

The Effects of Irrigating a Tomato Plant with Different Levels of Aqueous Saline Aqueous Solutions on it's Germination

Sanan Khairabadi

Hypothesis

If the tomato seeds are irrigated with an aqueous solution that is between saline and brine on the salinity status scale, then the tomato seed will take longer to germinate, and the germination rate will be lower than its counterparts irrigated with aqueous solutions between fresh and brackish on the salinity status scale.

Research Description

Salinity is a significant and notable issue that is impacting crops and vegetation detrimentally. Salinization of soil can have many causes. The causes range from climatic factors such as the natural accumulation of soluble salts being retained in the Earth which includes salt not being flushed out by water in Earth due to dry climate and low precipitation, and a high evaporation rate, to human-induced factors, such as the use of water in dry climates with heavy soils, irrigation water, and fertilization. Salinization is also directly related to the irrigation of soil with water that consists of high contents of soluble salts. In many plants, soil salinity can affect a plant's ability to reproduce, decrease its rate of growth, and can also affect a plant's ability to uptake nutrients.

It can also affect germination, an important process that influences crop yield and quality. Water, which can also be saline, is the most important factor in the germination of a seed. Because it is such an important factor, the quality of the water used to irrigate crops is very important, especially in early stages of plant growth, including germination. Saline water can cause drought for plants, and interfere with osmosis. A tomato seed takes approximately 5-10 days to germinate, but if the seed is irrigated with saline water, it can cause the inhibition of a seed's germination, and delay a seed's germination. However, a difference sets tomatoes apart from other plants. The current domestic tomato originates close to the Galápagos Islands, where environmental conditions are harsh, and the coast is highly saline. Two wild tomatoes endemic to the Galápagos Islands, *Solanum cheesmaniae* and *Solanum galapagense*, have adapted to the saline conditions.

Materials

The materials used for this experiment include:

- Three Ferry-Morse tomato 20 non-gmo pellet seeds
- Three Ferry-Morse 7 pot seed starter kit single 3" pots
- Ferry-Morse 25 pack plant labels
- Miracle-Gro seed starting potting mix
- Two 5 ml syringes
- Morton sea salt
- Fiskars Fiber Composite Soil Scoop.

Procedure

1. Using Ferry-Morse 7 pot seed starter kit single 3" pots, categorize 3 pots into each salinity status scale level, excluding marginal, for a total of 15 pots
 - Fresh, brackish, saline, highly saline, brine
 - There will be 21 pots total since each seed starter kit has 7 pots, however only 15 of these pots will be used.
2. Use Fiskars Fiber Composite Soil Scoop and scoop soil to fill $\frac{3}{4}$ of the Ferry-Morse seed start kit pots full for 15 pots.
3. After the soil has been settled in the pot, take three Ferry-Morse tomato 20 non-gmo pellet seeds and plant 5 seeds in each pot.
 - The seeds should be $\frac{1}{4}$ deep in the soil.
 - Do not plant seeds directly on each other; make sure to spread seeds evenly around pot.
4. Cover the seeds with the soil
5. Flatten the soil after seeds have been planted.
6. Use Ferry-Morse 25 pack plant labels and insert them in the soil in each pot.
 - Only 15 of 25 plant labels will be used.
7. Using a pencil, label three pot from 1-3 and for each salinity status scale level to keep track of each tomato pot's progress.
8. Use one 5 ml syringe to water each seed with solution, and use the other 5 ml syringe to measure the amount of Morton sea salt needed for each level.
 - Water 30 ml solution once a day.
 - Fresh solution should have 0 mg salt and 30 ml water.
 - Brackish solution should have 45 mg salt and 29.955 ml water.
 - Saline solution should have 195 mg salt and 29.805 ml water.
 - Highly saline solution should have 675 mg salt and 29.325 ml water.
 - Brine solution should have 2,100 mg salt and 27.9 ml water.
9. After watering each seed, cover each pot with a thin layer of soil.
10. Place pots in an area where the temperature is 70-75 degrees Fahrenheit during the day, and 60 to 65 degrees Fahrenheit at night for best growing conditions.

