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Effect of Different Quality Water on Chemical Properties of Soil in Pundri Block of Kaithal District

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ABSTRACT

The present investigation was carried out in Kalayat block of Kaithal district for measuring the effect of different quality of water on soil physico-chemical properties at different depths. The EC_e in most of the soil profiles decreased down the profile, i.e., highest being in surface layer (0-15 cm depth) and lowest at 45-60 cm soil depth. The pH of all soil profiles decreased with depth, the highest was found in surface layer (0-15 cm) and lowest at the depth of 45-60 cm. There was a decreasing trend in CEC with increase in depth. The distribution and concentration of major cations like Ca^{2+}, Mg^{2+}, Na^{+} and K^{+} and major anions like CO_3^{2-}, HCO_3^{-}, Cl^{-}, and SO_4^{2-} showed a decreasing trend with depth in all profiles.

Key words: *Saline, Alkali, EC_e, CEC, ESP*

INTRODUCTION

The quality of irrigation water (Salinity & Sodicity) has the potential to significantly affect soil structural properties. Saline irrigation water contains dissolved substances known as salts. In arid and semi-arid regions, most of the salts present in irrigation water are chlorides, sulphates, carbonates and bicarbonates of calcium, magnesium, sodium and potassium. While salinity can improve soil structure, it can also negatively affect plant growth and crop yields. Sodicity refers specifically to the amount of sodium present in the irrigation water. Irrigation with water that has excess amounts of sodium can adversely impact soil structure making it difficult for plant growth. Highly saline and sodic water qualities can cause problems for irrigation, depending on the type and amount of salts present, the soil type being irrigated, the specific plant species and growth stage, and the amount of water that is able to pass through the root zone. Salt affected soils and poor-quality ground waters are primary constraints for sustainable agriculture in arid and semi-arid climatic zones of central Haryana[19]. High evaporation during the dry season and lack of good quality water for irrigation caused salt accumulation in soil profiles. The use of poor quality ground water for irrigation has increased salt build-up in soil profiles and caused reduced productivity.

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Naturally, salts are drained from the Himalayas and Siwalik through rivers/streams and are accumulated at the alluvial plains[16]. The lack of adequate internal drainage in lower topographic regions prompted soil salinization. Canal irrigation in undrained areas has caused waterlogging, formation of high water table and secondary salinization in soils. The reported extents of salt affected soils in Haryana varied from 4.54 to 2.32 lakh ha[1], and needs verification using modern tools and field studies. Due to complex nature, salt affected soils vary widely in salt composition, physical properties, internal drainage and pedogenic processes. The irrigation with poor quality (sodic with RSC) ground water has favoured salt enrichment leading to poor soil health[7,3]. Soil physicochemical characteristics and water quality appraisal for irrigation are valuable inputs for precise assessment of reclamation and management[10]. In the present study, an attempt was made to analyse physico-chemical characteristics of some soils profiles and appraise quality of ground water samples collected from benchmark locations in Pundri block of Kaithal district of central Haryana for reclamation and management.

MATERIAL AND METHODS

With the aim of analysing the effects of ground water quality on the chemical properties of the soil, the soil samples were collected from fields at various profile depths of 0-15 cm, 15-30 cm, 30-45 cm and 45-60 cm with the help of auger, irrigated with all identified categories of groundwater. Sampling process was started in the month of June before the showers of monsoon. Locations of different sampling sites were recorded by using GPS.

Water-soluble and Exchangeable Sodium

With the help of flame photometer Water-soluble sodium was determined. By soaking soil sample in neutral ammonium acetate solution for several hours exchangeable sodium was extracted. This effectively displaced Na^+ ions from the exchangeable complex. With the help of flame photometer, the Na^+ ions released from the exchanged sites in ammonium acetate extract was measured.

Cation Exchange Capacity (CEC)

Cation exchange capacity of soil samples was determined by treating the soil with sodium acetate (CH_3COONa) solution (pH 8.2) for replacement of exchangeable cations by Na^+ ions. The excess of salt was washed down by alcohol and adsorbed Na^+ ions were replaced by $NH^{4+,}$ using neutral normal ammonium acetate (CH_3COONH_4) solution. The Na^+ ions released from the exchanged sites were measured in ammonium acetate extract with the help of flame photometer.

Exchangeable Sodium Percentage (ESP)

The percentage of cation exchange capacity of soil occupied by sodium is known as exchangeable sodium percentage. Ratio of exchangeable sodium to that of cation exchange capacity multiplied by 100 gives the value of Exchangeable sodium percentage.

