

Scientific inquiry in biology

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THE EFFECT OF SOIL-SALT CONCENTRATION ON PLANT GROWTH.

Introduction. Soil salt refers to dissolved ions within a given soil sample.

These ions may include Sodium, Potassium, Calcium, Nitrates, Sulphates and Chlorides among others. These ions are required by plants for growth, and are considered as either micro or macro nutrients. Some though, are required mainly for water balance within and without the plant. An example is Sodium that is found in its soluble forms (mainly Sodium Carbonate, and Chloride). The condition of high Soil sodium is referred to as sodic, and is common in desert and arid lands. An example is the Yelarbon area of Australia. When the Chloride form dominates, it is referred to as saline.

Salinity though may also refer to an increased amount of the chlorides of Potassium, Magnesium and Calcium. Increased Sodium salinity often leads to sodicity.

An excess of the cation may lead to increased pH and increased soil osmotic pressure retarding the ability of plants to absorb water. Furthermore, an increase in the Sodium Carbonate concentration leads to an ion exchange reaction that immobilizes Calcium. Calcium is an important regulator of growth and development in plants. Its participation involves nearly all aspects of plant development. (Harper J. F, 2004)

Another problem associated with increased soil Sodium is the toxicity to Na⁺ sensitive plants, and disruption of soil structure leading to crusting and poor drainage. (Ruiz Vera, 2006). This reduces available soil oxygen as well. The causes of increased sodium may be man-made or natural. Irrigation of soil with water having increased sodium carbonate is one artificial method. A natural cause may be weathering of rocks containing Sodium carbonates.

The control of sodicity is by addition of Calcium in form of Limestone, Sulphur and drainage of the soils affected.

Hypothesis.

“ The addition of salt as a thawing agent in winter retards growth of grass in summer due to an increase in soil osmotic pressure”

Prediction.

Taking the hypothesis holds true:

If an increase in soil osmotic pressure leads to retarded growth of lawn grass, then addition of a proportional amount of salt to a control sample will lead to retarded growth.

Controlled Experimental Method.

The experiment will utilize maize plant, *Zea mays*. This is because maize is a monocot (similar to most grasses), germinates in a short period, and is easy to grow and observe. It also does not require special conditions to grow.

Furthermore, its sensitivity to Sodium makes it suitable as an experimental plant.

The independent variable is the salt concentration, which will be measured in grams per liter (g/l).

The dependent variable is the rate of growth, which will be measured by germination time and height increase in millimeters per day (mm/d). This will be from the soil surface to the tip of the primary shoot. The whole length cannot be taken as uprooting the plants will surely destroy the experiment.

The set-up will comprise eight different maize seeds planted in four different glass jars. There will be two controls and six experimental plants. Out of the six, two will have a low salt concentration, another pair will have a moderate

salt concentration, and the last pair will have the highest. The basic conditions to be maintained are sunlight, warmth, total humidity, oxygen concentration, and use of similar seeds. The reason for paired seeds is to try and reduce the chance of errors due to seed deformation, genetics, disease, unviability and seed dormancy.

The maize seeds are planted at a depth of two centimeters and placed in an area with adequate shade to prevent desiccation. The area chosen must also allow direct sunlight to avoid phototropic responses and etiolation that will distort results. The water chosen for the purpose of irrigation must be from the same source, preferably rain water. Prepare three different salt solutions for watering the experimental set ups.

The first at a concentration of 5g/l,

The second will have a salt concentration of 10g/l.

The third will have 18g/l. The control plants will have the unchanged rain water.

The experiment will run for nine days, and the first reading will be in hours taken to germinate, followed by readings of length. The watering will be done twice a day in the early morning and evening to correct for water loss by evaporation and transpiration. The cumulative effect of salt during winter (frozen water) is simulated by not draining off the containers from below (similar to leaching), that would reduce salt concentration.

Results.

The results were measured over a period of nine days, and this was independent of the germination time. That is, tabulation was done in two separate parts, pre germination, and post germination. Pre germination (in

hours) allows for study of effect on germination time, and post germination (in length per day) allows for observation of effect on growth rate. Post germination time is measured from the time the coleoptile breaks the surface to allow emergence of embryonic leaf. The beginning of recording is marked by sprouting of the first seed, regardless of the state of the others' germination. For the germination to be observed, the seeds were planted close to the inner circumference of the glass jars.

Seeds

Pre-germination time(h) (averaged)

Post germination (mm/d)

Day1

Day 2

Day 3

Day 4

Day

5

Day 6

Day 7

Day 8

Day 9

Control 1

36

3

4

5

9

11

13

14

16

19

Control 2

36

4

6

9

12

13

15

17

19

25

Experimental seed pair1-(5g/l)

55

0

2

3

4

6

7

7

0

0

0

2

3

5

6

8

8

0

0

Experimental seed pair2-(10g/l)

63

0

0

1

2

2

4

0

0

0

0

0

1

2

2

3

0

0

0

Experimental seed pair3-(18g/l)

infinite

0

0

0

0

0

0

0

0

0

0

0

0

0

0

0

0

0

0

Conclusion.

The results from the simple experiment show that the presence of salt affects both germination rate and growth rate of the experimental plants.

The results indicate that the control group grows in a normal and predictable pattern. That is, they follow a distinct pattern of lag phase, exponential phase, slow down and plateau phase. The last two phases are not seen or recorded as the experimental plants succumbed to the saline conditions and wilted. Despite this unfortunate occurrence, it can still be observed that the saline conditions significantly affected their growth patterns. The experimental pair one germinated 19 hours after the controls, and showed a slowed growth rate even after emergence. The experiment pair number two germinated 27 hours later and showed much more diminished growth rate and vigor, stagnating on day four and five. It wilted a day earlier than the first experimental pair. The third experimental pair never germinated. This may be attributed to factors of sodium toxicity, and excessive soil osmotic pressure. This may have starved the seeds of essential water required for the germination process to start and proceed normally. All the results are similar to the retarded grass growth in spring.

Making suitable inference, it is seen that salt affects the rate of growth of plants, and this is highly dependent on its concentration. Therefore, the hypothesis holds true.

The results of the experiment can be used to educate landscapers on the need for placing a buffer zone of salt resistant grass, or a porous

underground layer of granite and limestone. This will allow for leaching to occur once thawing occurs, while the limestone replaces essential calcium and carbonates. Furthermore, alternative anti ice agents may be used that are not harmful to plants. An example is sugar beet molasses.

REFERENCES.

Harper, J. F., Breton, G., and Harmon, A. (2004). Decoding Ca²⁺ signals through plant protein kinases. Annual. Rev. Plant Biol. Page 55, 263–288.

Ruiz Vera, VM and Wu, L (2006). Influence of Sodidity, Clay mineralogy, Pre-wetting rate, and their interaction on aggregate stability. Soil Science Society of America Journal, Vol 70, no 6, page 1825-1833