Variables

Independent: Salinity level of water used to irrigate tomato seeds.

Dependent: Days it takes for each tomato seed to germinate in each pot, and the germination rate for each pot.

Control: The three pots watered with fresh water.

Constants: 30 ml solution, 3 seeds in each pot, 3 pots for each level, tap water

Data Tables

Days for each seed to germinate in fresh pots

Data	Seed 1	Seed 2	Seed 3	Seed 4	Seed 5
Fresh pot 1	4 days	5 days	6 days	6 days	6 days
Fresh pot 2	5 days	5 days	5 days	6 days	9 days
Fresh pot 3	5 days	5 days	5 days	5 days	5 days

Days for each seed to germinate in brackish pots

Data	Seed 1	Seed 2	Seed 3	Seed 4	Seed 5
Brackish pot 1	N/A	N/A	N/A	N/A	N/A
Brackish pot 2	6 days	8 days	9 days	9 days	9 days
Brackish pot 3	6 days	7 days	7 days	9 days	9 days

Days for each seed to germinate in saline pots

Data	Seed 1	Seed 2	Seed 3	Seed 4	Seed 5
Saline pot 1	N/A	N/A	N/A	N/A	N/A
Saline pot 2	N/A	N/A	N/A	N/A	N/A
Saline pot 3	N/A	N/A	N/A	N/A	N/A

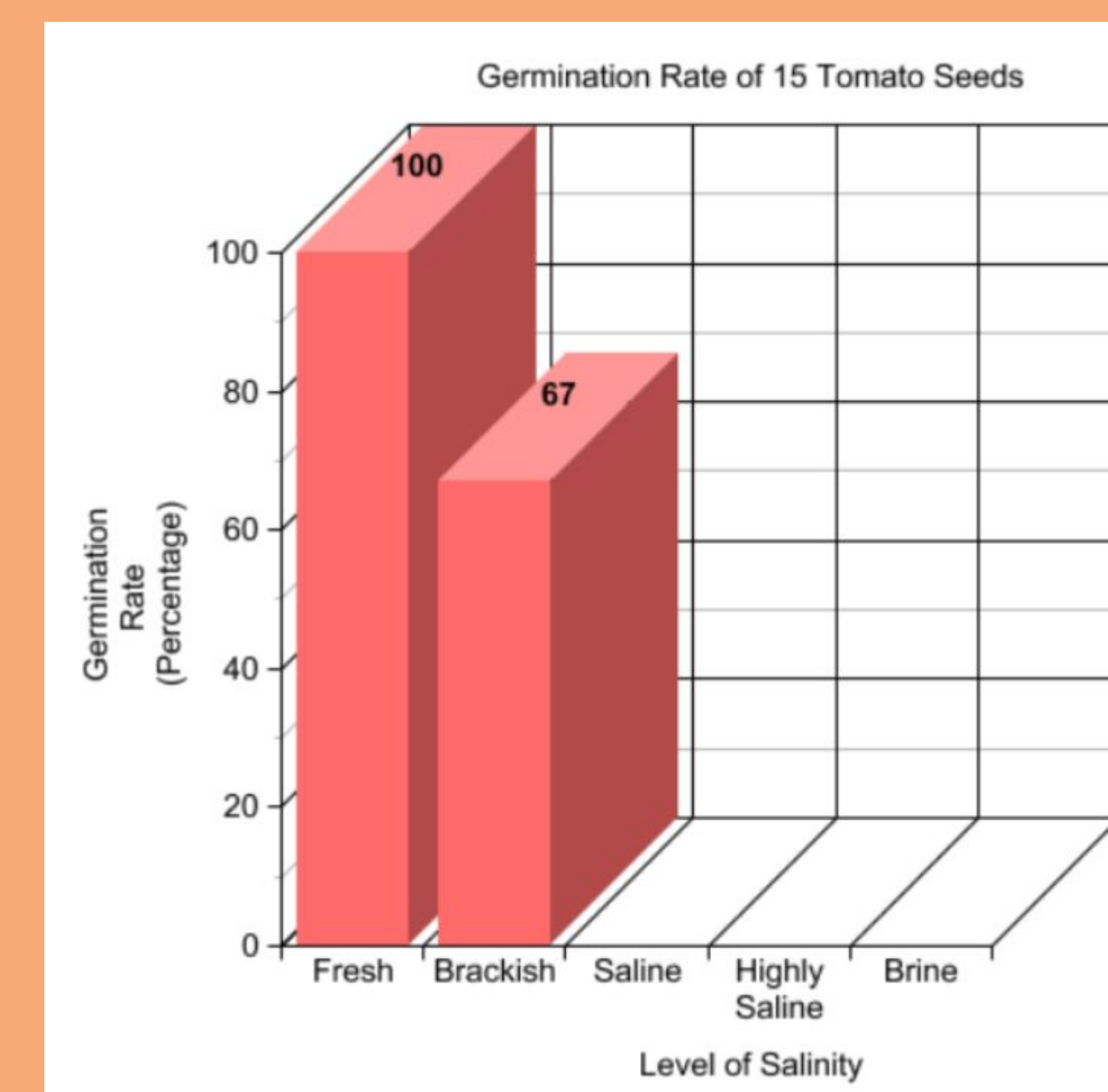
Days for each seed to germinate in highly saline pots

