**Salinization Lab**

Salinization refers to a build-up of salts in soil, eventually to toxic levels for plants. (3 – 6% salt results in trouble for most cultivated plants.) Salt in soil decreases the osmotic potential of the soil so that plants can't take up water from it. When soils are salty, the soil has greater concentrations of solute than does the root, so plants can't get water from soil. (Remember osmosis -- water "tries" to accomplish dilution -- it moves from areas with lower concentration of dissolved substances to areas with higher concentration?) The salts can also be directly toxic, but plant troubles usually result primarily from inability to take up water from salty soils.

As new land comes into use, it is often in arid areas of the world, which are highly susceptible to the problems associated with soil salinization. Irrigation water contains a variety of dissolved salts including NaCl, MgCl2, CaCl2, Na2SO4, CaSO4, MgSO4, Na2CO3, CaCO3, and MgCO3 among others. There are also concerns about the salt content in recycled water. When a field is irrigated, much of the water can evaporate, leaving these salts behind as a thin layer on top of the soil. If you take a glass of tap water and leave it in the sun until all the water evaporates, a film will be left on the glass. These are salts. Over time, salts build up on fields until the soil is so salty (saline) that plants will no longer grow in the soil.

Problems with salinization are most commonly associated with excessive water application, rather than with too little. Repeated irrigation can reduce crop yields by causing salt buildup in the soil and waterlogging of crop plants. All irrigation water contains dissolved salts derived as it passed over and through the land, and rain water also contains some salts. These salts are generally in very low concentration in the water itself. However, evaporation of water from the dry surface of the soil leaves the salts behind.

Salinization is especially likely to become a problem on poorly drained soils when the groundwater is within 3 m or less of the surface (depending on the soil type). In such cases, water rises to the surface by capillary action, rather than percolating down through the entire soil profile, and then evaporates from the soil surface.

Salinization is a worldwide problem, particularly acute in semi-arid areas which use lots of irrigation water, are poorly drained, and never get well flushed. These conditions are found in parts of the Mideast, in China's North Plain, in Soviet Central Asia, in the San Joaquin Valley of CA, and in the Colorado River Basin; all areas where the soil profile never (or rarely) gets well flushed. Globally, something on the order of 20% of the world's irrigated acreage is estimated to be affected by salinization, with salt concentrations high enough n about 10% of irrigated acreage to decrease yields significantly.

Salinization obviously reduces crop productivity. In the US, salinization may be **lowering crop yields on as much as 25-30% of the nation's irrigated lands.** In Mexico, salinization is estimated to be reducing grain yields by about 1 million tons per year, or enough to feed nearly million people. In extreme cases, land is actually being abandoned because it is too salty to farm profitably.

The "treatment" for salinization is to flush the soil with lots of water. However, this results in salinization of the river and groundwater where the flush water goes. For example, the Colorado River was too salty for the Mexican farmers to use for irrigation, so the Mexican government forced the US to construct a desalinization plant near the Mexican border so the water would be useable. At times in summer, the Red River in TX and OK is saltier than seawater from its load of leached salts. In addition, the flushing is very hard on the soil structure. In extreme cases, when the salt crust is too thick, it can't be flushed, as water just runs off the salty surface.

You will design an experiment to determine the effects of salinity on the health of germinating plants. You will determine the varying concentrations

**Requirements of Experiment & Lab Write-up:**

***Abstract***: Brief summary of the experiment, hypothesis and the principal result.

***Introduction***: Background information related to hypothesis/pre-lab questions.

1. How does this lab relate to soils ecosystems and food production?
2. Why do farmers need to know salt concentrations?
3. Identify some of the ways salt buildup is a potential problem in irrigated farm land in the US.
4. How much salt concentration is acceptable?

**Materials**:

* 5 petri dishes
* 5 paper towels
* Pipette
* Graduated cylinder
* Beaker
* Stirring rod
* Seeds
* Salt
* Water
* Ruler

**Procedures:**

Day One: Set-up

1. Create a hypothesis and determine your independent and dependent variables. Determine control and test groups.
2. Label each petri dish with the chosen concentration of salt solution.
3. Place a folded paper towel in the petri dish and pack it down.
4. Create salt solutions using provided materials. Keep in mind that sodium chloride has a solubility of 35.7g per 100mL water. Ocean water has a concentration of 3.5% (3.5g salt per100mL water) and freshwater has a concentration of 0.005% salt (0.005 g salt per 100mL water)
5. Using the pipette/graduated cylinder and the different concentrations of salt water, moisten the paper towel with enough water to saturate it, but do not leave any excess.
6. Place 10-20 seeds in each petri dish. (Use a consistent amount in each petri dish).
7. Place the petri dishes at the back of the lab station (do not stack).

Days Two – Four: Observations

1. Record your observations. Make sure you note when the seed coat breaks, and the length of the roots and shoots. Also note how many seeds germinate.

***Data Tables & Graphs***

Sample Data Table

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Name of Petri Dish | Number of seeds | Amount of solution | Concentration of salt solution | Number germinated | % germinated | Average length of roots & shoots | Other Observations |
| Control |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |

Create graph(s) that represents independent variable verse dependent variable (scatterplot with line of best fit). One graph for each variable measured.

***Conclusion:*** Answer the following questions within the analysis of results. dentify if the hypothesis was supported or not by the experiment.

1. Did your experiment support your hypothesis? Explain.
2. Compare your test groups to the control group.
3. What is the relationship between the percent of seeds that germinated and the concentration of the salt in the sample?
4. Relate your results to your understanding of toxicity. Is there a threshold level of salt that is acceptable based on your results?
5. 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?
6. Explain why increasing levels of salt concentrations affect seed growth and why irrigation seems to be the main cause of this. (Use other sources, if necessary, but cite them.)
7. Do you think all seeds would be affected in similar ways as the ones you used? Explain.
8. When soil becomes too salty, what are some methods of remediation?
9. How does the negative effects of salinization of soils affect farmers ability to keep up with the increase of human populations need for food?