Germination of Radish Seeds Experiment

**Aim :** To investigate how the germination of Radish seeds responds to the environmental stressor of salinity (Agriculture, 1990) (Development, 2001 ) (Richard D. Bliss, OCTOBER 1984 ) (How salt affects Seed Germination, 2011)

**Introduction**

The Radish ‘French Breakfast’ (Taphanus sativus) is a much longer red radish and is slightly mild. They are best grown in full sunlight, planted with a depth of 1cm and a distance of at least 3cm from each seed. Radishes are known for its rapid germination, sprouting from as little as 3 days to7, because of this they are ideal for experimentation. Salinity is the salt content in soil and can affect the germination of a seed it occurs naturally from the presence of  Na+, K+, Ca2+, Mg2+ and Cl-. Table salt or NaCl contains Na+ ions. Iodised salt however contains small traces of iodine in order for human consumption this however will not affect the experiment as vegetables do not absorb iodine and will have minimal effect if by chance they do. The germination of a seed is a very delicate stage and salinity will definitely affect it. This is due to sodium chloride which interferes with membrane functions. Sodium Chloride creates osmotic pressure in the seed which prevents absorption of water through the seed coat. This is due to the fact that water moves from areas of low concentration to areas of high concentration through a semi-permeable membrane and by adding salt the movement of these particles is prevented. of Salt tolerant plants deal with this by isolating these salt particles from cellular process . Radish has a threshold 1.2 dS/m of salt which is equivalent to 840mg of salt per litre

**Purpose :** I have chosen 10 days to ensure the latest expectance of germination, also allowing the growth of the plant and further analysis of how salinity can affect its health.

**Hypothesis :** Upon research I believe that radish will germinate fastest in water then 1 teaspoon etc. I assume that plant growth will have similar result to germination and that that 5tsp will have a significant difference in height compared to water.

**Independent variable:** Salinity

**Dependent variable:** Plant height, Day of plant sprout

Because germination will be hard to measure plant growth will allow salinity to show effect over time and can be analyzed and discussed I will still look closely into germination of seed however.

**Method and Materials**

Factors

* Temperature/humidity, the environment in which this experiment takes place also contains a heat pump which can affect the results greatly such as moisture but also keeps a much more consistent temperature
* Sunlight, self-explanatory

Materials

* 6 1Litre bottles
* 2 x 24 seedling trays (4x6)
* 2x Trays
* Table salt
* Tap Water
* Measuring Cylinder
* 30ml syringe
* Potting mix

**Method**

1. To prepare the materials, 6 x 1 litre bottles are cleaned and filled with 1000mLs of water. 6 different amounts of salt are then placed in each bottle, 0, 1, 2, 3, 4 and 5 teaspoons and sealed. A measuring cylinder a measuring spoons is used. The solutions are then stored a room temperature environment.
2. Seedling trays are filled with potting mix with a depth of 3cm, 1 seed is then then place in the center of each pot where a further 1cm of soil is placed on top all evenly spread, following the preferred 1cm sow depth of radish seeds.
3. 2 x 24 Seedling trays are then cut to form smaller 2x4 pots to account for the 8 repeats for each solution, this ensures that the results can be replicated and are correct. Seed spacing is 4cm. Due to bad climate the experiment will take place indoors to ensure maximum sunlight and growth however temperature will be inconsistent.
4. Pots are now placed onto another try to ensure soil is kept in their saline conditions while also allowing drain. The 6 separate pots are labeled with tags.
5. Seeds are watered on the first day to ensure that it will affect the germination which is the purpose of the investigation. The experiment will take place in 10 days where the plants will then be taken out and measured. During the germination and growth process the seeds will be watered once every 2 days beginning at the first in similar timeframes (1pm~2). The plants are watered with 10mls of water and a syringe is used to ensure accurate measurements, the syringe is also washed and rinsed in between different solutions to ensure the salinity concentration is not affected. Although the frequency of the watering is controlled temperature can affect the water content overtime. Sunlight and humidity are also factors which cannot be controlled and will differ day to day however exposure to these factors will be the same for all seeds.
6. While the experiment is taking place for 10 days record all data in a log book including weather conditions, and progress in plant growth etc
7. When the 10 days have ended harvest the plants and clean free of soil. Measure each plant individually with a ruler in cm and record, also take note of defections in the plant such as wilt, colour of leaves etc
8. Processes the data collected and then analyse and discuss the results.

**Evaluation**

Because of the many factors to consider when undergoing the experiment I made sure to control as many factors to ensure a fair test. During the experiment the all the seeds sprouted on the 3rd day and so I could not closely examine germination. Because of this I carried out a second test for a duration of 7 days as the expected germination of radish seeds are 3-7 days, this is enough time to see significant results where water seeds will likely sprout.

