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Assessment on Physico-chemical Properties of Soil from different Blocks of Rajsamand District of Rajasthan, India

Sujata Choudhary*, Narendra Swaroop and Tarence Thomas

Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, 211007 (U.P.), India

**Corresponding author*

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A B S T R A C T

The present study was conducted to assess physical properties of soil in block Rajsamand district of Rajasthan using standard laboratory procedures. Soil samples were collected from three blocks (Rajsamand, Nathdwara, Relmagra) of the Rajsamand district from two depths *viz.* 0-15 cm and 15-30 cm. Results of the study indicated that particle density ranged from 1.90 to 2.90 Mg m^{-3}, bulk density from 1.09-1.30 Mg m^{-3}, percent pore space from 33.00 to 60.00 %, water retaining capacity from 54.27 to 69.51 % and specific gravity from 1.35 to 2.34. The sand, silt and clay ranged from 43.1 to 74.9%, 5.2 to 32.3% and 12.7 to 30.5 % respectively.

Introduction

Soil is a dynamic natural body developed as a result of pedogenic processes through weathering of rocks, consisting of mineral and organic constituents, possessing definite chemical, physical, mineralogical and biological properties, having a variable depth over the surface of the earth, and providing a medium for plant growth (Thakre *et al.*, 2012). The rate of soil quality degradation depends on land use systems, soil types, topography, and climatic conditions. Among these factors, inappropriate land use aggravates the degradation of soil physicochemical and biological properties (Singh *et al.*, 1995) observed that changes in organic carbon contents after deforestation strongly depend on soil type. Increasing land conservation requires soil carbon and soil fertility management within a broader framework of sustainable development (Smith, 2008). Soil is the biologically active, structured porous medium that has developed below the continental land surface on our planet. Soils represent one of the most complex and dynamic natural systems studied by scientists. Knowledge of their chemical,

physical and biological properties is a prerequisite both for sustaining the productivity of the land. The soil and vegetation of Rajasthan alters with its wide-ranging topography of the state and the availability of water. The varied kind of soils available in Rajasthan are mostly sandy, saline, alkaline and chalky (calcareous). Clay, loamy, black lava soil and nitrogenous soils are also found. The climate of district is extremely hot in the summers and fairly cold in the winters. The prevailing climate in is known as local steppe climate. The average annual temperature is 26.5^{o}C in Rajsamand. The present investigation was therefore conducted owing to scarcity of information on layered physical characteristics of soil in the Rajsamand district and to serve as a database for making suitable modifications to farming practices for the enhancement of crop productivity.

Materials and Methods

Sample collection and analysis

Soil samples were collected from three different blocks of Rajsamand district Rajasthan. They are Rajsamand, Nathdwara and Relmagra. Soil samples were collected with the help of Khurpi, spade and meter scale. In each block, three villages were selected for sampling and samples were obtained from two different depths *viz*. 0- 15 cm and 15-30 cm. A total of eighteen soil samples were collected which were first air dried at room temperature, then crushed using wooden mallet and then sieved (2mm) for further analysis. The percent water holding capacity was estimated by volume basis (Muthuvel *et al.,* 1992). Analysis of soil texture was done by Bouyoucos Hydrometer method (Bouyoucos, 1927). The samples were matched against standard Munsell soil colour chart (Munsell, 1971) to obtain hue, value and chroma combinations for soil colour. The percent pore space was calculated from the 100 ml graduated measuring cylinder (Muthuvel *et al.,* 1992). The bulk density and particle density was determined by the graduated 100 ml measuring cylinder method (Muthuvel *et al.,* 1992). Specific gravity of soil was determined by the relative density bottle or pycnometer method of Black (1965).

Results and Discussion

Soil Texture

Table 1 depicts the soil texture in different villages of Rajsamand district. The sand, silt and clay percentage ranged from 43.1 – 74.9 %, 5.2 – 32.3 % and 12.7 – 30.5 % respectively.

Soil colour

Table 2 depicts the soil colour. Soil colour varied from brown to yellowish brown colour in the dry condition while dark brown colour predominated in the wet condition. Dark colour corresponds to high organic matter content.

Bulk density (Mg m^{-3})

Table 3 depicts the bulk density of soil. Maximum mean bulk density found was 1.29 Mg m^{-3} and minimum 1.11 Mg m^{-3}. The bulk density increases with the increase in soil depth. Different levels of erosion of soil depending upon the slop and management practices is also responsible for higher bulk density which might be due to greater compaction that might have occurred in the lower horizons of the soil profiles with time (Bhuyan *et al.,* 2013).

Particle density (Mg m^{-3})

Table 3 depicts particle density at different soil depths. It varied from 1.90 Mg m^{-3} to

2.90 Mg m^{-3}. The particle density decreases with the increase in soil depth.

Particle density is a density of just the solid parts of the soil, it does not include any pore space. Particle density varies according to the mineral content of the soil particles (Brady and Weil, 1996).

