"Study of physicochemical effect of saline water on Fenugreek and Maize growth"

Miss. Shaikh Sameena H. Mr. Kapse Sagar V

P.G. Department of Zoology
R.B.N.B. College Shrirampur.

Abstract:

Salinity is the saltiness or amount of salt dissolved in a body of water. Salinity is either expressed in grams of salt per kilogram of water, or in parts per thousand (ppt, or ‰). Saline water means addition of Nacl in the given water sample. Salinity is one of the most important abiotic factors limiting plant growth and yield. All plants can be killed by salt solutions if the concentration is high enough. In this study, the effect of different concentrations of NaCl (0, 50, 100, 150, 200 and 250 mM) on mineral ions content in various plant organs of fenugreek (Trigonella foenum graecumL.) and Maize plant (Zea mays) was investigated for its physicochemical properties such as pH, EC, N, P, Na, Ca, K, O.M., NaK ratio and Effect were observed on plant in two weeks for its growth. A five set of pot was set with different salinities under natural condition for experiments. A experiment design was use with three replications .The analysis results of crop growth Of maize and Fenugreek. They were Most significantly Affected by Saline Irrigation water were crop growth and studied the crop components like root, stem, leaves, leaf size and plant growth.

Key words:

Salinity, Fenugreek, Zea mays, nutrients, trace element, abiotic factor etc.

Introduction:

It is well known that fenugreek is a good source of atmospheric nitrogen fixation by rhizobium strains present in its root nodules. Rhizobium has been reported to minimize the effects of salinity and increase growth and productivity of the plants. The use of rhizobium has proved beneficial in improving the soil nitrogen and getting higher yield. Fenugreek plant is divided into root, shoot, leaf and pod parts for nutrient (Ca, Na, K, Cl, P, Fe, Mn, Cu and Zn) content measurements. Maize is cereal grain also known as corn; it has become a staple food in many parts of the world. Maize plant divided in to root stem and leafs for nutrient (Zn, K, Mg, P, S, and trace elements like B, Cu, Mn, and I).

Salinity is the saltiness or amount of salt dissolved in a body of water. Salinity is either expressed in grams of salt per kilogram of water, or in parts per thousand (ppt, or ‰). Saline water means addition of Nacl in the given water sample. For example, if you have 1 gram of salt and 1,000 grams of water, your salinity is 1 g/kg, or 1 ppt. Freshwater has very little salt, usually less than 0.5 ppt. Water with salinity of 0.5 - 17 ppt. is called brackish. Stalinization occurs naturally in arid and semiarid regions where evaporation is higher than rainfall.

The salinity water contains some salt and it will increase the salt content in the soil when the mineralization water was used for irrigation. When the salt content was much lower, the salt

can be absorbed by plants, promoting the growth of crops, thus play a positive role; but when accumulated salt content exceeds a certain level, crop growth is inhibited, causing crops wither, and even death, declining output. Therefore, when we use mineralization water for irrigation, inevitably causes increased salt content in the soil, increased as the irrigation time, salinity of irrigation water will gradually accumulate in the soil, which can lead to salinization of soil, thus having an impact on crop growth.

The natural distribution of plant species in salt-affected soils, although most agricultural interests deal with the effects of sub-lethal salinities. Generally, the effect of salinity on plants have been determined in terms of survival and its effect on vegetative growth. Growth clearly is a key parameter in both ecological and agricultural contexts.

The use of saline irrigation water has an adverse effect on soil–water–plant relations, occasionally severely restricting the normal physiological activity and productive capacity of the crops. Under high salinity level, the crop growth, leaf surface expansion, and primary carbon metabolism of many crops are negatively affected due to osmotic effect, water deficit, nutritional imbalance, and oxidative stress. Despite the number of studies on the subject, the sensitivity and tolerance of crops like Maize and Fenugreek to salinity level may vary depending on meteorological and soil conditions in the region, as well as the irrigation method.

The objective of this study, therefore, was to investigate the response of vegetable crops to different salinity levels of irrigation water under natural conditions in order to determine the target salinity level for a desalination system and to further our understanding of soil–water–plant relations.

Material and Method

The pot experiment was conducted under natural conditions in R.B. N. B. college campus, Shrirampur, Maharashtra. The experiment was set up as a completely randomized block design in pots with five treatments and three replications. Pots were filled with a commercial potting soil. The filled soil was loam (49.6% sand, 33.8% silt, and 16.6% clay). Study was carried out during August to November 2016. The experiment was carried out using a complete randomized design containing of salinity and sodium chloride (NaCl) application (0, 50, 100, 150, 200 and 250 mM) with 3 replications. Fenugreek plant and Maize plant was used as experimental material. The daily air temperature ranged from 30°C (maximum during the daytime) to 15°C (minimum during the night), with the daily average temperature being about 25°C. Relative humidity fluctuated between 30 and 85%; the average value was about 60%.Ten seeds in each plastic pot containing 5kg of field soil were directly sown. Thinning was carried out 15 days after planting, leaving four plants in each pot. The texture of the soil based on sand and clay silt, total organic matter 1.96%, total salt 0.038%, pH 7.8, total nitrogen 0.9%, available phosphorus 8.92 ppm in dry soil, exchangeable potassium 550 ppm in dry soil. All pots were fertilized with urea as a nitrogen fertilizer equivalent to 150 kg N ha-1 and triple-super phosphate (80 kg P2O5 ha-1) were incorporated into the soil before seeding. Non-salt-treated plants were kept as controls and salt-stressed plants were subjected to different salinity levels (0, 50, 100, 150, 200 and 250 mM) of NaCl 30 days after sowing and all plants, including controls, were then sampled. The salinity treatments were maintained until final harvest. The pots were randomly arranged in college campus.

