Effect of Salinity on The Strength and Vegetation in Laterite Soil

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Abstract- *Soil consists of soil solids, air voids and pore water. Salinity means the concentration of total soluble salts in the soil. Salinity may be in the form of calcium, magnesium ,chlorides or even carbonates of sodium. Pore water salinity influences the geotechnical properties of soil. This study aims to determine the effect of salinity on the unconfined compressive strength of soil. Also the effect of salinity on the vegetation is also investigated. Various concentrations of Nacl were added to make the soil saline. The result shows that the unconfined compressive strength decreases with the salinity. Also the shoot height and seed weight decreases with salinity.*

Keywords- Soil salinity, Naclconcentration, Unconfined compressive strength, Vegetation, Hyper salinity

I. INTRODUCTION

Soil is a mixture of several compounds such as soil, air voids and pore water. The term 'salinity' represents the total concentration of soluble salts in the soil. Those salinity salts come in different forms including calcium, magnesium, chlorides, sulphates or even carbonates of sodium. Pore water salinity influence on the behavior of solid soil particles as a result to the chemical interaction that may occur between the soil particles and the ions in the pore water.

Studies have proved that many material macroscopic characteristics (eg: shear stiffness, compressibility etc.) are affected by pore water concentrations. Yet salinity influence on the geotechnical properties of laterite soil is still yet to be further investigated. This study has been conducted to investigate the effect of pore water chemistry on the strength and compressibility characteristics are compared for tap water, saline water and hyper saline water.

SOIL SALINITY

Soil salinity is the salt content in the soil; the process of increasing the salt content is known as salinization. Salts occur naturally within soils and water. Salination can be caused by natural processes such as mineral weathering or by the gradual withdrawal of an ocean. It can also come about through artificial processes such as irrigation and road salt. Salts are a natural component in soils and water. The ions responsible for salination are Na^+, K^+, Ca^{2+}, Mg^{2+} and Cl^- As the Na^{2+} (sodium) predominates, soil can become sodic. Sodic soils present particular challenges because they tend to have very poor structure which limits or prevents water infiltration and drainage.

Over long periods of time, as soil minerals weather and release salts, these salts are flushed or leached out of the soil by drainage water in areas with sufficient precipitation. In addition to mineral weathering, salts are also deposited dust and precipitation. In dry regions salts may accumulate, leading to naturally saline soils. Human practices can increase the salinity of soils by the addition of salts in irrigation water. Proper irrigation management can prevent salt accumulation by providing adequate drainage water to leach added salts from the soil.

DRY LAND SALINITY

Salinity in drylands can occur when the water table is between two and three metres from the surface of the soil. The salts from the groundwater are raised by capillary action to the surface of the soil. This occurs when groundwater is saline (which is true in many areas), and is favored by land use practices allowing more rainwater to enter the aquifer than it could accommodate. For example, the clearing of trees for agriculture is a major reason for dryland salinity in some areas, since deep rooting of trees has been replaced by shallow rooting of annual crops.

SALINITY DUE TO IRRIGATION

Salinity from irrigation can occur over time wherever irrigation occurs, since almost all water (even natural rainfall) contains some dissolved salts. When the plants use the water, the salts are left behind in the soil and eventually begin to accumulate. Since soil salinity makes it more difficult for plants to absorb soil moisture, these salts must be leached out of the plant root zone by applying additional water. This water in excess of plant needs is called the leaching fraction. Salination from irrigation water is also greatly increased by poor drainage and use of saline water for irrigating agricultural crops. Salinity in urban areas often results from the combination of irrigation and groundwater processes.

II. OBJECTIVES

1) To study the basic properties of laterite soil.
2) To determine the strength of soil by adding different concentrations of Nacl
3) To study the effect of salinity on the vegetation

III. MATERIALS & METHODOLOGY

The laterite soil was collected from our college campus. The undisturbed soil was cleared and large particles were removed. After the soil was air dried and stored in bags under room temperature.

The tests were carried out on the collected soil and the basic properties of the soil were determined. After that Nacl solution were prepared at different concentrations. Saline water is prepared by adding 30g of salt to 1000 ml of water and its concentration increases by 32g, 34g,36g, 38g, 40g etc.Hyper saline water is prepared by adding 50g of salt by 1000ml of water and it's concentration increases by 52g, 54g, 56g, 58g, 60g etc. Compaction is done by adding saline water and hypersaline water at different concentrations. After unconfined compressive strength test is carried out to determine the strength of the sample. Finally theeffect of pore water salinity on the strength of the soil is determined.

Artificial saline soil is prepared by adding Nacl solution. After that vegetation of the plant species *pisum sativum* is done in good soil as well as in saline soil. The change in growth of plants in both soils was monitored and results were compared.

