Effects of Salinity on Plants – Final Lab Report

BIO100A

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Section I: Background

Water is essential for all living organisms and plays a major role in plant survival, growth, and reproduction. Through the water cycle, water moves between the atmosphere, land, and living organisms, making it available for biological processes (U.S. Geological Survey, 2023). Plants rely on water to transport nutrients through specialized tissues called xylem (Urry et al., 2020). This movement of water is driven by processes such as osmosis, capillary action, and transpiration. When environmental conditions change, such as increased salinity, water availability to plants can be affected. Salinity refers to the concentration of dissolved salts in water or soil. High salinity levels can make it difficult for plants to absorb water because the external environment has a lower water potential. This can lead to dehydration, reduced growth, and even death. Salinity also plays a major role in seed germination, as seeds require water absorption to activate metabolic processes needed for growth. Understanding salinity is important for agriculture and water management, especially in areas where irrigation or climate change increases salt levels in soil and water (Food and Agriculture Organization, 2021).

Hypothesis:

A - In Experiment 1, it is predicted that celery in low salt conditions will transport colored water further than celery in high salt conditions because high salinity reduces overall water absorption.

B - In Experiment 2, it is predicted that more seeds will germinate in low salt or pure water conditions, while high salt conditions will reduce or prevent germination due to low water absorption.

