Elizabeth, Grace, and Victoria

1.

a. In our lab, we plan to study the different genotypes of Arabidopsis thaliana and how it responds to high levels of salt in water and therefore, soil. While Arabidopsis thaliana is not a cash crop, the studies performed on this plant can be applied to other crops with economic value. Studying this plant would greatly benefit farmers who experience challenges growing crops in areas with high levels of salt, whether it occurs naturally or from human activities. In the Frontiers in Plant Science, the authors cite a 2005 report from the Food and Agriculture Organization (FAO), a government agency in the United Nations, where they estimated that increases of salt impacts a large area of agricultural production, over 397 million hectares of agricultural land. One of the authors, Keni Jian, is a researcher specialist in the Department of Plant and Microbial Biology in the University of California and has contributed to other research projects involving A. thaliana. Jian reports that human activities have made fertile land have increasing salt levels. With climate the changing, rainfall patterns change, which result in less rainfall in some areas, thus allowing salt to accumulate more over time. Over farming in different regions also contributes to increased soil and water salinity. However, not all contamination occurs from human impact, some soils have a naturally high quantity of salt. Therefore, studying how salt levels affect different genotypes of A.thaliana would help farmers better understand the exact effect on growth and how changing a plant's genotype could help counter against the effects of rising salt levels in soil and water.

b. What we know through background research and knowledge is that an increase salt levels affects the overall growth of the plant. More specifically, salt affects the root

growth of A. thaliana. Salt affects several areas of the root as stated in the Frontiers in Plant Science article, which was published in February 2016 with several contributing authors, including Keni Jiang. The article states that salt specifically affects the root length and structure because salt causes a decrease in cell division in the root tips, therefore decreasing the size and changing the structure of the root. An increase of salt also affects the response of reactive oxygen species (ROS). ROS, as explained in an article written by several authors including Dunyaporn Trachootham who works at the University of Texas at the MD Anderson Cancer Center in Houston. Trachootham and the other authors explain that ROS is vital to a plant, as it helps cells properly respond to external and internal factors in the cell. They also note that high levels of ROS would cause cell death. This information applies back to the plants as with an increase of salt causes the roots to respond by rising production of ROS. Therefore causing cell death in the root tips to then shorten the root length. The roots then are not able to get as much water in order to sustain the plant's growth, thus affecting the overall plant growth. High salt levels also affect other aspects of growth such as the transport of the auxin hormone. In the article by Thrachootham and other contributing authors, they explain that auxin is a plant hormone that triggers the growth of cells in the shoot. With an increase of salt levels, it disrupts the distribution of auxin hormones causing the cell growth in not only the root tips, but also in the shoot and other areas of the plant to decrease . In regard to the plants which we are studying in our lab, we looked into the three plants we are using, the wild A. thaliana Columbia, the wild Landsberg erecta, and the mutant (SOS1) Columbia A. thaliana. On the website TAIR, which collects information and maintains databases of the genetics and the microbiology of Arabidopsis thaliana, it explains that the wild Columbia plant is already sensitive to high salt

concentrations. It is also noted that the plant can not survive under low amounts of potassium which creates more ROS under salt stress. Regarding the Landsberg erecta, an article from the Think Green Module where it outlines the als of similar experiments, they explain briefly that the Landsberg erecta has a mutation from x-rays that cause the plant to grow taller. Also from a research article, written by Yanping Wang and other associates who are affiliated with the Key Laboratory of Plant Germplasm Enhancement and Specialty Agriculture among other organizations, they explain that Landsberg wild type also is notably more salt susceptible and more sensitive to salt than the wild Columbia. The mutant, (SOS1) plant, is a strain of the Columbian wild type, but is mutated to be highly sensitive to salt. A scientific report by Shaw-Jye

Wu, Lei Ding, and Jian-Kang Zhu all from the the Department of Botany and Microbiology in Auburn University, backs this idea up by explaining that the mutants in their experiments have been permanently damaged when exposed to high levels of salt and that the mutant is affected solely on the Na ion, not the Cl ion. They also mentioned how the mutant was unable to thrive in low amounts of potassium as the mutant has to compensate for salt sensitivity by taking in more potassium.

