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Evaluation of ground water impacts on soil fertility: A case study Shah Abdul Latif University, Khairpur, Sindh, Pakistan

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Abstract

Soil salinity is a big problem in Pakistan which is main cause of osmotic stress. It reduces productivity and recreational activity. The problem is found in Arid and Semi-Arid regions of Pakistan, and covering about 6.68 million hector land are affected by soil salinity. Soil salinity damages the growth of plant and it is main cause of desertification. Salt is a mineral caused of weathering of rocks. The soil samples were collected from Date Palm orchards of Shah Latif University Khairpur, studied to determine the level of soil salinity. Electrical conductivity (E.C) pH, Total Dissolve Salts (TDS) were analyzed using reference methods. . Results show that soil is non-saline soils were non-saline with EC 0.26 dSm^{-1} and strongly alkaline in reaction with mean pH 8.7, the result application recommended that water of Mir Wah canal is sufficient for the orchards of the University.

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Introduction

Soil salinity is possessed by sea water along with coast in low lying area and irrigation water also possesses some salts (Haque, 2006). Moreover after irrigating plants, water evaporates and salts remain store on surface; which increases the ratio of salts in soil. The addition of salts in soil is called Salinization (Jonathan, P, 2013). Salinity is also developed is when water table raise is raised, water evaporates and left salt in the soil and salinity is developed. Due to huge rainfall soil is affected by salinity in humid and semi humid regions. As salinity increases, plant growth is started to stop and cause chlorosis disease in plants that is alternately cause of death. Soil salinity slowly damages the processes of photosynthesis, transpiration and physiological activity of plants (Ayers, R.S; and Westcot, D.W, 1985). Soil salinity is the measure of soluble salts present in soil. Salt occurs naturally in soil and water salinity is caused by natural process such as mineral weathering. Salinity is dry climate or arid land. In arid land surface water and soil water is evaporated and left salinity on the surface. On the surface of the Earth, a layer of white crust is appear, which is cause of regular evaporation process, the evaporation of irrigation water can also increase soil salinity also. The availability of salts in the soil solution decrease the capability of the plant to sink water and nutrients thereby reducing productivity (Anchorman, D. and L. Richard, 1989). In arid regions, less rainfall available to leach out the salts and access of evaporation cause high amount of salt in soil at various layers of soil. Access of drainage water on the other hand reduces permeability of soil and irrigation water containing high concentration of salts from soil salinity (Muhammad S, 2009). The Geographical location of Pakistan is also arid and semi-arid so evaporation occurs with high amount and cause salinity because average temperature of Pakistan is high and rainfall average is low. Poor irrigation water system is also a cause of soil salinity especially at the Indus plain in Pakistan (Chandio, N.H and Mallah Q.H, 2017).

Salt effected soil occurs mainly in arid and semi-arid region of the world; where annual precipitation is less than evaporation and evapotranspiration occurs in huge amount. Soil salinity is worldwide problem and approximately 10% of the Earth is being affected by this disease and over half of countries having some quality of land which is affected by soil salinity (Anwar, M.M, 2012).

A few species of Plants are best example of transpiration of salts and absorb some amount of salt and maintain soil salinity; because when water moves into the plant root through a process of osmosis it controls the level of salt in the soil; if the level of salts in the soil water is too high, water may flow from the plant roots back into the soil, and plant under the dehydration conditions can't survive. Pakistan is on 8th number in soil salinity on world's level and according the report of (World Bank 2006) soil salinity is one of the challengeable and serious environmental and agricultural problem of Pakistan (Junejo, B, 1998).

A good way of measurement of soil salinity is to measure its Electric Conductivity (EC). Soil salinity is serious environmental problem that cause osmotic stress and recreational activity; about 6.68 million hectors of arid and semi-arid regions of Pakistan is affected by soil salinity (Chandio, N.H, 2017) Incensement of ESP stand for effects on the physical and chemical properties of soil; and a cause of deficiency in plant growth. Sodium affects the growth of plants by increasing the PH values of soil. Itd does not directly on plants, it decreases few important nutrients from the plants (Choudhry MR, Muhammad S, 1986); the decreasing amount of magnesium and calcium in soil solution increases PH values. Due to concentration of unsolvable magnesium carbonates and calcium with the response of resolvable sodium carbonate and cause deficiency in growth of plants. Soils of dry climate are mostly alkaline and contain lime and calcium carbonate (Penava, F, 2016).

The ground water quality of the Shah Abdul Latif University, Khairpur is unable to use for any type of the plantation or irrigation. Electric Conductivity, TDS and pH of the soil is at high level risk.

