

# Salt concentrations on germination of seeds



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Through my research, I decided to use rye, oats and barley seeds because due to the increasing salinity problems, there would be future food shortages due to global warming damaging crops and the increasing human population. The seeds were treated with different salt concentration solutions of sodium chloride, magnesium sulphate, calcium sulphates and bicarbonates. A Chi Squared test was done to find the relationship between each of the different salts concentrations and the germination rate.

### **Experimental Hypothesis:**

Increasing the concentration of NaCl (sodium chloride) will have the biggest decrease in the number of germinations compared to increasing the other salt concentrations.

### **Null Hypothesis:**

Increasing the salt concentration will have no effect on the germination of seeds.

- Dependent Variable: Seed germination rate
- Independent Variable: The salt solutions and salt concentration

Through my intensive research I discovered there were currently major environmental factors regarding to the lack of plant productivity for crop production regions, but through this research I discovered one of the main factors was salinity in soil. Salinity in soil is a major issue for growing crops for most regions of the planet, especially the dry regions where the seed would lack water to grow. The farmers won't be able to cultivate their own crops due to seeds not being able to germinate as crop yield is decreased. However in some cases, if the seed does manage to germinate, the plant

would often grow with many ion deficiencies. During my research I discovered a theory, which involved germinating a seed in seawater and it was told it had a huge effect on the seed. So I did research on seawater and compared and I discovered it had variety of different ions dissolved within the water. Furthermore, I also discovered that NaCl (sodium Chloride) was the most abundant ion dissolved in the seawater [6].

To test my hypothesis I will be using 3 types of cereal seeds, which are barley, oats, and rye seeds. Barley crops are very adaptable and can germinate very quickly between 1 to 3 days. Barley is normally grown in the temperate areas as a summer crop, but in the tropical regions it's sown as a winter crop. However, Barley is more tolerant than other cereal seeds to soil salinity and also more susceptible to plant diseases [9]. Oats has many uses in food, so it's vital to continue the supply for oats in the future, as global warming could affect the yield of oats produced, as oat seeds have greater tolerance of rain than any other cereal [8]. Furthermore, it has a lower summer heat requirement, which is why it's more grown throughout the temperate zones, for example Northwest Europe and Iceland. Rye grows really well in much poorer soils than most necessary cereal grains, as it's the most valuable crop in some regions. Rye withstands cold better than most grains, so farmers normally grow rye in the winter, as in spring the crop finally develops [7].

During the 1800s, researchers discovered that plants absorb essential minerals as inorganic ions in water. So basically soil acts as a mineral nutrient reservoir, but the soil isn't essential for plant growth. The plant roots only absorb nutrients and minerals when the nutrient mineral in the soil has

been dissolved in water, so it's the same as a plant absorbing the mineral nutrients as inorganic ions. If the required mineral nutrients have been introduced artificially into the plants water supply, the soil isn't required any longer, this is called a Hydroponic. Most terrestrial plants (plants grown on land) can survive or grow using a hydroponic. [3]

The advantages of using Hydroponics for food production are:

- no soil is required
- water stays within the system and can then be reused which will therefore lowering water costs
- Can be able to lower to control nutrition levels, which can also reduce nutrition costs
- Because of the controlled system, no nutrition pollution is released into the atmosphere
- Stable and high yields
- Pests and diseases are easier to get rid of because of the containers mobility
- Can be used in possible places where in-ground agriculture or gardening isn't possible [3]

However there are disadvantages of using Hydroponics for food production such as:

- Since hydroponics conditions consists the presence of fertilisers and high humidity, it creates an environment that stimulates salmonella growth

- Pathogens attacks including damp-off due to Verticillium wilt caused by high moisture levels associated with hydroponics and overwatering of terrestrial plants.
- Many hydroponic plants requires different fertilisers and containment systems, which can be very time-consuming and expensive for someone that's setting the whole hydroponic [3]

From my knowledge, I know that plant roots up take mineral nutrients by active transport. Active Transport is the movement of a substance against the concentration gradient using energy as ATP. Examples of substance which can also be taken up by active transport are ions, glucose and amino acids. Nonetheless, in my investigation I will also be looking at Osmosis and seeing so it's affected throughout my investigation. Osmosis is the diffusion of water (movement of water) across a semi-permeable membrane from an area of a less negative water potential to an even more negative water potential area and this process a non-passive process (doesn't require energy in the form of ATP). The reason I'm going to look at the effect of Osmosis throughout my investigation is because according to Muhammad Jamil's journal ' Effect of salt stress on germination and early seedling growth of four vegetables species.' It was stated in the journal that salt concentrations is a major contributor to the osmotic effect of ions on growth. Furthermore, it was also stated that high salt in the environment could lead to loss of water from cells which the cell undergoes plasmolysis, which even could lead to the death of the cell [5].

Seed Germination is the process in which the plant emerges from a seed or spore and begins growth. Seed germination depends on both internal and

external conditions. The most important external factors include water (required for vigorous metabolism), temperature, oxygen and light or even darkness. The structure of the seed consists of a seed coat, which is the covering of the seed, which protects it from any kind of injury, and also the entry of parasites and prevents it from drying. Within the seed there's an endosperm, which is a temporary food supply that's packed around the embryo in the form of cotyledons or even seed leaves. Plants are classed as monocots or dicots depending on the number of cotyledons. The seeds which I'm going to use (rye, oats and barley seeds) are monocotyledons. [2]

Several factors which prevent the germination of seed include:

- Over watering can prevent the plant to get enough oxygen
- Dry conditions can prevent germination, as the seed won't get enough moisture
- If the seed has very hard coat not enough oxygen and water will be able to get through it
- Soil temperature can also effect the germination process, regardless of whether it's too high or too low [2]

Monocotyledon is one of the two major groups of the flowering plants, well other being dicotyledons. Here's a table comparing the two major groups of the flowering plants:

Feature

Monocotyledon

Dicotyledons

Number of parts of each flower

In threes

In four or fives

Number of pores in pollen

One

Two

Number of Cotyledons (leaves in the seed)

One

Two

Arrangement of Vascular Bundles In The Stem

Scattered

Concentric Circles

Roots

Adventitious

Develop from Radical

Arrangement of major leaf veins

Parrell

Reticulate

[10]

[1]

The steps of seed germination:

Seed absorbs water and the seed coat bursts.

There's an activation of enzymes, increase in respiration and plant cells get duplicated.

A chain of chemical changes starts, which leads to the development of the plant embryo.

Chemical energy stored in the form of starch is converted to sugar, which is used during the later stages of the germination process.

Soon the plant embryo gets enlarged and the seed coat bursts open.

Growing plant emerges out.

Tip of root first emerges and helps to anchor the seed in place.

Also allows the plant embryo to absorb minerals and water from the soil.

If a monocotyledon plant, the primary root emerges from the seed and fruit and grows down.

The primary plants primary leaf grows up. It's protected by a cylindrical, hollow structure called coleoptiles.



Once the seedlings have grown above the soil surface, the growth of coleoptiles is stopped and it's pierced by a primary leaf. [2]