c. Though with the research, there was still a gap that we do not yet understand. We want to clarify the solution to the rising issue of higher salt levels due to human activities going into the soil and water to affect the growth of crops. We want to understand if there is a possible connection with the genotypes of the plants affecting their ability to survive in high salt levels, not only looking at their tolerance to salt, but other notable mutations such as the Landsberg erecta mutated to grow taller. Our question is what genotypes would be more apt to survive in human contaminated environment, what is the possible genotype that would be better fit for this new environment today?

d. Overall, the information we can gather from this lab can have a great impact on the world, mainly on agriculture production.The information gathered can help farms figure out how to grow their crops the most effectively in order to get high amounts of harvest under high salt levels. It has the possibility of providing the knowledge to mutate crops to be more tolerant to salt or give insight into other possible methods to adapt the crops to the new elevated salt environment. Our data can also help with bringing awareness to the importance of salt tolerance in crops, and that it plays a big factor in crops and it should focused on when planting as soil gets more contaminated with salt from human activities. Plus, the information gathered can also highlight on the importance of regulating human activities to decrease the levels of salt input in water.

e. Bibliography

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2. a. The aim of our experiment/study is to show how high/low concentrate of salt that gets

produced because of irrigation, pesticides and other agricultural practices affect the

germination of a variety of different plants. Through our question, we narrowed down the focus to only *Arabidopsis thaliana* and which genotypes are more apt to survive in a human contaminated environment.

b. What we aim to accomplish in our study is to show how high concentrate of salt negatively affects *Arabidopsis thaliana* and how that knowledge from this experiment with this specific plant can be applied to other plants.

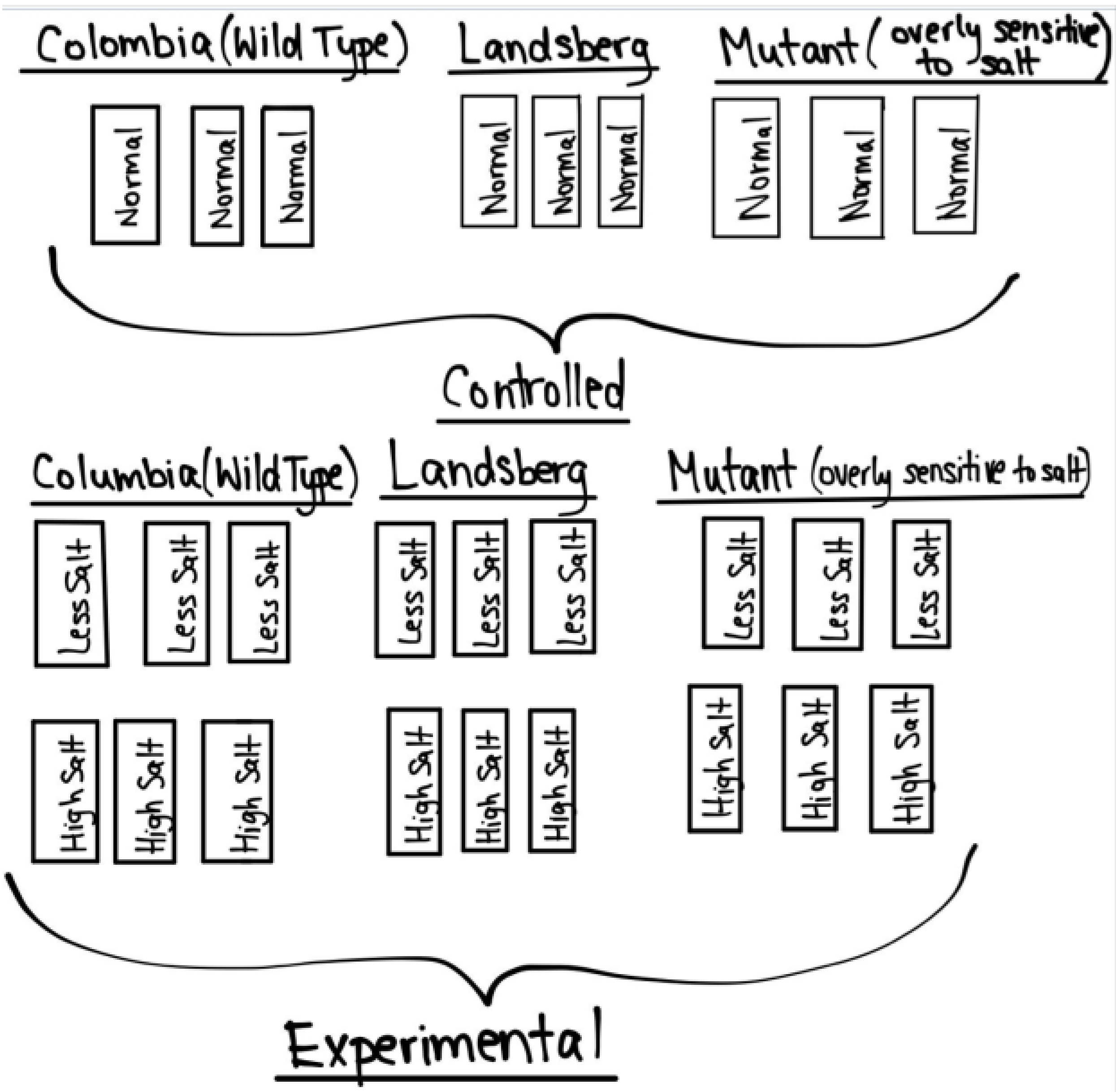
3.

