importance towards germination is enormous.

❖ CSE Citation (Article 3)

Daniells, I. G., Holland, J. F., Young, R. R., Alston, C. L., & Bernardi, A. L. (2001). Relationship between yield of grain sorghum (*Sorghum bicolor*) and soil salinity under field conditions. *Australian Journal of Experimental Agriculture*, 41(2), 211-217.

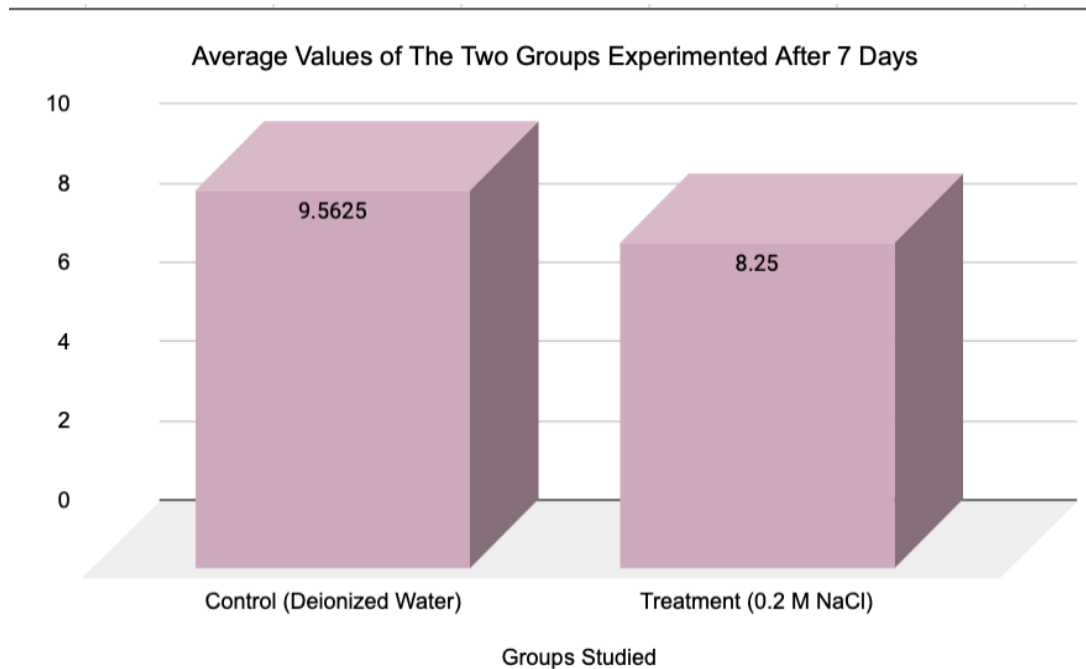
➤ Summary of Article 3

The authors conducted three field experiments entailing the germination of *Sorghum bipolar* in the New South Wales. The experiments were determining the effects of dry land salinity on the germination and yield of *Sorghum bipolar*. The results showed that the growth of *Sorghum bipolar* is adversely affected by salinity. The yield of sorghum was reduced by 50% when the salinity of soil was increased.

Results

The experiment used two broad types of data. There were both the control values and the treatment values. According to the hypothesis used, the experiment sought to understand whether there is a difference between when the treatment is present or not. The control values contained values obtained when deionized was used. On the other hand, the treatment values are values observed when the 0.2 M NaCl was used. There is a significant difference in the two respective types of data from general observation.

Figures and tables can be used to represent the data. The average of the control and the treatment values are 9.5625 seeds and 8.25 seeds respectively. A bar chart is the best representation of the above quantitative data. The following figure shows the bar graph of the average of the quantitative data collected.



The average value of the values obtained with treatment is less than the observations of the deionized water. The observations will be of great importance in determining whether the rate of germination changes in the presence of 0.2 M NaCl or not.

Discussion

This part involves the interpretation of the results and conclusions reached. The experiment's main objective is to check whether there is any effect on the germination of seed when 0.2 M NaCl is applied and when it is not applied. To enable interpretation of analysis, there was the formulation of the null and alternative hypotheses. The null hypothesis of the experiment stated that there is no significant difference between the germination rate of when the treatment is put in place and when it is not applied. The alternative hypothesis stated that there is a significant difference in the germination given the two conditions.

The expected outcome was that the treatment would result in a faster germination rate. There are other past works that seem to have the same conclusion as such. According to Casal & Sanchez (1998), there are several biological explanations on why some such would occur. They explained about phytochrome, both A and B, and how it influences seed germination. On the other hand, Vazquez-Ramos & Sanchez (2003), believed that influence of the cycles of the seed cells have a huge impact on the germination rate. Sodium chloride influences faster reaction of these biological processes hence faster germination.

The average of the two experiments shows that there is a significant difference in the time taken to germinate in the treatment and control experiments. The treated experiment shows a faster rate of germination than the control experiment on average. Additionally, the p-value associated with the experimental observations is 0.049797. The p-value is less than the 0.05 level of significance which implies that the results are statistically significant. This implies that the null hypothesis should be rejected and the alternative hypothesis supported. Based on the evidence from the experiment, it is valid to say that seeds grown at 0.2 M NaCl solution germinate faster than those that grow under deionized water at a 95% level of significance.

The data might have been biased because the lower average rate of the treatment data may have resulted from the seeds that never germinated. For the next experiment, there should be more observations for the accuracy of results and generalization. Besides that, the project findings were statistically significant.

References

- Casal. JJ, Sanchez RA., 1998. Phytochromes and Seed Germination. *Seed Science Research*. 8(3): 317-329
- Daniells, I. G., Holland, J. F., Young, R. R., Alston, C. L., & Bernardi, A. L. (2001). Relationship between yield of grain sorghum (*Sorghum bicolor*) and soil salinity under field conditions. *Australian Journal of Experimental Agriculture*, 41(2), 211-217. Retrieved from:
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