RESULTS AND DISCUSSION

To study the effect of irrigation water on soil properties, 5 representative soil sites (based on different categories of irrigation water) were selected, sampled and analysed for their chemical properties. The chemical composition of ground water of the sites concerned, and soil samples is presented below.

Good quality water

Location of water and soil sampling sites of village Ramana in Pundri block lies between 29^0 39’ 954” N Latitude and 76^0 31’ 411” longitude E. The chemical constituents of tube-well water are presented in the Table 1. Total salt concentration of water measured in term of EC has a value of (1.37 dSm^{-1}). The pH, RSC and SAR have following values 8.33, 1.21 me l^{-1} and 5.44 (mmol $l^{-1})^{1/2}$ respectively. The dominant cations and anions of water sample are given in Table1. After analyzing the different parameters of water, this was categorized in good category (A) as per AICRP classification.

The depth-wise variation in physico-chemical properties of soil profile with the use of good water by farmer is shown in the Table 2. Cation exchange capacity (CEC), exchangeable sodium percentage (ESP) and saturation percentage of soil profile varied from 14.39-15.45 (cmol (+) kg^{-1}), 5.91-6.96 and 45.35-48.00 % respectively. Soil properties show a decreasing trend with increasing depth of soil profile. Chemical composition of saturation extract of soil profile is presented in the Table 3. Top layer (0-15cm) of soil profile was found having maximum salt concentration having highest EC_e 2.94 dSm^{-1} and it showed a decreasing trend with increase in depth of the soil profile. Similarly, SAR_e was found maximum 4.90 (mmol $l^{-1})^{1/2}$ in the surface layer and it varied in between 3.97-4.90 (mmol $l^{-1})^{1/2}$. All cations and anions also show decreasing trend with increasing depth of soil profile.

Soil profile shows mean cationic composition in the order of $Na^+ > Mg^{2+} > Ca^{2+} > K^+$ similarly the anionic composition of saturation extract was in the order of $Cl^- > SO_4^{2-} > HCO_3^- > CO_3^{2-}$. The pH of saturation extract was varied in between 7.54-7.86 and it showed a decreasing trend down the soil profile. After analyzing all parameters and according to U.S Salinity laboratory the soil of this profile classified as normal.

Marginally saline water

Location of water and soil sampling sites of village Dig in Pundri block lies between 29^0 40'131" N Latitude and 76^0 38' 280" E longitude. The chemical constituents of tube-well water is presented in the Table 4.42. Total salt concentration of water measured in term of EC has an value of (2.06 dSm^{-1}). SAR and pH have following values 9.01 (mmol $l^{-1})^{1/2}$ and 8.44 respectively, RSC was found nil. Cationic and anionic composition of water samples are given in Table1. After analyzing the different parameters of water, this was categorized as marginally saline (B1) as per AICRP classification.

The depth-wise variation in physico-chemical properties of soil profile is shown in the Table 2. Cation exchange capacity (CEC), exchangeable sodium percentage (ESP) and saturation percentage of soil profile varied from 13.35-14.49 cmol (+) kg^{-1}, 8.14-9.23 and 42.90-45.60% respectively. Soil properties showed a decreasing trend with increasing depth of soil profile. Chemical composition of saturation extract of soil profile is presented in the Table 3. Top layer (0-15cm) of soil profile was found having maximum salt concentration having highest ECe 4.47dSm^{-1} and it showed a decreasing trend with increase in depth of the soil profile. Similarly, SARe was found maximum 7.30 (mmol $l^{-1})^{1/2}$ in the surface layer and it varied in between 6.98-7.30 (mmol $l^{-1})^{1/2}$. All cations and anions showed decreasing trend along with increase in the depth of the soil profile.

Soil profile shows mean cationic composition in the order of $Na^+ > Mg^{2+} > Ca^{2+} > K^+$ similarly the anionic composition of saturation extract was in the order of $Cl^- > SO_4^{2-} > HCO_3^- > CO_3^{2-}$. The pH of saturation extract was varied in between 8.10-8.46 and it showed a decreasing trend down the soil profile. After analyzing all parameters and according to U.S Salinity laboratory the soil of this profile classified as saline.