a. We believe that the the salt concentrations in the water will cause a significantly greater effect on the growth of the mutant of the Colombian variety of Arabidopsis thaliana when compared to the two wild types of Landsberg Erecta and Columbia. Our null Hypothesis is that there is no significant difference difference between the growth of the three strains when subjected to different concentrations of salt in the water.

b. We plan to test three strains of Arabidopsis thaliana (2 wild types: Colombian and Landsberg erecta, and a mutant strain of the Colombian) on their response in growth to three different concentrations of salt in the water we use to water them. One pot of each strain will be watered with normal water as the control, one pot of each strain will be watered with low saline levels of water (150 millimolars of NaCl) , and one pot will be watered with water with a high concentration of salt (300 millimolars of NaCl) We will then test the growth by measuring shoot height,leaf count, and biomass. We will then determine the percent difference for each dependent variable for each strain over the different salt levels to compare the effect that the salt had on the overall growth of the three different strains of Arabidopsis thaliana.

c.

i. Our setup is having 9 pots, in rows of three for each plant, in three chambers. In one chamber, the nine pots would be not contain any salt, the second would have 150 millimolars, and the third would have 300 millimolars of salt. The three chambers will be in there own trays and exposed to light for 24 hours.



ii.-Materials that will be used in this experiment include: One liter containers, Salt(NaCl), Arabidopsis thaliana Landsberg erecta seeds (CS76164 (Ler, Landsberg erecta)), Arabidopsis thaliana Columbia seeds(CS70000(Col, Columbia)), Arabidopsis thaliana Columbia mutant seeds (C S3862 (Mutant)), Ruler,Scale

iii. -Our independent variable is the concentration of NaCl in the water which we will use to water our Arabidopsis thaliana plants. We will subject the plants to two different concentrations, 150 millimolars of NaCl, and 300 millimolars. We will then observe the changes that the differing concentrations of salt have on the shoot height, leaf count, and biomass.

iv. Procedure

1. Calculate the amount in grams of NaCl is needed to achieve a concentration of 150 millimolars per liter of water. Add this amount to one liter of water.

2. Calculate the amount in grams of NaCl is needed to achieve a concentration of 300 millimolars per liter of water. Add this amount to one liter of water.

3. Arrange the pots for the seeds by type of plant and the concentration and label each. Place the seeds in the correctly labeled pot, according to the setup.

4. Water the plants regularly with the correct concentrations of NaCl

5. Measure regularly the shoot height and count the leaves

6. At the end of the experiment, carefully remove each plant from the soil and weigh the plants.

7. Allow a few days for the plant to dry, then calculate the weight

once again. Calculate the difference in weight between the two measurements, this difference is the mass of the water in the plants.

8. Determine the biomass by using the mass of the dried plant

d. We will evaluate our data by calculating the percent changes for each plant from our daily observation. For example if there is a change in height from day to day,

we will determine exactly how much has changed through percentages. We will then run a Z statistical test to determine whether or not we should reject our null hypothesis. By evaluating the daily changes via percentage, we could account for possible differences in the plants that is not because of the salt concentration in the water, but because they are separate plants entirely.