Assessment of physico-chemical properties of irrigated soils in Phagi Tehsil of Jaipur district of Rajasthan

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 Received: 12.01.2022/Accepted: 09.02.2022

ABSTRACT

In the present investigations, assessment of physico-chemical properties of irrigated soils was done in Phagi Tehsil of Jaipur district of Rajasthan. Soil samples were collected from sixteen different villages of the Tehsil. In physical properties sand, silt, clay, bulk density, particle density, porosity, soil moisture retention at 1/3 bar and 15 bar and in chemical properties $CaCo_3$, CEC, exchangeable sodium and ESP were analyzed. The soils found were dominant as loamy sand in texture. Soil moisture retention was high in clay and silt content of soil at both 1/3 and 15 bar tension. The soil of study area comes under non-calcareous in nature.

Keywords: Properties; irrigated; soil; quality

INTRODUCTION

Soil is a natural medium for crop production. Plants derive their nutrients, water and support from the soil. The suitability of the soil as a medium for plant growth depends upon its ability to provide sufficient amount of water and nutrients in available form which in turn is controlled by its properties. Therefore the study of soil properties in relation to plant growth is an important aspect of agriculture. The knowledge of soil properties helps in its management, improvement of problematic soil and implementation of efficient fertilizer techniques.

In Rajasthan, the arid and semi-arid tract occupy about three-forth of the geographical area of the state and underground water is the main source of irrigation in this belt. Due to limited availability of irrigation water in these areas, quality of irrigation waters assumes greater importance. These waters have generally high salt content and high proportion of sodium (Shankarnarayana et al 1965, Singh et al 1967 and Lal and Lal 1977).

Today farmers have increased the use of herbicides and chemical fertilizers and the fallow cycles have disappeared. The continuous use of chemicals is becoming more frequent (Zhang and Zhang 2007). Thus the assessment of soil quality postulates measuring soil physical, chemical and biological properties and using these measure values to observe changes occurring in soil as a result of management practices and land use changes (Adolfo et al 2007). Soil pH, EC and other properties affect the plant growth. Organic carbon showed positive relationship with available and total nitrogen in all soil groups (Verma et al 1980).

MATERIAL and METHODS

Sixteen surface irrigated soil samples were collected from different villages of Phagi Tehsil during April-May 2017. The processed soil samples were analyzed. The mechanical analysis of soil was determined by international pipette method (Piper 1966). Bulk density, particle density and porosity were determined as per standard methods given by Richards (1954). Soil moisture retention at 1/3 bar and 15 bar tensions was determined on pressure plate apparatus as described by Singh (1980). Calcium carbonate of soil was determined by Hutchinson rapid titration method as described by Piper (1966). CEC of soil was determined by the method using neutral normal ammonium acetate solution (Richards 1954).

Exchangeable sodium of soil was determined as per Bower et al (1952).

RESULTS AND DISCUSSION

The data presented in Table 1 reveal that the sand content in soil samples ranged from 81.50 to 90.10 per cent with a mean value of 85.09 per cent. The silt ranged from 6.20 to 12.10 per cent with a mean of 9.12 per cent. The clay particles range was 3.20 to 7.30 per cent with a mean of 5.24 per cent. The bulk density of soils ranged between 1.47 to 1.54 Mg/m^3 with corresponding mean value of 1.52 Mg/m^3. Minor variation in bulk density might be due to slightly higher sand content. Similar results were also reported by Kameriya (1995) and Agrawal et al (2002). The particle density of soils ranged between 2.51 to 2.67 Mg/m^3 with a mean value of 2.60 Mg/m^3. Minor variation in particle density might be due to changes in mineralogical composition of soil (Vyas et al 1974, Naga 1984, Yadav 1985). The porosity value of soil varied from 39.68 to 44.15 with an average value of 41.65. Similar observations were also reported by Kekane et al (2015) and Hossain et al (2015).

The soil moisture retention at 1/3 bar in different types of soils of study area ranged from 8.20 to 10.80 per cent with an average value of 9.42 per cent. The soil moisture content at 15 bar of the soil ranged from 1.90 to 2.52 per cent with a mean value of 2.19 per cent. Soil moisture is closely related with clay content as compared to sand and silt fractions. Soil with highest clay and lowest sand showed highest water retention. These results are in accordance with the findings of Padole et al (1996), Prasad et al (1998) and Srinivasarao et al (2009).