Marginally alkali water

Location of water and soil sampling sites of village Habri in Pundri block lies between 29^0 42' 810" N Latitude and 76^0 36' 950" E longitude. The chemical constituents of tube-well water are presented in the Table 1. Total salt concentration of water measured in term of EC has a value of (1.46 dSm^{-1}). SAR and pH have following values 8.85 (mmol $l^{-1})^{1/2}$ and 8.37 respectively, RSC was found 3.70 (me l^{-1}). After analyzing the different parameters of water, water of village Habri was categorized as marginally alkali (C1) as per AICRP classification.

The depth-wise variation in physico-chemical properties of soil profile with the use of good water by farmer is shown in the Table 2. Cation exchange capacity (CEC), exchangeable sodium percentage (ESP) and saturation percentage of soil profile varied from 13.13-14.82 (cmol (+) kg^{-1}), 15.31-16.14 and 42.40-46.40 % respectively. Soil properties showed a decreasing trend with increasing depth of soil profile. Chemical composition of saturation extract of soil profile is presented in the Table 3. Top layer (0-15cm) of soil profile was found having maximum salt concentration having highest ECe 2.56 dSm^{-1} and it showed a decreasing trend with increase in depth of the soil profile. Similarly, SARe was found maximum 14.53 $(mmol\ l^{-1})^{1/2}$ in the surface layer and it varied in between 13.96-14.53 $(mmol\ l^{-1})^{1/2}$. All cations and anions show decreasing trend along with increase in depth of the soil profile.

Soil profile shows mean cationic composition in the order of Na^{+}> Mg^{2+}> Ca^{2+}>K^{+} similarly the anionic composition of saturation extract was in the order of HCO_3^- >Cl^->SO_4^{2-}> CO_3^{2-}. The pH of saturation extract was varied in between 8.42-8.81 and it showed a decreasing trend down the soil profile. After analyzing all parameters and according to U.S Salinity laboratory the soil of this profile classified as marginally alkali.

Alkali water

Location of water and soil sampling sites of village Ahou in Pundri block lies between 29^0 46’ 956” N Latitude and 76^0 40’ 546” E longitude. The chemical constituents of tube-well water are presented in the Table 1. Total salt concentration of water measured in term of EC has an value of (1.01 dSm^{-1}). SAR and pH have following values 6.44 $(mmol\ l^{-1})^{1/2}$ and 8.46 respectively, RSC was found 5.20 (me l^{-1}). After analyzing the different parameters of water, this was categorized as alkali (C2) as per AICRP classification.

The depth-wise variation in physico-chemical properties of soil profile with the use of good water by farmer is shown in the Table 2. Cation exchange capacity (CEC), exchangeable sodium percentage (ESP) and saturation percentage of soil profile varied from 13.78-14.82 (cmol (+) kg^{-1}), 17.04-18.34 and 43.90-46.40 % respectively. Soil properties showed a decreasing trend with increasing depth of soil profile. Chemical composition of saturation extract of soil profile is presented in the Table 3. Top layer (0-15cm) of soil profile was found having maximum salt concentration having highest ECe 3.20 dSm^{-1} and it showed a decreasing trend with increase in depth of the soil profile. Similarly, SARe was found maximum 16.19 $(mmol\ l^{-1})^{1/2}$ in the surface layer and it varied in between 15.37-16.19 $(mmol\ l^{-1})^{1/2}$. All cations and anions show decreasing trend along with increase in depth of the soil profile.

Soil profile shows mean cationic composition in the order of Na^{+} >Mg^{2+} >Ca^{2+} >K^{+} similarly the anionic composition of saturation extract was in the order of HCO_3^- >Cl^- > CO_3^{2-}>SO_4^{2-}. The pH of saturation extract was varied in between 8.22-8.73 and it showed a decreasing trend down the soil profile. After analyzing all parameters and according to U.S Salinity laboratory the soil of this profile classified as alkali.

Highly alkali water

Location of water and soil sampling sites of village Hagwana in Pundri block lies between 29^0 41’ 531” N Latitude and 76^0 35’ 300” E longitude. The chemical constituents of tube-well water are presented in the Table 1. Total salt concentration of water measured in term of EC has an value of (1.47 dSm^{-1}). SAR and pH have following values 10.67 $(mmol\ l^{-1})^{1/2}$, 8.47 respectively and RSC was found 5.60 (me l^{-1}). After analyzing the different parameters of water, this was categorized as highly alkali (C3) as per AICRP classification.