This is first time study of the research area, focused on the evolution of the soil fertility of the orchard of Shah Abdul Latif University, Khairpur. Therefore present study was conducted to measure the soil salinity and soil alkalinity status of soils under date palm and orchards of the University. The aim of study is point pout the problem the administration of the University.

Materials and method

The main objective of the study is to evaluate the quality of ground water and its impacts on the soil of the Shah Abdul Latif University, Khairpur, Sindh. For this purpose, three parameters pH, TDS and EC have been analyzed at the Water and Soil tested laboratory Rohri, Sindh. Nine soil samples were collected from three orchards. All nine soil samples were air dried in a distinct room of laboratory. Air dried soil has been converted in powdered form by an especial grinder machine. The purpose of this whole process is to calculate the pH, Total Dissolved Salts and Electric Conductivity of collected soil samples (Chandio. N.H 2017). All samples were taken from the soil depth of 0-15cm.

At the water and soil laboratory, collected samples were analyzed for the purpose to measure the pH, TDS and EC sixty grams of powdered soil blended in 300 ml of refined water in funnel shaped bottle. The samples were retained with special holders of the Mechanical Shaker for thirty minutes as they mixed with water (M.M. Anwar and N.H. Chandio. 2012), pH was conducted by pH meter, TDS meter and EC meter respectively. The primary results of soil samples are very shocking as given below.

Table 1. Primary result of Soil sampling collected from three orchards of Shah Abdul Latif University, Khairpur.

S.No	GPS Location	pH	TDS (ppm)	EC (dSm^{-1})
1	27°29'33.11"N and 68°45'33.07"E	7.5	1200	5.2
2	27°29'32.07"N and 68°45'33.88"E	7.4	1350	5.1
3	27°29'32.46"N and 68°45'36.18"E	7.6	1250	3.1
4	27°29'30.48"N and 68°45'55.32"E	7.7	1280	4.3
5	27°29'30.92"N and 68°45'57.93"E	7.4	1160	4.2
6	27°29'29.36"N and 68°45'54.34"E	7.3	1210	3.5
7	27°29'42.24"N and 68°45'42.99"E	7.6	1390	5.5
8	27°29'39.92"N and 68°45'45.72"E	7.5	1200	4.2
9	27°29'36.83"N and 68°45'44.73"E	7.7	1450	5.3

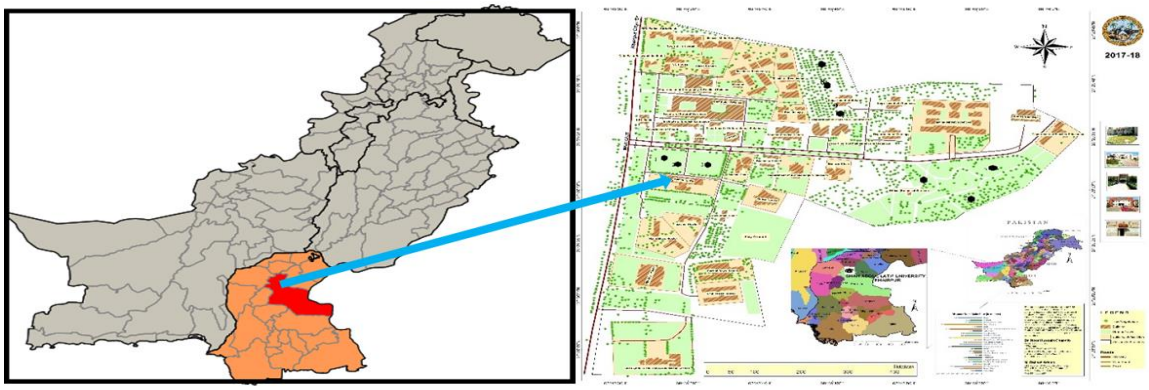

Fig. 1. Location of Shah Abdul Latif University and soil sampling area in black spots.

The table 1 shows that pH, TDS and EC tests of the all three orchards is found high, in this situation plants cannot grown at study area. At the vicinity of the University, more than 20 electric water pumps/motors are installed to irrigate the special grass of orchards of the university, but soil fertility is effected due to bad quality of ground water Purpose four samples were collected from running water motors to analyze the water quality. The primary results of ground water are also very shocking. As given in table 2

Table 2. Ground water quality of Shah Abdul Latif University, Khairpur.