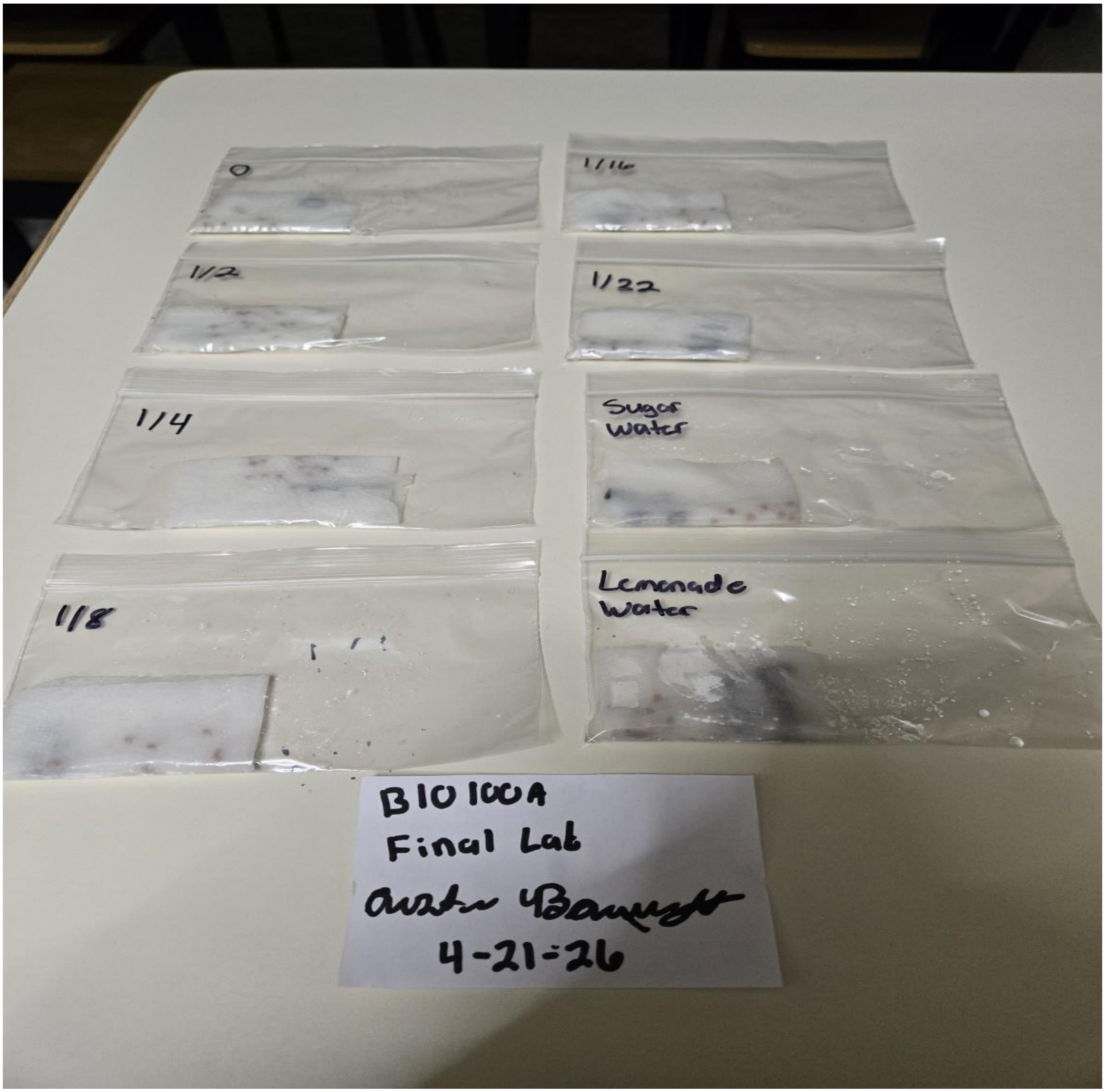
Section II: Materials and Methods

Experiment 1

Two celery stalks with leaves were used along with four cups containing 400 mL of water each. McCormick brand red and blue food coloring (20 drops each) were added to create visible tracking. Two cups were designated as high-salt by adding four additional spoonfuls of salt, while two cups remained low-salt with just one spoonful of salt. Each celery stalk was split so that each half sat in different colored solutions. One stalk was placed in high salt solutions, and the other in low salt solutions. The experiment ran overnight from 9:14 PM to 5:15 AM. Afterward, the celery was cut and measured to determine how far the dye traveled.

Experiment 2

Radish seeds were placed on moist paper towels inside labeled Ziplock bags with different salinity levels (0%, 3.1%, 6.3%, 12.5%, 25%, 50%) and two additional conditions: sugar water and lemonade water. Each bag contained an equal number of seeds (15) and was monitored over 4 days. Sprouting was recorded daily. All seed samples were kept under similar environmental conditions, including temperature and light exposure, to ensure that salinity was the primary variable affecting germination.



Section III: Results

Experiment 1

Table 1: Celery Start and Stop Times

	Start time	Stop time
a. S cups (high salt)	9:14 PM	5:15 AM
b. Non-S cups (low salt)	9:14 PM	5:15 AM

Observations:

The dye was clearly visible in the leaves of the celery placed in low salt conditions, indicating strong water transport through the vascular tissue. In contrast, the celery exposed to high salt conditions showed significantly less dye movement, with color only visible closer to the base of the stalk. Physically, the low salt celery remained firm but flexible and slightly moist, suggesting proper hydration. The high salt celery appeared drier, more rigid, and brittle, breaking apart more easily when handled. These differences indicate that salinity affected both water transport and tissue structure.

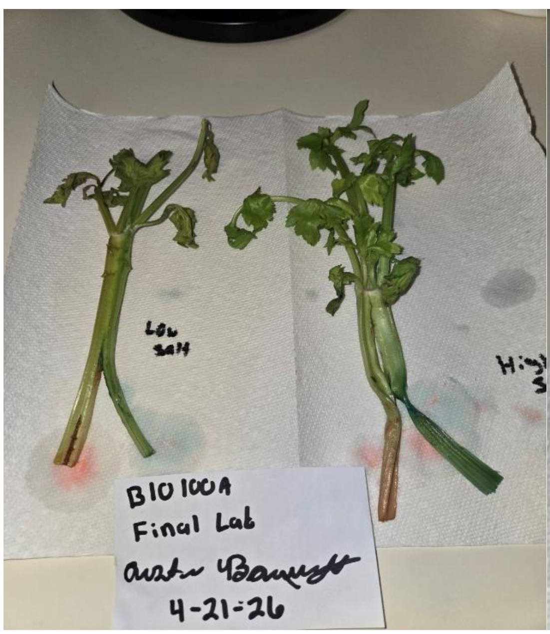


Table 2: Celery Dye Distances

Sample	Distance (cm)
Red dye (S)	7.44
Blue dye (S)	7.44
Red dye (non-S)	21.84 (full length)
Blue dye (non-S)	21.84 (full length)