IV. RESULTS & DISCUSSIONS

The basic properties of laterite soil determined and tabulated in table 4.1

Table 4.1: Basic properties of laterite soil

Properties	Value
Specific gravity	2.67
Uniformity coefficient	13.66
Coefficient of curvature	1.17
Liquid limit	40%
Plastic limit	20%
Shrinkage limit	8.4%
Plasticity index	15.33
Soil type	CL
Optimum moisture content	14%
Maximum dry density	1.87
Unconfined compressive strength	404.945KN/m2
Electrical conductivity	20
pH	5.5

Fig 4.1: UCC testing machine

Unconfined compressive strength of soil is determined by adding different concentrations of Nacl in saline and hyper saline cases as shown in the table below (table 4. 2)

Table 4.2:UCS values for different saline conditions

Nacl concentration	Unconfined compressive strength
30g	385KN/m2
32g	380KN/m2
34g	376KN/m2
36g	373KN/m2
38g	370KN/m2
40g	368KN/m2

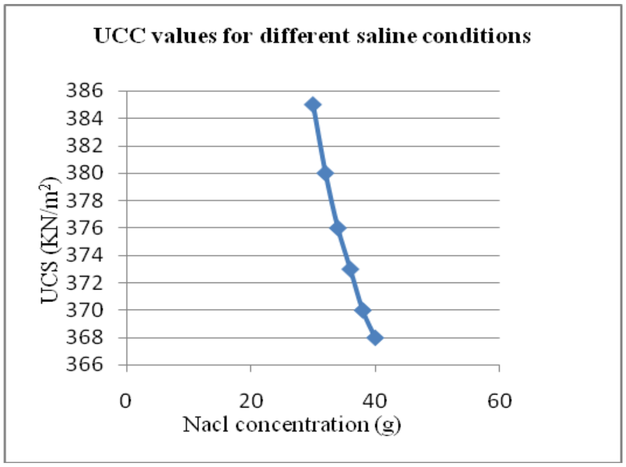

Figure 4.2: Graph showing UCS values for different saline condition

Table4. 3: Unconfined compressive strength values at various hyper saline conditions

Nacl concentration	Unconfined compressive strength
50g	250KN/m2
52g	245KN/m2
54g	241KN/m2
56g	240KN/m2
58g	240KN/m2
60g	240KN/m2

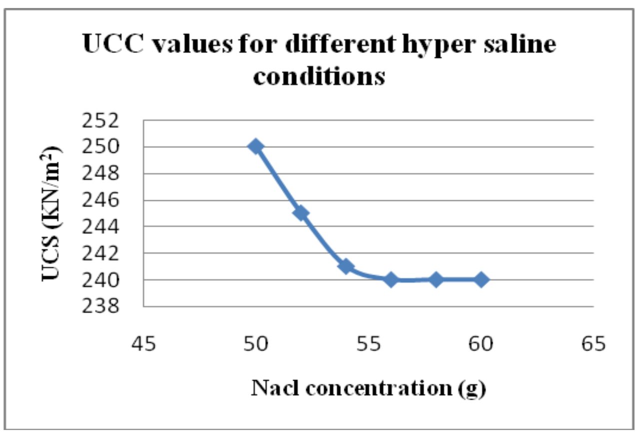

Figure 4.3:graph showing Unconfined compressive strength values at various hyper saline conditions

Pea plants were grown in 12 plastic grow bags. Plastic grow bags are filled with soil. Then the soil is made saline by mixing it with about 14% of water at varying concentrations of Nacl. The shoot height of each plant was evaluated after 20 days of planting. The seeds were observed after 50 days of planting. The seed size were evaluated at varying concentrations of Nacl. The details of shoot height of pea plants in saline and hyper saline conditions are shown in the table below.