The data presented in Table 2 show that the calcium carbonate content of soil varied from 2.14 to 5.13 per cent with the mean value of 3.39. The soil samples collected from different locations were low in cation exchange capacity (CEC) which ranged between 5.21 to 9.22 Cmol (p^+)/kg with an average value of 6.71 Cmol (p^+)/kg. CEC mostly depends upon the types of clay minerals present in soils and the amount of finer fraction present in soils (Satyavathi et al 1994). CEC of soil governs the buffering capacity, ion exchange behavior and moisture retention capacity. The overall exchangeable sodium content ranged from 0.98 to 1.21 Cmol/kg with the mean value of 1.08 Cmol/kg. Calcium carbonate increases the exchangeable sodium in arid and semi-arid regions in the absence of neutral soluble salts that results in high pH. Exchangeable sodium and calcium carbonate react in

Table 1. Physical properties of irrigated soils of Phagi Tehsil

Sample code number	Sand (%)	Silt (%)	Clay (%)	Bulk density (Mg/m^3)	Particle density (Mg/m^3)	Porosity	Soil moisture retention (%) at	
							1/3 bar	15 bar
PIS_1	87.50	7.70	4.00	1.54	2.65	41.89	8.80	2.01
PIS_2	82.50	11.60	5.40	1.49	2.60	42.69	9.30	2.19
PIS_3	84.20	8.40	6.80	1.53	2.57	40.86	10.40	2.48
PIS_4	84.70	10.60	3.90	1.53	2.67	42.70	8.80	1.97
PIS_5	90.10	6.20	3.20	1.54	2.65	41.89	8.20	1.90
PIS_6	84.30	10.80	4.40	1.53	2.65	42.26	8.90	2.16
PIS_7	83.20	9.70	6.60	1.50	2.51	40.24	10.20	2.42
PIS_8	85.00	9.10	5.20	1.54	2.64	41.67	9.20	2.16
PIS_9	88.70	7.30	3.40	1.54	2.64	41.67	8.70	1.90
PIS_{10}	81.50	12.10	5.70	1.47	2.51	41.43	9.40	2.19
PIS_{11}	82.20	9.90	7.30	1.48	2.65	44.15	10.80	2.52
PIS_{12}	84.10	9.20	6.10	1.52	2.57	40.86	9.60	2.23
PIS_{13}	83.30	9.20	6.80	1.50	2.59	42.08	10.40	2.48
PIS_{14}	88.90	6.90	3.70	1.54	2.61	41.00	8.70	1.97
PIS_{15}	83.90	9.00	6.20	1.52	2.52	39.68	9.90	2.32
PIS_{16}	86.00	8.10	5.20	1.54	2.60	40.77	9.20	2.16
Range	81.50-90.10	6.20-12.10	3.20-7.30	1.47-1.54	2.51-2.67	39.68-44.15	8.20-10.80	1.90-2.52
Mean	85.09	9.12	5.24	1.52	2.60	41.65	9.42	2.19
SD	2.55	1.66	1.34	0.02	0.05	1.08	0.75	0.21
CV	3.00	18.21	25.50	1.57	2.05	2.59	7.93	9.48

Table 2. Chemical properties of irrigated soils of Phagi Tehsil

Sample code number	$CaCo_3$ (%)	CEC (C mol (p^+)/kg)	Exchangeable sodium (C mol (Na^+)/kg)	ESP
PIS_1	3.18	5.61	1.05	18.72
PIS_2	2.75	6.09	1.02	16.75
PIS_3	4.93	7.13	1.21	16.97
PIS_4	4.10	8.82	1.14	12.93
PIS_5	3.32	5.21	1.07	20.54
PIS_6	2.14	5.75	0.98	17.04
PIS_7	3.08	7.03	1.04	14.79
PIS_8	5.13	5.98	1.21	20.23
PIS_9	2.19	9.22	0.98	10.63
PIS_{10}	3.02	6.22	1.04	16.72
PIS_{11}	3.93	7.62	1.12	14.70
PIS_{12}	2.84	6.48	1.03	15.90
PIS_{13}	4.57	7.13	1.19	16.69
PIS_{14}	3.20	5.48	1.05	19.16
PIS_{15}	2.48	6.67	1.00	14.99
PIS_{16}	2.88	5.99	1.04	17.36
Range	2.14-5.13	5.21-9.22	0.98-1.21	10.63-20.54
Mean	3.39	6.71	1.08	16.40
SD	0.92	1.14	0.08	2.58
CV	27.14	17.03	7.18	15.71

neutral salt environment conditions to produce high pH and appreciable concentration of sodium carbonate (Cruz-Romero and Coleman 1975). ESP of soil varied from 10.63 to 20.54 with an average value of 16.40. These result get support from the findings of Gangappa (1989), Ram (1998) and Prakash (2001).

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