Pore space (%)

Table 3 depicts the pore space. Maximum pore space was recorded in T_1 with value of 60.0 %. The minimum pore space was recorded in T_5 with a value of 33.00 %. The range of values obtained, *i.e.* 33.00 to 60.0 % of pore space is indicative of clayey soils.

Table.1 Analysis of soil texture of different villages

Village	% Sand	% Silt	% Clay	Textural class
T_1	56.2	20.2	23.6	Sandy clay loam
T_2	57.4	22.5	21.1	Sandy loam
T_3	60.8	16.2	23.0	Sandy clay loam
T_4	68.7	8.2	23.1	Sandy clay loam
T_5	48.5	32.3	19.3	Loam
T_6	43.1	30.0	26.4	Clay loam
T_7	71.5	11.5	17.0	Sandy loam
T_8	61.4	12.9	25.8	Sandy clay loam
T_9	56.8	15.6	27.6	Sandy clay loam

Table.2 Soil colour of different villages in dry and wet condition of soil in Rajsamand

Village	0-15 cm		15-30 cm	
	Dry	**Wet**	**Dry**	**Wet**
T_1	Dark brown	Dark grayish brown	Very dark grayish brown	Dark grayish brown
T_2	Dark brown	Brown	Brown	Dark brown
T_3	Yellowish brown	Yellowish brown	Brownish yellow	Brownish yellow
T_4	Dark brown	Dark brown	Grayish brown	Dark grayish brown
T_5	Dark brown	Dark brown	Dark brown	Dark brown
T_6	Dark grayish brown	Dark grayish brown	Dark grayish brown	Dark grayish brown
T_7	Brown	Dark brown	Dark brown	Dark brown
T_8	Yellowish brown	Dark Yellowish brown	Yellowish brown	Dark Yellowish brown
T_9	Very dark grayish brown	Dark grayish brown	Dark Yellowish brown	Dark brown

Table.3 Bulk density (Mg m^{-3}), Particle density (Mg m^{-3}) and Pore space (%) of soil in different villages of Rajsamand at 0-15 and 15-30 cm depth

Village	Bulk density (Mg m^{-3})		Particle density (Mg m^{-3})		Pore space (%)	
	0-15	15-30	0-15	15-30	0-15	15-30
T_1	1.12	1.18	2.85	2.30	60.00	48.00
T_2	1.09	1.14	2.60	2.35	58.00	51.00
T_3	1.18	1.23	2.80	2.50	57.00	50.00
T_4	1.12	1.19	2.75	2.28	59.00	47.00
T_5	1.10	1.22	2.20	1.90	50.00	33.00
T_6	1.28	1.30	2.85	2.68	55.00	51.00
T_7	1.15	1.25	2.85	2.70	59.00	53.00
T_8	1.18	1.24	2.90	2.35	59.00	47.00
T_9	1.24	1.30	2.90	2.85	57.00	54.00
F- test	S		S		S	
S. Em. (±)	0.028		0.150		3.15	
C.D. (P=0.05)	0.059		0.319		4.01	

Table.4 Water holding capacity (%) and Specific gravity of soil in different villages of Rajsamand at 0-15 and 15-30 cm depth

Village	Water holding capacity (%)		Specific gravity	
	0-15	15-30	0-15	15-30
T_1	66.50	65.45	1.35	2.20
T_2	61.74	59.00	1.88	2.10
T_3	65.40	62.86	1.70	2.25
T_4	62.33	56.82	1.85	2.20
T_5	65.70	63.63	1.66	2.32
T_6	69.51	64.70	1.95	2.32
T_7	68.29	64.71	1.82	2.24
T_8	58.63	54.27	1.95	2.38
T_9	63.50	57.40	1.90	2.34
F- test	S		NS	
S. Em. (±)	1.006		0.128	
C. D. (P = 0.05)	2.133		0.272	

Water holding capacity (%)

Table 4 depicts the water holding capacity. Maximum mean water holding capacity found was 67.15 % and minimum 56.45 %. Water holding capacity of different soil depths varied from 54.27% to 69.51 %. These variations were due to clay, silt and organic carbon content in sandy soils.

Specific gravity

Table 4 depicts the specific gravity at different soil depths. Specific gravity varied

from 1.35 to 2.34. The specific gravity increases with the increase in soil depth. Similar results were reported by (Meena *et al.*, 2009).

It can be concluded from the analysis of soil samples that the soils of Rajsamand have good physical condition which favours the cultivation of most crops. Lighter soil colour was observed in the surface layer while the subsurface was characterized by darker colour. Soil texture showed high clay percentage. The bulk density values were considerably low and increased with increase in depth. The particle density also increased with depth. Low specific gravity values indicate high organic matter content. Good water holding capacity and pore space percentage is indicative of high clay content.

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