**Findings**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Plant no. | Salt concentration % | | | | | |
|  | 0 | 0.005 | 0.01 | 0.015 | 0.02 | 0.025 |
| 1 | 6.2 | 8.3 | 8.6 | 6.4 | 6 | 2.9 |
| 2 | 8.4 | 8.8 | 9.1 | 7 | 7.4 | 3.5 |
| 3 | 8.5 | 9.1 | 9.4 | 7 | 7.5 | 4 |
| 4 | 8.9 | 9.4 | 9.4 | 8 | 8 | 5.3 |
| 5 | 10.2 | 10 | 9.4 | 8.3 | 8.4 | 6.4 |
| 6 | 10.4 | 10.3 | 9.6 | 8.6 | 8.6 | 6.6 |
| 7 | 11.5 | 9.5 | 9.3 | 8.9 | 8.6 | 6.8 |
| 8 | 12.2 | 9.6 | 8.8 | 10.2 | 8.8 | 7 |
| Average | 9.5375 | 9.375 | 9.2 | 8.05 | 7.9125 | 5.3125 |

The findings are expected where water has the greatest average height followed by 0.005%, 0.01 etc

The table shows clear trends in the average however as the values are arranged from smallest to tallest it shows that there is a very wide range in the plant height. Particularly water and 0.025mg/L.

The bar graph shows the data more clearly and the obvious trend salt affecting plant growth. There is minimal difference between 0.00mg/L, 0.005mg/L, 0.010mg/L and with a significant difference in height of 0.025mg/L plants.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Water | | 0.005 | | 0.010 | | 0.015 | | 0.020 | | 0.025 | |
| Day1 | x | x | x | x | x | x | x | x | x | x | x | x |
|  | x | x | x | x | x | x | x | x | x | x | x | x |
|  | x | x | x | x | x | x | x | x | x | x | x | x |
|  | x | x | x | x | x | x | x | x | x | x | x | x |
| Day2 | x | x | x | x | x | x | x | x | x | x | x | x |
|  | x | x | x | x | x | x | x | x | x | x | x | x |
|  | x | x | x | x | x | x | x | x | x | x | x | x |
|  | x | x | x | x | x | x | x | x | x | x | x | x |
| Day3 | o | o | o | o | o | o | x | x | x | x | x | x |
|  | o | o | o | x | o | x | x | x | x | x | x | x |
|  | o | o | o | o | o | x | x | x | x | x | x | x |
|  | o | o | o | o | x | o | x | x | x | x | x | x |
| Day4 | o | o | o | o | o | o | o | x | x | x | x | x |
|  | o | o | o | o | o | o | x | x | x | x | x | x |
|  | o | o | o | o | o | o | x | o | o | x | x | x |
|  | o | o | o | o | x | o | x | x | x | x | x | x |
| Day5 | o | o | o | o | o | o | o | o | o | o | o | x |
|  | o | o | o | o | o | o | o | o | x | o | o | o |
|  | o | o | o | o | o | o | o | o | o | o | x | x |
|  | o | o | o | o | o | o | o | o | o | x | o | o |
| Day6 | **^** | **^** | o | o | o | **^** | o | o | o | o | o | x |
|  | **^** | o | **^** | o | o | o | o | o | o | o | o | o |
|  | **^** | o | **^** | o | **^** | o | o | o | o | o | x | o |
|  | **^** | **^** | **^** | **^** | o | o | o | o | o | o | o | o |
| Day7 | **^** | **^** | **^** | o | o | **^** | o | o | o | o | o | x |
|  | **^** | **^** | **^** | **^** | o | o | o | o | o | o | o | o |
|  | **^** | o | **^** | **^** | **^** | o | o | o | o | o | x | o |
|  | **^** | **^** | **^** | **^** | **^** | o | o | o | o | o | o | o |

x = no sign of germination o = sign of germination ^ = plant has sprouted about soil

During investigation of seed germination I peeked through the soil in order to collect data.

The table shows a clear trend in germination, having a distinct progression of germination across the 6 concentrations. It appears that 0.015mg/L and 0.025mg/L have a more significant impact on the germination of radish seeds and can relate to the salt tolerance of radishes.

**Conclusion**

The results prove that there is a relationship between salinity of water and seed germination. In the germination table the trend is obvious in that seeds watered with less salt content germinated faster than those with higher salt concentration on the 7th day none of the 3 highest values had sprouted which was an interesting observation. The bar graph shows the significant levels of plant height. Seed watered with 0mg/L on average grew the tallest at 9.5cm (numbers are rounded to 1sf) and there was a steady difference in average height in 0.005mg/L and 0.01mg/L with only a 0.1cm difference. However, 0.015 and 0.02 both had the average height of 8.0 cm. Seeds watered with 0.025mg/L had the shortest plants with an average of 5.3cm which was expected. These results fit my hypothesis of salinity having a negative effect on radish seed germination as the concentration increases.