The depth-wise variation in physicochemical properties of soil profile with the use of good water by farmer is shown in the Table 2. Cation exchange capacity (CEC), exchangeable sodium percentage (ESP) and saturation percentage of soil profile varied from 13.18-14.33 (cmol (+) kg^{-1}), 18.56-19.72 and 42.50-45.20 % respectively. Soil properties showed a decreasing trend with increasing depth of soil profile. Chemical composition of saturation extract of soil profile is presented in the Table 2. Top layer (0-15cm) of soil profile was found having maximum salt concentration having highest ECe 3.18 dSm^{-1} and it showed a decreasing trend with increase in depth of the soil profile. Similarly, SARe was found maximum 17.25 (mmol $l^{-1})^{1/2}$ in the surface layer and it varied in between 16.85-17.25 (mmol $l^{-1})^{1/2}$. All cations and anions show decreasing trend along with increase in depth of the soil profile.

Soil profile shows mean cationic composition in the order of $Na^+ > Mg^{2+} > Ca^{2+} > K^+$ similarly the anionic composition of saturation extract was in the order of $HCO_3^- > Cl^- > CO_3^{2-} > SO_4^{2-}$. The pH of saturation extract was varied in between 8.76-9.02 and it showed a decreasing trend down the soil profile. After analyzing all parameters and according to U.S Salinity laboratory the soil of this profile classified as highly alkali

Table 1: Chemical composition of tube well water used for irrigation in different locations

Location	EC	pH	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}	NO_3^-	Ca^{2+}	Mg^{2+}	Na^+	K^+	RSC	SAR	CLASS
Ramana	1.37	8.33	0.10	6.00	5.20	1.60	0.00	1.22	3.67	8.50	0.15	1.21	5.44	A (Good)
Dig	2.06	8.44	0.40	1.20	13.20	4.90	0.20	1.40	4.00	14.80	0.29	0.00	9.01	B1(Marginally saline)
Habri	1.46	8.37	0.80	6.10	4.80	1.90	0.62	0.80	2.40	11.20	0.28	3.70	8.85	C1(Marginally Alkali)
Ahou	1.01	8.46	2.40	5.30	1.20	0.20	0.09	0.55	1.95	7.20	0.16	5.20	6.44	C2(Alkali)
Hagwana	1.47	8.47	2.50	5.00	5.80	0.40	0.20	0.50	1.40	10.40	0.19	5.60	10.67	C3(Highly alkali)

Table 2: Physico-chemical properties of soil profile of different locations

Location	Soil depth (cm)	CEC cmol (+) kg^{-1}	ESP %	Saturation %
Ramana	0-15	15.45	6.96	48.00
	15-30	15.10	6.48	47.10
	30-45	14.74	6.05	46.20
	45-60	14.39	5.91	45.35
Dig	0-15	14.49	9.23	45.60
	15-30	14.06	8.97	44.56
	30-45	13.74	8.39	43.80
	45-60	13.35	8.14	42.90
Habri	0-15	14.82	16.14	46.40
	15-30	13.95	15.97	44.30
	30-45	13.61	15.75	43.50
	45-60	13.13	15.31	42.40
Ahou	0-15	14.82	18.34	46.40
	15-30	14.37	17.85	45.30
	30-45	14.18	17.29	44.85
	45-60	13.78	17.04	43.90
Hagwana	0-15	14.33	19.72	45.20
	15-30	13.96	19.31	44.32
	30-45	13.74	18.67	43.80
	45-60	13.18	18.56	42.50

Table 3: Chemical composition of saturation extract of soil profile of different locations