Data	Seed 1	Seed 2	Seed 3	Seed 4	Seed 5
Highly saline pot 1	N/A	N/A	N/A	N/A	N/A
Highly saline pot 2	N/A	N/A	N/A	N/A	N/A
Highly saline pot 3	N/A	N/A	N/A	N/A	N/A

Days for each seed to germinate in brine pots

Data	Seed 1	Seed 2	Seed 3	Seed 4	Seed 5
Brine pot 1	N/A	N/A	N/A	N/A	N/A
Brine pot 2	N/A	N/A	N/A	N/A	N/A
Brine pot 3	N/A	N/A	N/A	N/A	N/A

Graph



All data tables, graphs, and photos taken by Sanan Khairabadi

Pictures



Day 10, brackish pot 3



Day 7, brackish pot 3



Day 9, fresh pot 2



Day 9, brackish pot 3



Day 10, brackish pot 2



Day 10, brackish pot 1

Results

The data shows that the tomato seeds irrigated with water that was fresh on the salinity status scale were able to germinate, and two of three pots irrigated with water that is brackish on the salinity status scale were able to germinate. The other pots irrigated with water that was saline, highly saline, and brine were not able to germinate seeds within the 10 day time period. All fresh pots and brackish pots 2 and 3 had germination rates of 100%. All other pots had germination rates of 0%. The tomato seeds irrigated with water higher than brackish on the salinity status scale were not able to withstand the salty conditions, and were not able to germinate.

Conclusion

In summary, my hypothesis was correct. The tomato seeds irrigated with saltwater between saline and brine on the salinity status scale did not germinate within the 10 day period, and the tomato seeds irrigated with solution between fresh and brackish on the salinity status scale were able to germinate, with the exception of brackish seed 1. Pots watered with a 30 ml solution that is fresh on the salinity scale germinated in 6, 6, and 5 days. Pots 1 and 2 germinated in 6 days, and pots 3 germinated in 5 days. Pots watered with a 30 ml solution that is brackish on the salinity scale germinated in 6, 6, and 5 days. Pots 2 and 3 germinated in 8 days, and pot 1 was not able to germinate within the 10 day time frame. Pots watered with a 30 ml solution that is saline, highly saline, and brine on the salinity scale were not able to germinate within the 10 day time frame. My hypothesis was correct because the seeds irrigated with water that was too salty were not able to germinate. The seeds were not able to germinate because of the hostile growing conditions. All pots irrigated with water that is fresh and brackish on the salinity status scale were able to germinate with the exception of brackish pot 1. The pots had a germination rate of 100%, and were able to germinate five out of the five seeds planted.