**Discussion**

The United States Department of Research carried out a research in 1990 on the salt tolerance of Herbaceous Crops with Radish having a threshold of 1.2 dS/m being rated as moderately sensitive. It was upon this data in which the solutions chosen only have a difference of 0.005 in mg/L of salt.

In germination there are three main factors which can greatly affect the seed.

* Water is the main factor in germination and cannot occur without it. Through imbibition, water is absorbed allowing the swelling of a seed from which it can break the seed coat. As the seedling absorbs water, enzymes are activated allowing the breaking down of resources which can be used by the plant to grow roots and leaves which will provide the plant with energy instead through a process called photosynthesis.
* Oxygen is also needed in germination for metabolism, sets of chemical reactions which allow the seed to continue to grow. One of these sets of reactions is aerobic respiration where biochemical energy is converted into ATP as a main source of energy of the seedling prior to its growth of leaves where it can then undergo photosynthesis. The density and depth of thee seed can result in oxygen depravity and certain measurements are preferred when sowing a seed.
* Temperature is specific to a plant, considering the wide differences in weather conditions across the globe, however 16-24°C are the most common conditions for seed germination

While oxygen and temperature are important values to consider in plant germination several precautions were taken practiced to control these factors. Soil levels were strict with no pressure and compaction of the soil, the seed was sowed 1cm below with a 4cm depth in total. During the experiment temperature was kept as consistent as possible through the use of a heat pump temperatures ranged from 20-22°C at daytime and 16-17°C at night. Although by using a heat pump moisture levels may be higher than usual.

Osmosis is the movement of water through a semi-permeable membrane through an area of low concentration to an area of high concentration in order to balance the concentrations of each side. Salinity, the independent variable of this experiment greatly affects osmosis which explains the outcomes in the research. Na+ ions are impermeable to this membrane and are found in salt. When salt is added into water ‘decreases’ its concentration, this decrease in water concentration means that the movement of water will reverse and water particles will move out rather than in thereby preventing ideal osmosis rate. This is more obvious in much higher concentrations of salt. By using small values of a 0.005mg/L difference results would show a much clearer understanding on the effects of slightly saline conditions to the germination of radish seeds.

Because of this salt acts as an obstacle to water particles and so decreases the amount absorbed. This can be seen by the average difference in plant height as less water is absorbed, the plants growth rate is much slower.

The conclusion that as salinity increases, the growth rate of plants decrease can therefore be seen as true from the evidence shown in the experiment.

* As salinity increased the germination of radish seeds occurred at a slower rate with values 0.015mg/L and below had already sprouted with leaves clearly visible whereas values above were still undergoing germination.
* As salinity increased the growth rate of plants was much slower having a maximum 5.5cm difference in average height after 10 days, this is due to salt preventing plants from absorbing water.

As the experiment was carried there were several points of interest. Firstly one water plant had unusual brown and crumpled leaves yet continued to grow, there were 2 instances of 0.025mg/L plants having brown tinted leaves

**Evaluation**

To make the experiment valid, many variables were considered when planning the experiment and ways to minimize them. These variables included temperature, light intensity, sunlight exposure, soil content

When planning out the experiment 2 mock attempts were carried out. In each attempt changes were made to the method to ensure more valid results. In the first attempt a total of 5 long bean seeds were used to the same 5 concentrations (without 0.025mg/L). In this experiment salinity trends were apparent however the experiment was carried out for the duration of 10 days with minimal results which I found unsatisfactory.

In the 2nd mock attempt the similar methods were used however long bean seeds were used again and the experiment was carried outdoors. The results were again unsatisfactory as after 10 days there was barely any sprouting. This could possibly be the cause of poor weather. Although the seeds were sheltered temperature levels at the time could reach around 10-14°C at night. Sunlight was also an issue at the time as days were more cloudy meaning pots would still be damp after several days.

After the failure of the experiment I made several changes to how variables were controlled. Firstly radish seeds would be used instead as upon research I found out that the germination was much faster. Secondly the experiment was to be taken place indoors where I could control temperature. The finalised methods had superior results as weather conditions were perfect during the duration.

There were 8 trials for each concentration to ensure no errors in seedlings. A second set (germination trial) was carried after the final experiment to look closer into the germination of the radish seeds. These two experiments can then be compared to check for inconsistences and accuracy in the results. When processing the data I chose to use the average plant height for each concentration to achieve consistency.

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