Location	Soil depth (cm)	EC_e (dSm^{-1})	pH (1:2)	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	K^+	SARe ($m\ mol\ l^{-1}$)$^{1/2}$
				(me l^{-1})								
Ramana	0-15	2.94	7.86	0.75	3.86	18.45	5.56	3.33	9.67	12.50	3.06	4.90
	15-30	1.51	7.72	0.50	2.15	8.56	3.10	1.65	3.97	7.40	1.68	4.41
	30-45	1.43	7.68	0.42	1.96	8.20	2.90	1.40	3.60	6.60	1.60	4.17
	45-60	1.33	7.54	0.36	1.82	7.60	2.58	1.35	3.30	6.05	1.56	3.97
Dig	0-15	4.47	8.46	2.74	7.60	23.46	9.26	7.50	12.00	22.80	1.10	7.30
	15-30	4.19	8.36	2.45	6.80	22.80	8.45	6.80	11.60	21.75	0.92	7.17
	30-45	4.11	8.32	2.20	6.20	21.75	8.24	6.50	10.85	20.80	0.85	7.06
	45-60	3.98	8.10	1.86	5.90	20.96	8.10	6.20	9.90	19.80	0.79	6.98
Habri	0-15	2.56	8.81	3.50	12.25	4.60	4.25	1.25	2.50	19.90	1.15	14.53
	15-30	2.39	8.77	3.15	11.80	4.30	3.70	1.10	2.25	18.50	1.06	14.29
	30-45	2.31	8.66	2.98	11.25	4.20	3.58	1.10	2.06	17.80	0.97	14.16
	45-60	2.25	8.42	2.74	10.78	3.96	3.40	1.00	1.95	16.95	0.90	13.96
Ahou	0-15	3.20	8.73	5.25	15.75	6.98	3.10	1.76	3.25	25.62	1.25	16.19
	15-30	3.09	8.63	4.95	15.00	6.24	2.92	1.68	3.06	24.76	1.25	16.08
	30-45	2.88	8.52	4.80	14.26	5.98	2.84	1.50	2.80	22.85	1.20	15.58
	45-60	2.70	8.22	4.45	13.50	5.62	2.62	1.35	2.60	21.60	0.85	15.37
Hagwana	0-15	3.18	9.02	4.15	14.75	8.50	3.10	1.25	2.75	24.40	1.85	17.25
	15-30	3.06	9.00	3.98	14.56	8.36	3.10	1.16	2.52	23.35	1.74	17.21
	30-45	2.98	8.85	3.85	14.10	8.10	2.96	1.12	2.33	22.30	1.62	16.98
	45-60	2.84	8.76	3.55	13.65	7.70	2.72	1.05	2.04	20.94	1.50	16.85

THe EC_e in most of the soil profiles decreased down the profile, i.e., highest being in surface layer (0-15 cm depth) and lowest at 45-60 cm soil depth. The reason might be ascribed to the high concentration of soluble salts in the surface layer due to high evapotranspiration as a result of which the soluble salts come to the surface layer by capillary action and also leaching of salts had not taken place from top to lower layers as sampling was done prior to monsoon. The decrease in ECe was also due to reduced concentration of calcium and magnesium in the soil solution. The results are in agreement with Mediratta *et al.*[11], Singh[17], Qadir *et al.*[14], Raghubanshi and Singh[15], and Vijaykant[18].

The pH of all soil profiles decreased with depth, the highest was found in surface layer (0-15 cm) and lowest at the depth of 45-60 cm. The high values are possibly due to presence of soluble and exchangeable sodium along with HCO_3^- ions, which precipitate as calcium and magnesium carbonates during evaporation. Therefore, high pH values indicate development of salinity and sodicity in the area. The results are in confirmation with those of Deshmukh[5], and Vijaykant[18].

Cation-exchange capacity (CEC) is a measurement of the soil's ability to hold positively charged ions and nutrients. There was an decreasing trend in CEC with increase in depth reason can be ascribed to increase in sodium ion, high clay content and organic matter at upper layer of soil the soil profile and decreasing downwards reported by More *et al.*[12], Christensen[4], Jayaprakash *et al.*[8]. Simillar results were found by Vijayakant[18], in Kaithal block and Gulha block of Kaithal district. Similar trend was followed in case of saturation percentage; it also decreases with increase with depth reason may be ascribed to increase in compaction which led to decrease in pore size[13].

Exchangeable Sodium percentage determines the percentage of exchangeable sodium adsorbed on soil exchange complex. Decreasing trend was found to follow at all sights with increase in depth of soil profile reason may be ascribed to presence of higher exchangeable sodium at the surface layer as the prevailing conditions facilitate it. The decreasing ESP with increasing depth also indicates that process of alkalization had started at the surface and proceeded in downward direction. The results are in confirmation with those of More *et al.*[12] and Amin[2].

The distribution and concentration of major cations like Ca^{2+}, Mg^{2+}, Na^+ and K^+ and major anions like CO_3^{2-}, HCO_3^-, Cl^-, and SO_4^{2-} showed a decreasing trend with depth in all profiles. The more pronounced concentration of cations and anions at upper surfaces and their decrease with depth was may be due to the upward movement of the ions with the capillary water during the summer months as the rise in temperature leads to high evapotranspiration thereby increasing the concentration of these ions in surface layers. Moreover, the sampling was done before showers of rainfall. The carbonate ions are almost lesser in amount in majority of soil samples. This is due to precipitation of calcium and magnesium as carbonates. The results are in agreement with More *et al.*[12], Gandhi *et al.*[6], and Deshmukh[5].