S.No	pH	TDS (ppm)	EC (dSm-1)
01	7.7	1400	5.5
02	7.6	1550	5.4
03	7.7	1650	3.5
04	7.8	1480	4.6

The table 2 is indicated the high level salts has been mixed in ground water of the University, which is main cause of saline soils.

Results and discussion

The research area is near the Mir Wah Canal (this is riverine water), water of this canal is able to irrigation and this is main source of drinking water for the Khairpur city. Mir Wah (canal) is also crossing the area of the University, the branch is just like bless for the university.

Table 3. Result of soil pH, TDS and EC.

S.No.	pH	TDS (ppm)	EC (dSm-1)
01	7.1	700	4.2
02	7.2	950	4.6
03	7.2	850	2.9
04	7.1	780	3.2
05	7.3	900	3.2
06	7.3	850	3.1
07	7.4	850	4.2
08	7.2	950	4.3
09	7.3	790	3.9

The water quality of this branch is at the standard level of WHO. Three parameters of Mir Wah pH, TDS and EC were calculated, 7.1 pH, 422 TDS (ppm) and 2.1 EC (dSm-1) were measured. Nine samples of soil were tested as shown in table 3. The samples were taken from the very close to banks of riverine water branch which crossed the area of the university. This water has been kept clearly positive impacts on the soil of the University.

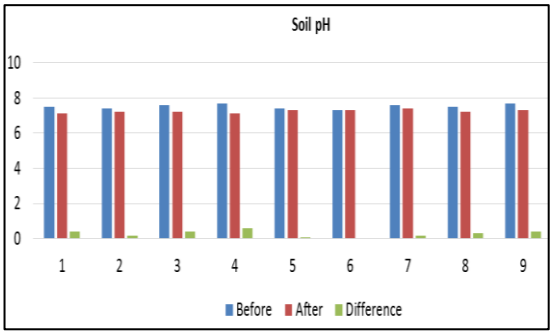

Fig. 2. Soil pH before, after experiment and difference.

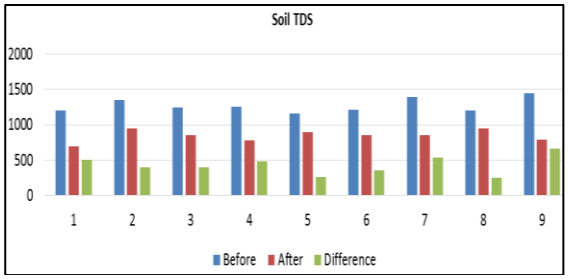

Fig. 3. Soil TDS before and after experiment and difference.

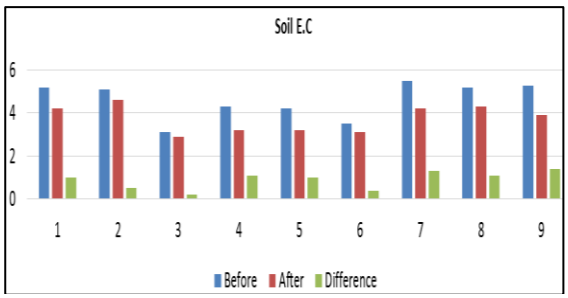

Fig. 4. Soil Electric Conductivity before and after experiment and difference.

In general discussion, the result of the sweet water is positive, meanwhile the maximum pH before the experiment was 7.7 and minimum result 7.3 pH was calculated but a result after experiment was very positive, the maximum 7.4 pH was and minimum 7.1 pH was calculated as shown in table 1 and 3 and in Fig. 1. Therefore, by the result indicate that the soil of the university can be maintained by the water of Mir Wah Canal.

The test of Total Dissolved (TDS) is indication of availability of salts in soil, the maximum TDS level of soil before experiment was 1450 ppm; meanwhile the minimum level of TDS was recorded 1160 ppm, as published in table 1, 3 and Fig. 2. Meanwhile the maximum TDS level of after experiment was 950 ppm and minimum TDS level in soil of study area was 700ppm. The reduction of TDS level is positive indication for orchards of the University.

The data presented in table.1 and 2 showed that EC of the soil maximum and minimum before the experiment of samples ranged from 3.1 dSm^{-1} to 5.5dSm^{-1} with an average value of 4.3 dSm^{-1}.

Meanwhile the maximum and minimum Electric Conductivity was recorded after the experiment was 4.6 dSm^{-1} and 3.1 dSm^{-1}.

Suggestion

In successful difference in minimum and maximum result of pH, TDS and EC is constructive, now it is suggested that a minor branch of canal which crossed the ground/area of the university may be extend and increase the volume of water to supply of water for all orchards of the university.

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