

Experimental Design and the Scientific Method Involving salt and germinating seeds

Introduction

Salt build-up is an existing or potential hazard on almost all of the 42 million acres of irrigated farmland in the United States. Much of the world's unused lands are in arid or semi-arid regions where irrigation will be necessary. Excessive salinity is presently costing the U.S. billions of dollars.

Salt kills germinating seedlings by removing the water from their cells (plasmolysis, exomosis). Several salts and their ions are responsible: NaCl, CaCl, KCl, MgCl, and others. Farmers in the Central Valley of California have become increasingly concerned about the build-up of salt in the soil and water. Farmers need to know at what salt concentration crop seeds such as peas, mung beans, and radishes lose the ability to germinate.

Central valley farmers have gotten together and hired your company (cooperative learning team) to investigate the problem for them. It is your companies' job to use the Scientific Method and design a controlled experiment that addresses this problem.

Materials

Zip-loc bags, paper towels

NaCl concentrations - 0, 0.25, 0.5, 0.75, 1.0, 1.5, 2.0, 2.5, 3.0 grams/100 mL H₂O

Distilled water

Graduated cylinders, 25 mL

Seeds, radish, squash or wheat

Procedure:

1. Fold paper towels into squares;
2. Dampen the paper towel to keep the seeds from rolling off the towel, and place 10 radish/squash seeds on the towel.
3. Carefully fold the towel in half and place it inside the Zip-loc bag.
4. Using a graduated cylinder, measure 20 mL of the desired salt solution and add to the labeled plastic bag.
5. Remove excess air and seal the bag to prevent evaporation.
6. Complete steps 4-6 until all salt concentrations have been used. Record all data in the data table
7. Place the bags in a secure location (wall cabinet or drawer) until the next class period
8. Check the status of your seeds during the next two class periods, recording your information in the data table.
9. Graphs: From your data table you should be able to draw two graphs.
 - a. Construct a line graph on which you compare the % of salt solution on the x - axis with the number of seeds that germinated on the y-axis. Be sure and give your graph a title and label the axes.

- b. Construct a bar graph on which you compare the percentage of salt solution on the x-axis with the % of seeds that germinated on the y-axis.

Analysis:

1. Does there seem to be a relationship between the number of seeds that germinated and the concentration of the salt water? If so, what is that relationship?
2. Did your experiment support your hypothesis?
3. Can you think of any errors that might have occurred that would invalidate your experiment? If so what were they and how might they be corrected?
4. Explain why increasing levels of salt concentrations affect seed growth and why irrigation seems to be the main cause of this. (Use your textbook, if necessary)
5. Do you think all seeds would be affected in similar ways as the ones you used?
6. When soil becomes too salty, what are some methods of remediation?

Sample Table

Label	Number of Seeds used	Amount of Salt solution, mL	Concentration of salt solution	Number of seeds germinated	Number of seeds with no growth	% Germination
Control	5	20	0.25	4	5	
0.25						
0.5						
0.75						
1.0						
1.5						
2.0						
2.5						
3.0						