Based on the data of present investigation, correlation coefficient between water and soil parameters is given in Table 4. It showed that correlation coefficient between electrical conductivity of irrigation water (ECiw) and electrical conductivity of saturation extract of soil (ECe) are positively correlated (0.653*). Sodium adsorption ratio of irrigation water (SARiw) and sodium adsorption ratio of saturation extract of soil (SARe) showed non-significant correlation (0.588).

Table 4: Correlation matrix between chemical parameters of water and saturation extract of soil of Pundri block

Water / Soil	EC	pH	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	K^+	SAR
ECe	0.653^{*}	0.123^{NS}	0.177^{NS}	-0.489^{NS}	0.630^{NS}	0.617^{NS}	0.375^{NS}	0.372^{NS}	0.724^{*}	0.266^{NS}	0.555^{NS}
pH	-0.191^{NS}	0.745^{*}	0.675^{*}	0.386^{NS}	-0.356^{NS}	-0.276^{NS}	-0.544^{NS}	-0.564^{NS}	-0.030^{NS}	-0.395^{NS}	0.773^{**}
CO_3^{2-}	-0.204^{NS}	0.584^{NS}	0.792^{**}	0.361^{NS}	-0.347^{NS}	-0.355^{NS}	-0.443^{NS}	-0.441^{NS}	-0.089^{NS}	-0.468^{NS}	0.461^{NS}
HCO_3^-	-0.329^{NS}	0.728^{*}	0.793^{**}	0.412^{NS}	-0.478^{NS}	-0.445^{NS}	-0.612^{NS}	-0.620^{NS}	-0.195^{NS}	-0.494^{NS}	0.609^{NS}
Cl^-	0.824^{**}	-0.453^{NS}	-0.424^{NS}	-0.744^{*}	0.914^{**}	0.851^{**}	0.814^{**}	0.807^{**}	0.776^{**}	0.654^{*}	0.022^{NS}
SO_4^{2-}	0.786^{**}	-0.293^{NS}	-0.462^{NS}	-0.690^{*}	0.866^{**}	0.905^{**}	0.648^{*}	0.672^{*}	0.780^{**}	0.455^{NS}	0.201^{NS}
Ca^{2+}	0.795^{**}	-0.474^{NS}	-0.446^{NS}	-0.785^{**}	0.895^{**}	0.873^{**}	0.792^{**}	0.790^{**}	0.763^{*}	0.711^{*}	-0.011^{NS}
Mg^{2+}	0.805^{**}	-0.534^{NS}	-0.513^{NS}	-0.745^{*}	0.907^{**}	0.869^{**}	0.840^{**}	0.843^{**}	0.748^{*}	0.671^{*}	-0.100^{NS}
N^{a+}	0.122^{NS}	0.570^{NS}	0.641^{*}	0.030^{NS}	0.009^{NS}	0.019^{NS}	-0.217^{NS}	-0.219^{NS}	0.249^{NS}	-0.230^{NS}	0.700^{*}
K^+	-0.335^{NS}	0.535^{NS}	0.046^{NS}	0.530^{NS}	-0.439^{NS}	-0.317^{NS}	-0.425^{NS}	-0.412^{NS}	-0.347^{NS}	-0.688^{*}	0.240^{NS}
SARe	-0.400^{NS}	0.720^{*}	0.784^{**}	0.492^{NS}	-0.552^{NS}	-0.524^{NS}	-0.673^{*}	-0.684^{*}	-0.268^{NS}	-0.528^{NS}	0.588^{NS}

** Correlation is significant at the 0.01 level of significance; * Correlation is significant at the 0.05 level;
NS shows nonlinear correlation between variables

CONCLUSION

Continuous use of low quality water resulted in salt accumulation throughout the soil profiles. Due to high salt concentration in top layer highest electrical conductivity and sodium adsorption ratio of saturation extract was observed in upper layers of the soil which goes on decreasing with depth of soil profile. With increase in salinity of irrigation water salinity of soil also increases with the extent of time, and the value of leaching requirement (LR) goes on increasing. To prevent soil hazard and to minimize crop damage conjunctive use of water for irrigation should be done. To minimize the bad effect of saline water on soil health it should be used in combination with good water for irrigating the crops. Alternative irrigation with good quality and poor-quality water use in addition with good soil water management strategies will help in maintaining adequate salt-water balance for good crop growth.

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