Table 4.4:Shoot height at various saline conditions

Nacl concentration(g)	Shoot height(cm)
30	28
32	26
34	24
36	23
38	20
40	17

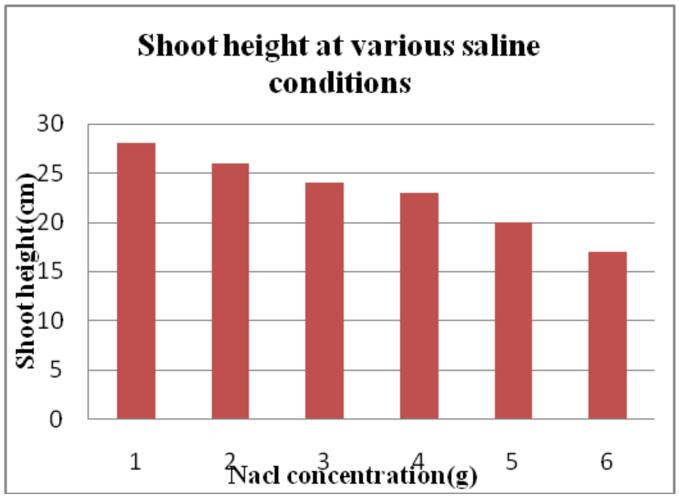

Figure 4.4: graph showing Shoot height at various saline conditions

Table 4.5:Shoot height at various hypersaline conditions

Nacl concentration(g)	Shoot height(cm)
50	16
52	15
54	14
56	10
58	9
60	8

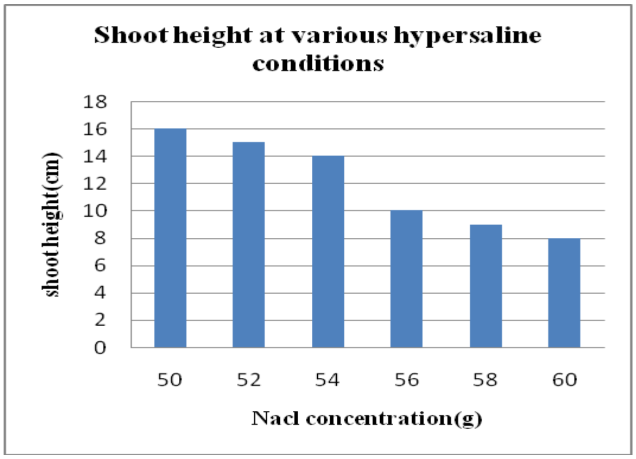

Figure 4.5: graph showing Shoot height at various hyper saline conditions

Table 4.6:Seed size at various saline conditions

Nacl concentration(g)	Seed size(g)
30	0.32
32	0.30
34	0.30
36	0.25
38	0.20
40	0.18

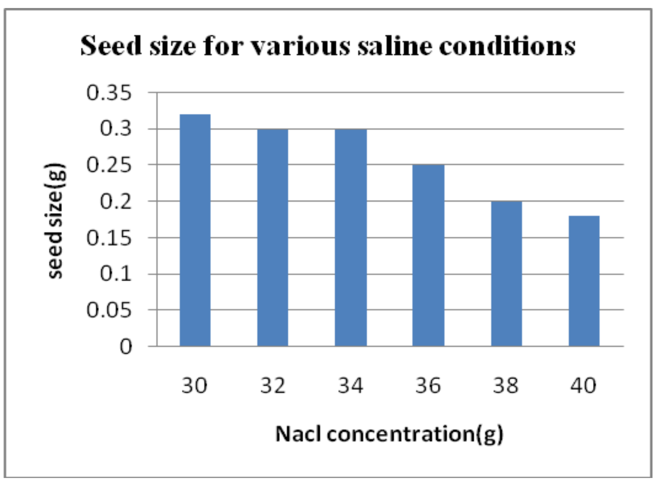

Figure 4.6:graph showing Seed size at various saline conditions

Table 4.7:Seed size at various hyper saline condition

Nacl concentration(g)	Seed size(g)
50	0.16
52	0.14
54	0.10
56	Nil
58	Nil
60	Nil

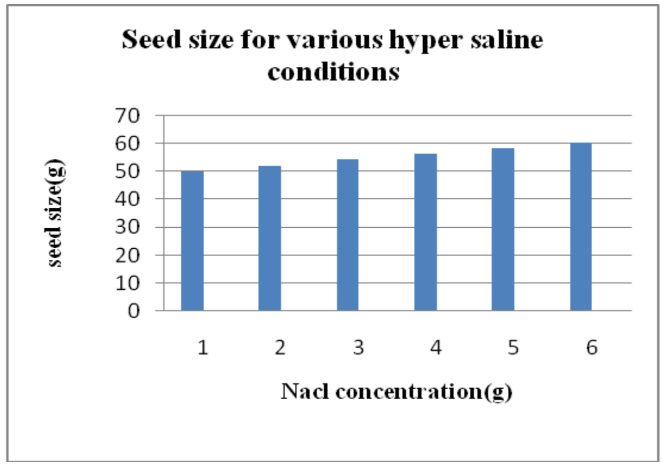

Figure 4.7:graph showing Seed size at various saline conditions

The figure 4.2 shows the values of unconfined compressive strength at various saline conditions. When the salinity increases the unconfined compressive strength decreases.

The figure 4.3 shows the values of unconfined compressive strength at various hyper saline conditions. When the salinity increases the unconfined compressive strength decreases

The figure 4.4 shows the shoot height of pea plant at different Nacl concentrations. When salinity increases the shoot height decreases

The figure 4.5 shows the shoot height of pea plant at different hyper saline conditions. The shoot height is very less at hyper saline conditions.

The figure 4.6 shows the seed size of pea plant at different saline conditions size of seed decreases with salinity.

The figure 4.7 shows the seed size of pea plant at different hyper saline conditions size of plant decreases with hyper salinity. There is no seed when the concentration of Nacl increases more than 56g.

V. CONCLUSIONS

Unconfined compressive strength decreases with salinity. Also salinity adversely affects the vegetation as well. The shoot height of the plant decreases with increase in salinity. The weight of seed also decreases with salinity. Hence the saline soil should be properly treated to mitigate the effect on the strength and vegetation.

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