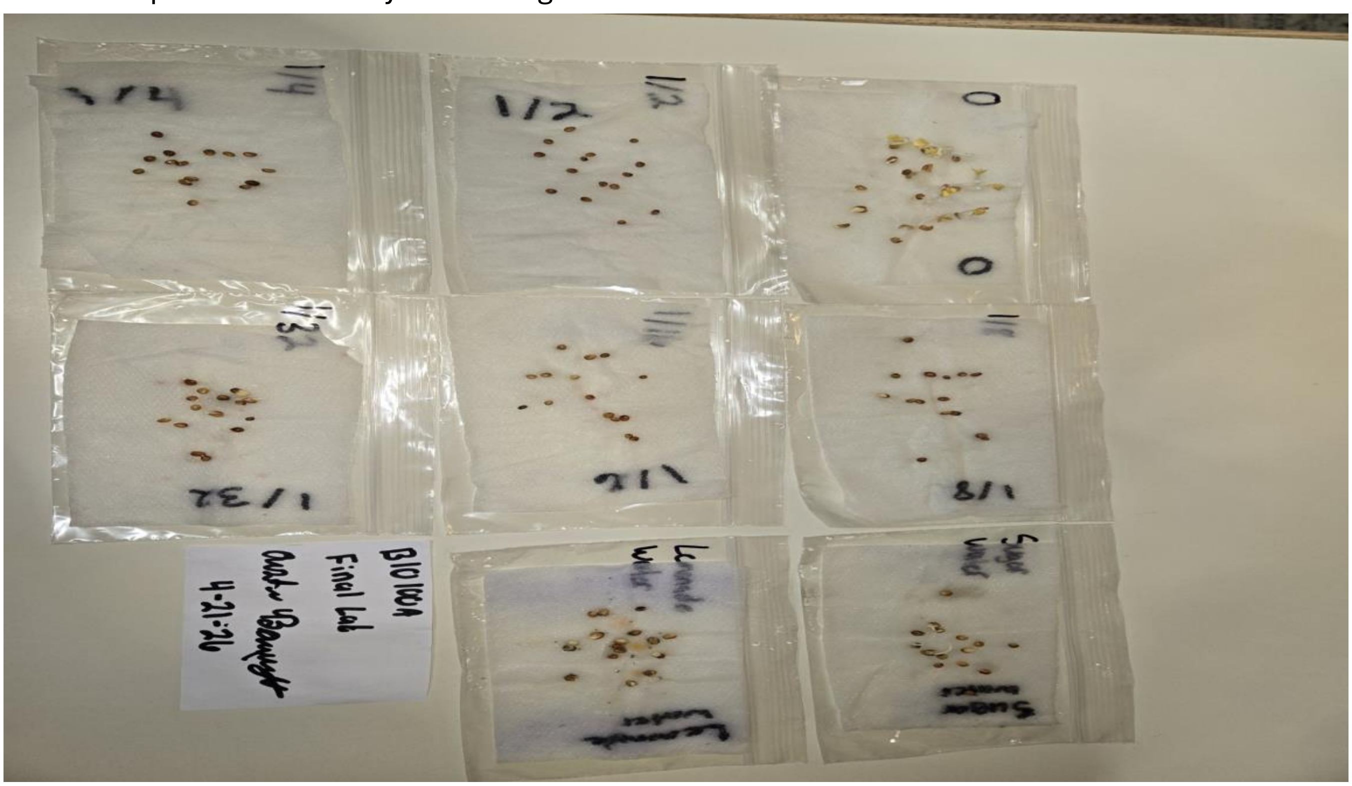
Experiment 2

Table 3: Number of Sprouted Seeds   Initial Date: 4-21-26

Saline Solution (%)	Day 1	Day 2	Day 3	Day 4
0 (0 cup)	0	2	6	15
3.1 (1/32)	0	3	7	13
6.3 (1/16)	0	0	1	2
12.5 (1/8)	0	0	1	1
25 (1/4)	0	0	0	0
50 (1/2)	0	0	0	0
Water + Sugar	0	1	3	6
Water + Lemonade	0	0	3	7

Observations:

Seed germination varied significantly across salinity levels. The highest germination occurred in the 0% and 3.1% solutions, where most seeds successfully sprouted by Day 4. As salinity increased, the number of sprouts decreased dramatically, with little to no growth observed in the 25% and 50% solutions. The sugar water condition showed moderate germination but less than pure water, suggesting osmotic effects. The lemonade condition produced visible mold growth, likely due to sugar content and acidity, which may have interfered with seed development. Overall, the results showed a clear inverse relationship between salinity and seed germination.