Immediately after sowing, soils were watered with Saline water, watering was carried out regularly every two days during experiment (120days) and NaCl applications (50, 100, 150, 200 and 250 mM) were given together with water and plant growth were checked weekly for its root, stem, leaves and hight of plant. Plants were irrigated until saturated, with the excess solution allowed to drain into collection pots.

Study Design:
A cross sectional study was carried out from August 2016 to August 2017 to in the Study of effect of saline water on Fenugreek and Maize growth in the college campus.

Sample Size Determination:
Ten pots for experiment are used 30 cm diameter and 25 cm height in dimension and each pot with four seeds and 5 kg of field soil.

Observation Table:

A) Chemical properties of the sampled soils collected from Maize.

Sample	Concentration (mM)	pH	EC (dS/m)	N (%)	P	Mg	Na	Ca	K	O. M.(%)	Na K ratio
S1	50	7.4	6.79	0.59	1500	2300	1414	7154	1865	65.5	5.6
S2	100	7.5	8.84	0.6	1450	2140	1500	7230	1743	65.5	5.8
S3	150	7.7	11.03	0.62	1300	1930	1680	7321	1673	65.5	6.2
S4	200	7.7	13.04	0.64	1250	1600	1780	7200	1711	65.5	6.8
S5	250	7.8	15.76	0.65	1100	1520	1830	7400	1532	65.5	7.2

B) Chemical properties of the sampled soils collected from Fenugreek.

Sample	Concentration (mM)	pH	EC (dS/m)	N (%)	P	Mg	Na	Ca	K	O. M.(%)	Na K ratio
S1	50	7.4	6.79	0.54	1400	2200	1200	6990	1234	65.5	5.4
S2	100	7.5	8.84	0.55	1450	2190	1340	7012	1342	65.5	5.6
S3	150	7.7	11.03	0.53	1300	1820	1480	7190	1376	65.5	6.1
S4	200	7.7	13.04	0.58	1220	1620	1380	7264	1480	65.5	6.2
S5	250	7.8	15.76	0.57	1110	1600	1430	7300	1421	65.5	6.6

C) Maize growth

Sample	Concentration (mM)	Length of Root (cm)	Height of Plant (Feet)	Length of leaf (cm)	Stem diameter (cm)
S1	50	5.9	2.8	46.7	2.8
S2	100	5.5	2.6	44.5	2.7
S3	150	5.3	2.2	43.6	2.6
S4	200	5.2	1.9	42.1	2.5
S5	250	5.1	1.8	41.8	2.4

D) Fenugreek:

Sample	Concentration (mM)	Length of Root (cm)	Height of Plant (cm)	Length of leaf (cm)	Stem diameter (cm)
S1	50	2.8	25.3	2.8	0.5
S2	100	2.8	22.5	2.8	0.5
S3	150	2.7	23.6	2.7	0.6
S4	200	2.7	21.4	2.7	0.6
S5	250	2.6	18.9	2.6	0.5

Results And Discussion

Generally plants depend on inorganic nutrients for synthesis of complex organic compound. These organic compounds are useful for maintaining osmotic pressure of plants, energy storage and also important role in physiological process but due to highly saline water there is fluctuation in concentration of elements like Ca, Mg, Na, K, P, and organic matter, which shows deficiency condition in Maize and Fenugreek like purple leaves, limited root growth, delayed plant maturity and chlorosis in leaves due to increased salinity in soil.

In Soil from Maize and Fenugreek the pH range from 7.4 to 7.8, EC values ranged from 6.79 to 15.76 dS/m, it increased with increased salinity. As the salinity of soil increased Mg and K decreased, Na and Ca increased with increase in salinity of soil, other nutrient is value are changes with salinity. The concentration of Na+ in soil increased in all treatments. Crop Growth of the both plants were decreased with increase salinity level of the soil but it did not significantly affect the length of root, diameter of the stem, length of leaves among the treatments of all experiments for both plants. The leaf length significantly decreased with the increase in salinity level, no significant differences were found among the treatment.

Results indicated that the nutrient concentrations in plant tissues like leaves, roots, shoots and pods of fenugreek was strongly affected by all salt treatments. The chloride and sodium ions increased significantly in various parts of the plant depending on salinity increase. Specifically, increased salt concentration caused an increase in some nutrient contents (Na, Cl, P, Fe, Mn, Cu and Zn), while same factor caused a decrease in some nutrient contents (Ca and K). In general, an evident increase in nutrient composition in plant organs was observed mainly at the higher level of salt concentration when compared to control.

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