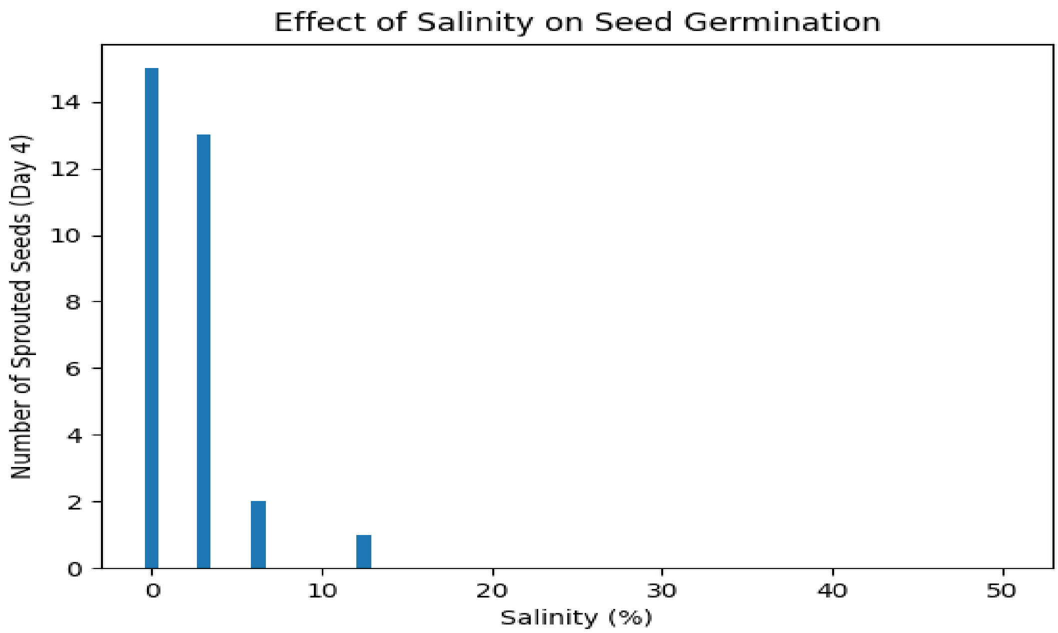


Figure 1. The effect of increasing salinity on seed germination after 4 days. As salinity increased, the number of sprouted seeds decreased significantly.

Section IV: Discussion

The results show that salinity had a clear negative effect on both water transport and seed germination. In Experiment 1, celery placed in low salt conditions transported water much further than celery in high salt conditions. This supports the idea that high salinity reduces water uptake due to osmotic pressure differences. The low salt celery was also more flexible and hydrated, while the high salt celery appeared dry and stiff. In Experiment 2, seed germination was highest in pure water and low salinity conditions. As salinity increased, germination decreased significantly, with no growth observed in the highest salt concentrations. This is likely because high salt levels prevent seeds from absorbing water, which is required to activate growth processes. The lemonade condition resulted in mold, which may have affected seed growth due to sugar and acidity creating an environment for microbial growth. Sugar water allowed some growth but reduced germination compared to pure water, possibly due to osmotic effects. The results supported both hypotheses. Low salt conditions allowed better water transport and higher germination rates. These findings are important in agriculture, where high soil salinity can reduce crop yield and impact food production.

One unexpected observation was the presence of mold in the lemonade condition, which likely affected the results by introducing microbial competition for resources. This suggests that not only salinity, but also environmental contaminants, can influence seed germination outcomes. Additionally, while some seeds still germinated in low salt conditions, the sharp decline in higher concentrations supports the idea that osmotic stress limits water uptake. These findings reinforce the importance of maintaining balanced soil conditions in agriculture. Farmers must monitor salinity levels carefully, as excessive salt buildup can reduce crop yield and negatively impact food production. These results are especially relevant in regions where irrigation practices increase soil salinity over time, highlighting the importance of sustainable water management strategies.

Section V: References

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